APPENDIX A
SUMMARY OF RELEVANT CONSERVATION PRACTICES

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APPENDIX A—SUMMARY OF RELEVANT CONSERVATION PRACTICES

Following this paragraph is a summary listing of conservation practices (CPs) for the proposed Oregon Conservation Resource Enhancement Program (CREP).

Natural Resource Conservation Service (NRCS) CP: Filter Strip
Farm Service Agency (FSA) Conservation Reserve Program (CRP) CPs for proposed Oregon CREP

- CP21—Filter Strips

Purposes:

- Reduce pollution and protect surface water and subsurface water quality
- Reduce sediment, particulate organics, and sediment-adsorbed contaminant loadings in runoff
- Reduce dissolved contaminant loadings in runoff
- Reduce sediment, particulate organics, and sediment-adsorbed contaminant loadings in surface irrigation tailwater
- Restore, create, or enhance herbaceous habitat for wildlife and beneficial insects
- Maintain or enhance watershed functions and values.

Maintenance Standards:

- Encourage shallow sheet water flow across the filter so that the filter functions properly
- Repair occurring channels or rills immediately
- Treat concentrated flow areas using terraces, dikes, berms, trenches, or vegetative barriers
- Remove sediment when accumulation reaches a height of 6 inches or higher and level filter so that sheet flow is re-established
- Filter strips removing bacteria or other pathogens may be closely mowed to allow sunlight and air movement to decimate entrapped pathogens
- Control all weeds, particularly noxious weeds, in the filter area
- Use pre-approved prescribed burning to manage and maintain filter strip.

NRCS CP: Riparian Buffer/Herbaceous Riparian Cover/Permanent Wildlife Habitat
FSA CRP CPs for proposed Oregon CREP

- CP22—Riparian Buffer Strips

- CP29—Marginal Pastureland Wildlife Habitat Buffer

Purposes:

- Remove nutrients, sediment, organic matter, pesticides, and other pollutants from surface runoff and subsurface flow using vegetation
- Reduce pollution and protect surface water and subsurface water quality while enhancing the ecosystem of the water body
- Provide a source of detritus and woody debris for aquatic wildlife while enhancing habitat for terrestrial wildlife
- Create shade to lower water temperatures to improve habitat for aquatic organisms
- Create wildlife habitat and establish wildlife corridors
- Reduce excess amounts of sediment, organic material, nutrients, and pesticides in surface runoff and reduce excess nutrients and other chemicals in shallow groundwater flow
- Provide a harvestable crop of timber, fiber, forage, fruit, or other crops consistent with other intended purposes
- Restore natural riparian plant communities
- Moderate winter temperatures to reduce freezing of aquatic over-wintering habitats
- Increase carbon storage in plant biomass and soils
- Increase connectivity of existing terrestrial wildlife habitats.

Maintenance Standards:

- Prevent harvesting or grazing of buffers by domestic livestock
- Establish vegetation that closely matches native and historical vegetation
- Periodically harvest trees, once buffer stands mature, to maintain plant health and buffer function
- Control noxious weeds and other undesirable plants, insects, and pests
- Apply registered chemicals, strictly according to authorized and registered uses, to control unwanted vegetation and pests.

NRCS CP: Wetland Enhancement/Wetland Restoration

FSA CRP CPs for proposed Oregon CREP

- CP23—Wetland Restoration
- CP30—Marginal Pastureland Wetland Buffer

Purposes:

- Restore the functions and values of wetland ecosystems on land previously committed to agricultural use

- Restore hydric soil conditions, hydrologic conditions, hydrophytic plant communities, and wetland functions that occurred on the disturbed wetland site prior to modification to the extent practicable

- Modify the hydrologic condition, hydrophytic plant communities, and/or other biological habitat components of a wetland for the purpose of favoring specific wetland functions or values (e.g., managing site hydrology for waterfowl or amphibian use or managing plant community composition for native wetland hay production).

Maintenance Standards:

- A permanent water supply would be available, similar to the needs of the wetland

- Restore vegetation as close to the original natural plant communities as the site will allow

- Monitor depth to measure the accumulation of sedimentation to determine when removal of sedimentation is required

- Mow and fertilize vegetation on dam and spillway to prevent the growth of trees and brush in these areas

- Perform erosion control maintenance on the spillway

- Remove debris from trashtrack

- Repair damages from wildlife, such as beaver or muskrat damage

- Ensure any use of fertilizers, mechanical treatments, prescribed burning, pesticides, and other chemicals to assure the wetland enhancement function shall not compromise the intended purpose and shall be pre-approved by the governing agency.

APPENDIX B
CRITICAL HABITAT

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APPENDIX B—CRITICAL HABITAT

Table B-1 lists species with critical habitat designations in Oregon. Also included are the counties and hydrological units in which the critical habitat is located.

Table B-1. Critical habitat in Oregon.

Common Name	Scientific Name	Counties Containing or Bordering Critical Habitat	Hydrological Units
Butterfly, Oregon silverspot[1]	*Speyeria zerene hippolyta*	Lane	Not applicable (NA)
Chub, Borax Lake[2]	*Gila boraxobius*	Harney	NA
Fairy shrimp, vernal pool[3]	*Branchinecta lynchi*	Jackson	NA
Murrelet, marbled[4]	*Brachyramphus marmoratus marmoratus*	Benton, Clatsop, Coos, Curry, Douglas, Josephine, Lane, Lincoln, Polk, Tillamook, Washington, Yamhill	NA
Owl, northern spotted[5]	*Strix occidentalis caurina*	Benton, Coos, Clackamas, Curry, Deschutes, Douglas, Hood River, Jackson, Jefferson, Klamath, Lake, Lane, Lincoln, Linn, Marion ,Polk, Tillamook, Wasco, Yamhill	NA
Plover, western snowy[6]	*Charadrius alaxandrinus nivosus*	Coos, Curry, Douglas, Lane, Tillamook	NA
Salmon, Chinook (fall, Snake River)[7]	*Oncorhynchus tshawytscha*	Baker, Clatsup, Columbia, Gilluim, Hood River, Morrow, Multnomah, Sherman, Umatilla, Wallowa, Wasco	NA
Salmon, Chinook (spring/summer, Snake River)[7]	*Oncorhynchus tshawytscha*	Baker, Clatsop, Columbia, Gillium, Hood River, Morrow, Multnomah, Sherman, Umatilla, Union, Wallowa, Wasco	NA
Salmon, Chinook (Lower Columbia River)[8]	*Oncorhynchus tshawytscha*	Clackamas, Clatsop, Columbia, Hood River, Marion, Multnomah, Washington	Lower Columbia, Lower Columbia-Clatskanie, Lower Columbia-Sandy, Middle Columbia-Hood, Clackamas, and Lower Willamette
Salmon, Chinook (Upper Willamette River)[8]	*Oncorhynchus tshawytscha*	Benton, Clatsop, Columbia, Clackamas, Douglas, Lane, Lincoln, Linn, Marion, Multnomah, Polk, Tillamook, Washington, Yamhill	Lower Columbia, Lower Columbia-Clatskanie, Lower Willamette, Middle Willamette, Middle Fork Willamette, Coast Fork Willamette, Upper Willamette, McKenzie, North

Table B-1. (continued).

Common Name	Scientific Name	Counties Containing or Bordering Critical Habitat	Hydrological Units
			Santiam, South Santiam, Molalla-Pudding, Tualatin, Yamhill, and Clackamas
Salmon, chum (Columbia River)[8]	*Oncorhynchus keta*	Clatsop, Columbia, Multnomah, Washington	Lower Columbia, Lower Columbia-Sandy, Lower Columbia-Clatskanie, and Lower Willamette
Salmon, Coho (Oregon and California population)[8]	*Oncorhynchus kisutch*	Benton, Clatsop, Columbia, Coos, Curry, Douglas, Josephine, Lane, Lincoln, Polk, Tillamook, Washington, Yamhill	Alsea, Coos, Coquille, Necanicum, Nehalem, Sixes, Siletz-Yanquina, Siuslaw, Siltcoos, Umpqua, North Umpqua, South Umpqua, and Wilson-Trask-Nestucca
Salmon, sockeye[7]	*Oncorhynchus nerka*	Clatsop, Columbia, Gillium, Hood River, Morrow, Multnomah, Sherman, Umatilla, Wallowa, Wasco	Lower Salmon, Middle Salmon-Panther, Upper Salmon, Middle Salmon-Chamberlain, Lower Snake, Lower Snake Tucannon, and Lower Snake-Asotin
Steelhead (Snake River Basin)[8]	*Oncorhynchus mykiss*	Baker, Clatsop, Columbia, Gilliam, Hood River, Morrow, Multnomah, Sherman, Umatilla, Union, Wallowa, Wasco	Hells Canyon, Imnaha, Lower Snake-Asotin, Upper Grande Ronde, Wallowa, Lower Grande Ronde, Middle Columbia-Lake Wallula, Middle Columbia-Hood, Lower Columbia-Sandy, Lower Columbia-Clatskanie, Lower Columbia, and Lower Willamette
Steelhead (Lower Columbia River)[8]	*Oncorhynchus mykiss*	Clackamas, Clatsop, Columbia, Hood River, Marion, Multnomah, Washington	Lower Columbia-Clatskanie, Lower Columbia, Upper Willamette, Middle Willamette, Lower Willamette, North Santiam, South Santiam, Yamhill, Molalla-Pudding, and Tualatin
Steelhead (Middle Columbia River)[8]	*Oncorhynchus mykiss*	Clatsop, Columbia, Crook, Gilliam, Grant, Harney, Hood River, Jefferson, Morrow, Multnomah, Sherman, Umatilla, Union, Wallowa, Wasco, Wheeler	Walla Walla, Middle Columbia-Lake Wallula, Middle Columbia-Hood, Umatilla, Willow, Upper John Day, North Fork John Day, Middle Fork John Day, Lower John Day, Lower Deschutes, Lower Columbia-Sandy, Lower Columbia-Clatskanie, Lower Columbia, Lower Willamette, and Trout
Steelhead (Upper Willamette River)[8]	*Oncorhynchus mykiss*	Benton, Clatsop, Clackamas, Columbia, Lincoln, Linn, Marion, Multnomah, Polk,	Lower Columbia, Lower Columbia-Clatskanie, Lower Columbia-Sandy, Middle

Table B-1. (continued).

Common Name	Scientific Name	Counties Containing or Bordering Critical Habitat	Hydrological Units
		Tillamook, Washington, Yamhill	Columbia-Hood, Clackamas, and Lower Willamette
Sucker, Warner[9]	*Catostomus warnerensis*	Lake	NA
Trout, bull[10]	*Salvelinus confluentus*	Baker, Clatsop, Columbia, Crook, Deschutes, Gilliam, Grant, Harney, Hood River, Jefferson, Klamath, Lake, Lane, Linn, Malheur, Morrow, Multnomah, Sherman, Umatilla, Union, Wallowa, Wasco, and Wheeler	NA
Malheur wire-lettuce[11]	*Stephanomeria malheurensis*	Harney	NA
Source: [1]45 Federal Register (FR) 129, 1980; [2]47 FR 193, 1982; [3]68 FR 151, 2003; [4]61 FR 102, 1996; [5]57 FR 10, 1992; [6]64 FR 234, 1999; [7]58 FR 247, 1993; [8]65 FR 32, 2000; [9]50 FR 188, 1985; [10]69 FR 193, 2004; [11]47 FR 218, 1982			

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APPENDIX C
IMPAIRED SURFACE WATERS

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APPENDIX C—IMPAIRED SURFACE WATERS

Table C–1 lists impaired surface waters in the basins of Oregon. Surface waters are designated as impaired by the Oregon Department of Environmental Quality (ODEQ) and listed in the *Oregon Final 303(d) List of Impaired Waters* (ODEQ 2002). Explanation of impairment and season codes are provided at the end of the table.

Table C–1. Impaired surface waters in Oregon.

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Alsea	Alsea River	0–10	FC	Y
Alsea	Alsea River	15.2–47.4	T	S
Alsea	Alsea River	4.9–31.4	DO	9/15–5/31
Alsea	Buck Creek	0–7.7	T	S
Alsea	Camp Creek	0–2.7	T	S
Alsea	Cascade Creek	0–4.4	T	S
Alsea	Depew Creek	0–1.5	T	S
Alsea	Green River	0–6.7	T	S
Alsea	Little Lobster Creek	0–2.1	T	S
Alsea	Lobster Creek	0–17.7	T	S
Alsea	Mercer Lake/Mercer Creek	0.6–2.5	AW/A	*
Applegate	Applegate River	0–46.8	T	S
Applegate	Beaver Creek	0–3.5	T	S
Applegate	Beaver Creek	0–8.8	BC, S	*
Applegate	Cheney Creek	0–6	DO	6/1–9/30
Applegate	East Fork Williams Creek	0–2.4	DO	6/1–9/30
Applegate	Forest Creek	0–9.3	DO	6/1–9/30
Applegate	Grouse Creek	0–1.8	DO	6/1–9/30
Applegate	Humbug Creek	0–5	T	S
Applegate	Jackson Creek	0–3.5	DO	6/1–9/30
Applegate	Little Applegate River	0–20.9	T	S
Applegate	Palmer Creek	0–5.7	T	S
Applegate	Powell Creek	0–2	T	S, 10/1–5/31
Applegate	Slate Creek	0–5.3	DO	6/1–9/30
Applegate	Slate Creek	0–5.3	T	S
Applegate	Star Gulch	0–4.3	T	S
Applegate	Sterling Creek	0–2.5	T	S

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Applegate	Thompson Creek	0–3.9	DO	6/1–9/30
Applegate	Waters Creek	2.4–4.3	T	S
Applegate	West Fork Williams Creek	0–3	DO	6/1–9/30
Applegate	Williams Creek	0–7.1	DO	6/1–9/30
Applegate	Williams Creek	0–7.1	T	S
Applegate	Yale Creek	0–1.3	T	S
Chetco	Chetco River	39.4–57.1	T	S
Chetco	Hunter Creek	0–16.6	T	S
Chetco	Jack Creek	0–1.2	T	S
Chetco	North Fork Chetco River	0–5.1	T	S
Chetco	North Fork Hunter Creek	0–4.8	T	S
Chetco	Pistol River	0–19.8	DO	6/1–9/30
Chetco	Pistol River	0–19.8	T	S
Chetco	South Fork Pistol River	0–0.5	T	S
Chetco	Winchuck River	0–11.1	DO	10/1–5/31
Chetco	Winchuck River	0–11.1	T	S
Coos	Burnt Creek	0–2.6	T	S
Coos	Catching Slough	0–5.6	FC	Y
Coos	Cedar Creek	0–11.6	T	S
Coos	Coalbank Slough	0–0.5	FC	Y
Coos	Coos Bay	7.8–12.3	FC	Y
Coos	Eel Lake/Eel Lake	0–2.5	pH	S
Coos	Elk Creek	0–8.7	Fe	Y
Coos	Haynes Inlet	0–3.3	FC	Y
Coos	Isthmus Slough	0–10.6	DO	S/F
Coos	Isthmus Slough	0–10.6	FC, Mn	Y
Coos	Joe Ney Slough	0–2.2	FC	Y
Coos	Kentuck Slough	0–2.2	FC	W/Sp/F
Coos	Larson Slough	0–3.9	FC	Y
Coos	Millicoma River	0–8.9	DO	10/1–5/31
Coos	North Slough	0–2.4	FC	Y
Coos	North Tenmile Lake/North Tenmile Lake	0–4.5	AW/A	*

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Coos	Pony Creek	0–5.8	FC	W/Sp/F
Coos	Pony Slough	0–0.8	FC	Y
Coos	South Fork Coos River	0–31.1	DO	Y
Coos	South Slough	0–5.3	FC	Y
Coos	Tenmile Lake/Tenmile Lake	0–5	AW/A	*
Coos	Tioga Creek	0–17.5	T	S
Coos	Willanch Slough	0.7–2.8	FC	Y
Coos	Williams River	0–20.9	T	S
Coquille	Alder Creek	0–3.1	T	S
Coquille	Baker Creek	0–2.9	T	S
Coquille	Battle Creek	0–1.5	T	10/1–5/31
Coquille	Bear Creek	0–13.2	DO, FC	W/Sp/F
Coquille	Belieu Creek	0–3.1	T	S
Coquille	Bingham Creek	0–2.4	T	S
Coquille	Boulder Creek	0–4	T	S
Coquille	Cherry Creek	0–3.8	T	S
Coquille	Coquille River	0–35.6	FC	Y
Coquille	Coquille River	21–35.3	T	S
Coquille	Coquille River	4.2–35.6	ChlA	S
Coquille	Cunningham Creek	0–7.4	DO, FC	Y
Coquille	Dement Creek	0–6	T	S
Coquille	East Fork Coquille River	0–26.2	T	S
Coquille	Elk Creek	0–5.7	T	S
Coquille	Fishtrap Creek	0–4.7	Fe	Y
Coquille	Middle Creek	0–24.2	T	S
Coquille	Middle Fork Coquille River	0–39.6	DO, FC	W/Sp/F
Coquille	Middle Fork Coquille River	0–39.6	T	S, 10/1–5/31
Coquille	North Fork Coquille River	0–44.2	T	S
Coquille	Rowland Creek	0–4.6	T	S
Coquille	Salmon Creek	0–9.2	T	S
Coquille	South Fork Coquille River	0–18.9	FC	W/Sp/F
Coquille	South Fork Coquille River	0–42.2	T	S
Coquille	Twelvemile Creek	0–10.2	T	S

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Coquille	Unnamed1	0–3.6	T	S
Coquille	Woodward Creek	0–7.6	T	S
Illinois	Althouse Creek	0–7.5	T	S
Illinois	Anderson Creek	0–3.2	T	S
Illinois	Briggs Creek	0–11.6	T	S
Illinois	Canyon Creek	0–5.9	T	S
Illinois	Collier Creek	0–4.5	T	S
Illinois	Deer Creek	0–16.9	T	S
Illinois	East Fork Illinois River	0–14.7	T	S
Illinois	Elk Creek	0–4.1	T	S
Illinois	Fall Creek	0–4.8	T	S
Illinois	Free and Easy Creek	0–2.1	T	S
Illinois	Illinois River	0–31.9, 32.1–56.1	T	S
Illinois	Indigo Creek	0–8.2	T	S
Illinois	Josephine Creek	0–12.4	T	S
Illinois	Klondike Creek	0–7.4	T	S
Illinois	Lawson Creek	0–11.1	T	S
Illinois	Little Sixmile Creek	0–1.2	T	S
Illinois	McMullin Creek	0–6.6	T	S
Illinois	North Fork Indigo Creek	0–6	T	S
Illinois	North Fork Silver Creek	0–7	T	S
Illinois	Panther Creek	0–2.6	T	S
Illinois	Rancherie Creek	0–5.2	T	S
Illinois	Rough and Ready Creek	0–6.1	T	S
Illinois	Silver Creek	0–13.3	T	S
Illinois	Sixmile Creek	0–5.2	T	S
Illinois	Soldier Creek	0–2	T	S
Illinois	South Fork Canyon Creek	0–2.4	T	S
Illinois	South Fork Deer Creek	0–2.2	T	S, 10/1–5/31
Illinois	South Fork Rough and Ready Creek	0–6.3	T	S
Illinois	South Fork Silver Creek	0–7	T	S
Illinois	Squaw Creek	0–3	T	S

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Illinois	West Fork Illinois River	0–17.3	T	S
Illinois	Whiskey Creek	0–4.2	T	S
Lower Columbia	Bear Creek	2.5–9	T	S, 9/15–5/31
Lower Columbia	Cullaby Lake/Cullaby Lake	0–1.6	AW/A	S
Lower Columbia	Gnat Creek	0–9.8	T	9/15–5/31
Lower Columbia	Klaskanine River	0–2.7	DO	Y
Lower Columbia	Lewis And Clark River	0–10.8	DO	6/1–9/14
Lower Columbia	Lewis And Clark River	8.6–10.8	T	S
Lower Columbia	Skipanon River	0–2	DO	Y
Lower Columbia	Skipanon River	0–6.1	DO	Sp/S
Lower Columbia	Smith Lake	0–0	AW/A	S
Lower Columbia	Unnamed Creek	0–0	CrHx, Cu, Zn	Y
Lower Columbia	Unnamed Creek	0–3.2	Fe, Mn	Y
Lower Columbia	Youngs River	9–23.2	T	S
Lower Columbia Clatskanie	Beaver Creek	0–14	T	S
Lower Columbia Clatskanie	Clatskanie River	0–1.9	DO	Y
Lower Columbia Clatskanie	Clatskanie River	0–1.9	FC, T	S
Lower Columbia Clatskanie	Clatskanie River	1.9–25.5	T	S, 9/15–5/31
Lower Columbia Clatskanie	Little Clatskanie River	0–6.2	T	S
Lower Columbia Clatskanie	South Fork Goble Creek	0–3.9	BC	*
Lower Columbia Clatskanie	Tide Creek	0–16.1	T	9/15–5/31
Lower Rogue	Big Boulder Creek	0–1.8	T	S
Lower Rogue	Boulder Creek	0–3.9	T	S
Lower Rogue	Butte Creek	0–2.5	T	S
Lower Rogue	Coyote Creek	0–7.4	T	S
Lower Rogue	East Fork Whisky Creek	0–3.7	T	S, 10/1–5/31
Lower Rogue	Foster Creek	0–5.2	T	S
Lower Rogue	Grave Creek	0–33.1	T	S

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Lower Rogue	Hog Creek	0–5.2	T	S
Lower Rogue	Indian Creek	0–1.7	T	S
Lower Rogue	Jumpoff Joe Creek	0–21.3	T	S, 10/1–5/31
Lower Rogue	Louse Creek	0–10	T	S, 10/1–5/31
Lower Rogue	Pickett Creek	0–3.9	T	S
Lower Rogue	Quartz Creek	0–7.3	T	S
Lower Rogue	Quosatana Creek	0–8.1	T	S
Lower Rogue	Reuben Creek	0–6.5	T	S
Lower Rogue	Shasta Costa Creek	0–13.4	T	S
Lower Rogue	Slate Creek	0–3.1	T	S
Lower Rogue	Taylor Creek	0–5.3	T	S
Lower Rogue	West Fork Whisky Creek	0–4.2	T	S
Lower Rogue	Whisky Creek	0–2.4	T	S, 9/15–5/31
Lower Rogue	Wolf Creek	0–11.5	T	S
Middle Rogue	Ashland Creek	0–2.8	FC	Y
Middle Rogue	Battle Creek	0–3.9	T	S
Middle Rogue	Bear Creek	0–26.3	FC	Y
Middle Rogue	Bear Creek	0–26.3	T	S
Middle Rogue	Birdseye Creek	0–1.4	T	S
Middle Rogue	Butler Creek	0–5.2	DO	Sp/S, 10/1–5/31
Middle Rogue	Butler Creek	0–5.2	FC	W/Sp/F
Middle Rogue	Butler Creek	0–5.2	T	S
Middle Rogue	Carter Creek	0–4.8	T	S
Middle Rogue	Cold Creek	0–4.2	T	S
Middle Rogue	Coleman Creek	0–6.9	DO	6/1–5/31
Middle Rogue	Coleman Creek	0–6.9	FC	Y
Middle Rogue	Coleman Creek	0–6.9	T	S
Middle Rogue	Crooked Creek	0–4.3	FC	Y
Middle Rogue	Emigrant Creek	0–3.6, 5.6–15.4	T	S
Middle Rogue	Evans Creek	0–19.1	FC	Y
Middle Rogue	Gaerky Creek	0–4.6	T	S
Middle Rogue	Galls Creek	0–4.5	T	S

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Middle Rogue	Griffin Creek	0–14.4	DO, T	10/1–5/31
Middle Rogue	Griffin Creek	0–14.4	FC	Y
Middle Rogue	Griffin Creek	0–9.2	T	S
Middle Rogue	Hobart Creek	0–0	T	S
Middle Rogue	Jackson Creek	0–12.6	FC	Y
Middle Rogue	Jackson Creek	0–12.6	T	S, 10/1–5/31
Middle Rogue	Larson Creek	0–6.7	DO	10/1–5/31
Middle Rogue	Larson Creek	0–6.7	FC	Y
Middle Rogue	Larson Creek	0–6.7	pH	6/1–5/31
Middle Rogue	Larson Creek	0–6.7	T	S
Middle Rogue	Lazy Creek	0–4.5	FC	Y
Middle Rogue	Lazy Creek	0–4.5	pH	10/1–5/31
Middle Rogue	Lazy Creek	0–4.5	T	S
Middle Rogue	Lone Pine Creek	0–0	T	S
Middle Rogue	Meyer Creek	0–5.3	FC	Y
Middle Rogue	Meyer Creek	0–5.3	T	S
Middle Rogue	Neil Creek	0–4.8	DO	6/1–5/31
Middle Rogue	Neil Creek	0–4.8	T	S, 10/1–5/31
Middle Rogue	Payne Creek	0–2.1	FC	Y
Middle Rogue	Payne Creek	0–2.1	T	S
Middle Rogue	Payne Creek	1–2.1	DO	6/1–5/31
Middle Rogue	Ramsey Canyon	0–3.1	T	S
Middle Rogue	Reeder Reservoir/Ashland Creek	4.9–5.4	S	*
Middle Rogue	Rock Creek	0–6.5	T	S
Middle Rogue	Salt Creek	0–6.2	T	S
Middle Rogue	Savage Creek	0–4.8	T	S
Middle Rogue	Tyler Creek	0–4	T	S
Middle Rogue	Wagner Creek	0–7.4	T	S
Middle Rogue	Walker Creek	0–6.7	T	10/1–5/31
Middle Rogue	West Fork Evans Creek	0–17.1	T	S
Necanicum	Necanicum River	0–15	T	S
Necanicum	Necanicum River	0–20.6	T	9/15–5/31

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Necanicum	Necanicum River	0–5.9	EC	S
Necanicum	Pacific Ocean	26–30	FC	Y
Necanicum	Sunset Lake	0–3.1	AW/A	S
Nehalem	Beneke Creek	0–10.1	T	S
Nehalem	Buster Creek	0–9.1	T	9/15–5/31
Nehalem	Cook Creek	0–9.3	T	9/15–5/31
Nehalem	Cronin Creek	0–1.8	T	9/15–5/31
Nehalem	East Fork Nehalem River	0–9.8	T	S
Nehalem	East Humbug Creek	0–4.5	T	9/15–5/31
Nehalem	Fishhawk Creek	0–11.9	T	S, 9/15–5/31
Nehalem	Foley Creek	0–3.7	T	S
Nehalem	Gods Valley Creek	0–4.8	T	9/15–5/31
Nehalem	Humbug Creek	0–6.5	T	S, 9/15–5/31
Nehalem	Nehalem Bay	0–4.1	FC	*
Nehalem	Nehalem River	0–3	FC	Y
Nehalem	Nehalem River	14.7–120	T	S, 9/15–5/31
Nehalem	North Fork Nehalem River	10.5–23.6	T	S, 9/15–5/31
Nehalem	Northrup Creek	0–7.5	T	S, 9/15–5/31
Nehalem	Oak Ranch Creek	0–9.3	T	S, 9/15–5/31
Nehalem	Pebble Creek	0–9.8	T	S, 9/15–5/31
Nehalem	Rock Creek	0–11	T	S, 9/15–5/31
Nehalem	Salmonberry River	0–5	T	S, 9/15–5/31
Nehalem	Soapstone Creek	0–3.9	T	S
Nehalem	West Humbug Creek	0–5.1	T	9/15–5/31
Nehalem	Wolf Creek	0–7.8	T	9/15–5/31
North Umpqua	Boulder Creek	0–8.7	T	Sp/S
North Umpqua	Calf Creek	0–8	T	S
North Umpqua	Canton Creek	0–10	S	*
North Umpqua	Canton Creek	0–12.5	T	S
North Umpqua	Cedar Creek	0–1.9	T	S
North Umpqua	City Creek	0–6.6	T	S
North Umpqua	Cooper Creek Reservoir/Cooper Creek	0–5.9	Fe, Hg	Y

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
North Umpqua	Copeland Creek	0–11.6	T	S
North Umpqua	Deer Creek	0–2.6	T	S
North Umpqua	Diamond Lake/Diamond Lake	0–3.7	AW/A	*
North Umpqua	Diamond Lake/Diamond Lake	0–3.7	pH	S
North Umpqua	East Fork Rock Creek	0–5.9	T	9/15–5/31
North Umpqua	East Pass Creek	0–3	T	9/15–5/31
North Umpqua	Fish Creek	0–6.9	DO	S
North Umpqua	Fish Creek	0–6.9	T	Sp/S
North Umpqua	Harrington Creek	0–3.8	T	S, 9/15–5/31
North Umpqua	Honey Creek	0–3.2	T	S, 9/15–5/31
North Umpqua	Horse Heaven Creek	0–6.3	S	*
North Umpqua	Horse Heaven Creek	0–6.3	T	S
North Umpqua	Lake Creek	0.9–11.5	T	Y
North Umpqua	Lemolo Lake/North Umpqua River	91.8–93.5	pH	S
North Umpqua	Little Rock Creek	0–6.6	S	*
North Umpqua	Little Rock Creek	0–6.6	T	S
North Umpqua	Mellow Moon Creek	0–3.1	T	9/15–5/31
North Umpqua	Miller Creek	0–3.6	T	9/15–5/31
North Umpqua	Mowich Creek	0–7	T	S
North Umpqua	North Umpqua River	0–47.7, 68.3–72.3, 75.5–83.3	T	S
North Umpqua	North Umpqua River	34.8–65.9	T	Sp/S
North Umpqua	North Umpqua River	35–52	As	Y
North Umpqua	North Umpqua River	77–78	pH	S
North Umpqua	North Umpqua River	75–75, 77–78, 86.9–87.4	TDG	Y
North Umpqua	Panther Creek	0–1.7	T	S
North Umpqua	Platt I Reservoir	0–0	Hg	Y
North Umpqua	Potter Creek	0–2.7	BC	Y
North Umpqua	Rock Creek	0–12.4	T	S
North Umpqua	Rock Creek	12.4–19.1	T	9/15–5/31
North Umpqua	Scaredman Creek	0–2.1	T	9/15–5/31
North Umpqua	Slide Creek	0–4.9	T	S

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
North Umpqua	Steamboat Creek	0–6.1	DO	S
North Umpqua	Steamboat Creek	0–23.4	pH	S
North Umpqua	Steamboat Creek	0–19	T	S
North Umpqua	Steamboat Creek	10.9–23.4	S	*
North Umpqua	Steelhead Creek	0–4.8	T	S
North Umpqua	Susan Creek	0–4.3	T	S, 9/15–5/31
North Umpqua	Sutherlin Creek	0–16	As, Fe, Pb, Mn	Y
North Umpqua	Sutherlin Creek	4.6–10	Cu	Y
North Umpqua	Unnamed Creek	0–0	As, Pb, Fe	Y
North Umpqua	Unnamed Waterbody	0–2.8	T	9/1–5/31
North Umpqua	Watson Creek	0–7.7	T	S
Siletz-Yaquina	Depot Slough	0–1.3	FC	Y
Siletz-Yaquina	Drift Creek	0.8–21.6	T	S
Siletz-Yaquina	Elk Creek	0–29.5	S	*
Siletz-Yaquina	Elk Creek	0–29.5	T	S
Siletz-Yaquina	North Creek	0–3.2	T	S
Siletz-Yaquina	Nute Slough	0–1.5	FC	W/Sp/F
Siletz-Yaquina	Olalla Creek	0–3.2	FC	Y
Siletz-Yaquina	Poole Slough	0–2.6	FC	Y
Siletz-Yaquina	Salmon River	0–23.1	DO	9/15–5/31
Siletz-Yaquina	Siletz River	7–46.8	T	S
Siletz-Yaquina	Thompson Creek	0–2	FC	Y
Siletz-Yaquina	Unnamed Waterbody	0–3.1	ChlA, pH	S
Siletz-Yaquina	Yaquina River	0–15.4	FC	Y
Siletz-Yaquina	Yaquina River	15.4–27.6	T	S
Siletz-Yaquina	Yaquina River	27.6–57.5	DO	6/1–5/31
Siltcoos	Fiddle Creek	0–7.5	T	S
Siltcoos	Siltcoos Lake/Siltcoos Lake	0–2.3	AW/A	*
Siltcoos	Tahkenitch Lake/Tahkenitch Lake	0–3.4	AW/A	*
Siuslaw	Deadwood Creek	0–20.9	T	S
Siuslaw	Drew Creek	0–3.2	S	*
Siuslaw	Eames Creek	0–4.8	BC	*

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Siuslaw	Failor Creek	0–4	T	S
Siuslaw	Gibson Creek	0–1.5	T	9/15–5/31
Siuslaw	Indian Creek	0–22	T	S
Siuslaw	Knowles Creek	0–13.1	T	9/15–5/31
Siuslaw	Lake Creek	0–28.3	T	S
Siuslaw	McLeod Creek	0–7.4	S	*
Siuslaw	McLeod Creek	0–7.4	T	9/15–5/31
Siuslaw	Morris Creek	0–3.9	S	*
Siuslaw	North Fork Siuslaw River	0–21	T	S
Siuslaw	North Fork Siuslaw River	0.4–27.3	S	*
Siuslaw	North Fork Siuslaw River	0.4–27.3	T	9/15–5/31
Siuslaw	Porter Creek	0–4.9	S	*
Siuslaw	Siuslaw River	20–105.9	T	S
Siuslaw	Siuslaw River	5.7–105.9	DO	6/1–5/31
Siuslaw	South Fork Siuslaw River	0–3.8	BC	*
Siuslaw	Sweet Creek	0–11.5	T	S
Siuslaw	Taylor Creek	0–2.3	S	*
Siuslaw	West Fork Deadwood Creek	0–7.7	T	S
Siuslaw	West Fork Indian Creek	0–8.9	T	S
Sixes	Bald Mountain Creek	0–2.3	T	S
Sixes	Cedar Creek	0–4.5	T	S
Sixes	Crystal Creek	0–7.3	T	S
Sixes	East Fork Floras Creek	0–7.5	T	S
Sixes	Edson Creek	0–5.8	T	S
Sixes	Elk River	0–29.9	T	S
Sixes	Euchre Creek	0–2.6	T	S
Sixes	Floras Creek	0–12.8	T	S
Sixes	Floras Lake/Boulder Creek	0.8–2.1	AW/A	*
Sixes	North Fork Floras Creek	0–10.9	T	S
Sixes	Sixes River	0–30.1	DO	10/1–5/31
Sixes	Sixes River	0–30.1	T	S
Sixes	South Fork Floras Creek	0–3.7	T	S
Sixes	Unnamed Waterbody	0–1.5	T	S

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Sixes	Willow Creek	0–6.9	T	S
South Umpqua	Applegate Creek	0–4.8	T	S
South Umpqua	Bear Creek	0–4.7	T	S
South Umpqua	Beaver Creek	0–2.1	S	*
South Umpqua	Beaver Creek	0–2.1	T	S
South Umpqua	Black Canyon Creek	0–5.2	pH	S
South Umpqua	Black Rock Fork	0–9.7	T	S
South Umpqua	Boulder Creek	0–10.7	T	S
South Umpqua	Brownie Creek	0–5.8	T	S
South Umpqua	Buckeye Creek	0–9.8	T	S
South Umpqua	Callahan Creek	0–6.2	T	S
South Umpqua	Canyon Creek	0–4.3	T	9/15–5/31
South Umpqua	Castle Rock Fork	0–11.9	T	S
South Umpqua	Cattle Creek	0–3.2	T	S, 9/15–5/31
South Umpqua	Coffee Creek	1.8–4.7	T	S
South Umpqua	Cow Creek	0–2	Cl	Y
South Umpqua	Cow Creek	0–26.3	pH	S
South Umpqua	Cow Creek	0–26.3	T	S, 9/15–5/31
South Umpqua	Cow Creek	26.3–50.8, 60.8–74	T	S
South Umpqua	Dads Creek	0–3.4	T	S
South Umpqua	Days Creek	0–13.9	T	S, 9/15–5/31
South Umpqua	Deadman Creek	0–9	T	S
South Umpqua	Deer Creek	0–9.6	DO, FC	Y
South Umpqua	Deer Creek	0–9.6	T	S, 9/15–5/31
South Umpqua	Dismal Creek	0–2.7	T	S
South Umpqua	Drew Creek	0–8.3	T	S
South Umpqua	Dumont Creek	0–2.9	BC	
South Umpqua	Dumont Creek	0–2.9	T	S
South Umpqua	East Fork Creek	0–0	T	S
South Umpqua	East Fork Deadman Creek	0–5.8	T	S
South Umpqua	East Fork Shively Creek	0–3.5	T	9/15–5/31
South Umpqua	East Fork Stouts Creek	0–4.9	T	S, 9/15–5/31

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
South Umpqua	Elk Creek	0–14.6	T	S
South Umpqua	Elk Valley Creek	1.9–6	T	S
South Umpqua	Fate Creek	0–2.5	T	S, 9/15–5/31
South Umpqua	Flat Creek	0–5	T	S
South Umpqua	Fortune Branch	0–4.7	T	S
South Umpqua	Francis Creek	0–3.7	T	S
South Umpqua	Galesville Reservoir	0–0	Hg	Y
South Umpqua	Iron Mountain Creek	0–3.8	T	S, 9/15–5/31
South Umpqua	Jackson Creek	0–25	BC, S	*
South Umpqua	Jackson Creek	0–25	pH, T	S
South Umpqua	Joe Hall Creek	0–3.4	T	S
South Umpqua	Lavadoure Creek	0–2.2	T	S, 9/15–5/31
South Umpqua	Martin Creek	0–2	T	S
South Umpqua	Martin Creek	0–3.3	T	9/15–5/31
South Umpqua	Middle Creek	0–12.8	T	S
South Umpqua	Middle Fork Deadman Creek	0–4.6	T	S, 9/15–5/31
South Umpqua	Mitchell Creek	0–4.2	T	S
South Umpqua	North Fork Deer Creek	0–6.7	EC	6/1–9/30
South Umpqua	North Myrtle Creek	0–0.5	Am	Y
South Umpqua	North Myrtle Creek	0–15	T	S
South Umpqua	Olalla Creek	0–15.6	BC	*
South Umpqua	Olalla Creek	0–15.6	T	S
South Umpqua	Poole Creek	0–3.3	T	9/15–5/31
South Umpqua	Quartz Creek	0–8.4	T	S
South Umpqua	Quines Creek	0–6	T	S
South Umpqua	Rice Creek	0–6.8	T	S, 9/15–5/31
South Umpqua	Riffle Creek	0–5.7	T	S
South Umpqua	Riser Creek	0–4.1	T	S
South Umpqua	Saint John Creek	0–5.6	T	S, 9/15–5/31
South Umpqua	School Hollow	0–1.6	T	S
South Umpqua	Shively Creek	0–5.2	T	9/15–5/31
South Umpqua	Skull Creek	0–2	T	S
South Umpqua	Slick Creek	0–4.9	T	S

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
South Umpqua	Slide Creek	2.6–4.4	T	9/15–5/31
South Umpqua	Snow Creek	0–5.3	T	S
South Umpqua	South Fork Middle Creek	0–4.4	T	S, 9/15–5/31
South Umpqua	South Myrtle Creek	0–22.2	T	S, 9/15–5/31
South Umpqua	South Umpqua River	0–57.7	AW/A	S
South Umpqua	South Umpqua River	0–15.9	As	Y
South Umpqua	South Umpqua River	0–57.7	BC	*
South Umpqua	South Umpqua River	0–15.9	Cd	Y
South Umpqua	South Umpqua River	0–15.9	FC	W/Sp/F
South Umpqua	South Umpqua River	15.9–57.7	FC	Y
South Umpqua	South Umpqua River	0–15.9	pH	S/F
South Umpqua	South Umpqua River	0–5	pH	W/Sp/F
South Umpqua	South Umpqua River	15.9–102.2	pH	S
South Umpqua	South Umpqua River	0–15.9	P	S
South Umpqua	South Umpqua River	0–15.9	T	S, 9/15–5/31
South Umpqua	South Umpqua River	57.7–102.2	T	S
South Umpqua	South Umpqua River	15.9–57.7	T	9/15–5/31
South Umpqua	South Umpqua River	0–51	Cl	Y
South Umpqua	South Umpqua River	5–15.9	DO	9/15–5/31
South Umpqua	South Umpqua River	80–102	S	Y
South Umpqua	Stouts Creek	0–7.9	T	S
South Umpqua	Thompson Creek	0–7.6	T	S, 9/15–5/31
South Umpqua	Union Creek	0–7	T	S, 9/15–5/31
South Umpqua	Unnamed Waterbody	0–2.9	T	S
South Umpqua	Unnamed Waterbody	0–2.9	T	9/15–5/31
South Umpqua	Weaver Creek	1.5–5.7	T	9/15–5/31
South Umpqua	West Fork Canyon Creek	0–8.8	T	S, 9/15–5/31
South Umpqua	West Fork Cow Creek	0–17.9	T	S
South Umpqua	Windy Creek	0–9.4	T	S
South Umpqua	Wood Creek	0–4	T	9/15–5/31
South Umpqua	Woodford Creek	0–3.5	T	S
Umpqua	Brush Creek	0–7.4	T	S
Umpqua	Buck Creek	0–0.7	T	S

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Umpqua	Bum Creek	0–2.3	T	S
Umpqua	Calapooya Creek	0–18.7	DO	W/S/F
Umpqua	Calapooya Creek	0–18.7	FC	Y
Umpqua	Calapooya Creek	0–18.7	T, pH	S
Umpqua	Cedar Creek	0–3	T	S, 9/15–5/31
Umpqua	Cleghorn Creek	0–2.8	T	S, 9/15–5/31
Umpqua	Cook Creek	0–2.9	Cu, Fe, Pb, Mn	Y
Umpqua	Elk Creek	0–25.9	DO, FC	Y
Umpqua	Elk Creek	0–45.5	T	S
Umpqua	Halfway Creek	0–6.3	T	9/15–5/31
Umpqua	Herb Creek	0–2.7	T	S
Umpqua	Little Wolf Creek	0–5.4	T	S, 9/15–5/31
Umpqua	Middle Fork North Fork Smith River	0–4.6	T	S
Umpqua	Miner Creek	0–4.2	T	S, 9/15–5/31
Umpqua	North Fork Smith River	0–31.8	T	S
Umpqua	North Fork Smith River	19.1–31.8	BC	
Umpqua	North Fork Tom Folley Creek	0–2	T	S, 9/15–5/31
Umpqua	Rader Creek	0–4.7	T	S, 9/15–5/31
Umpqua	Russell Creek	0–2.2	T	S
Umpqua	Scholfield Creek	0–5	FC	Y
Umpqua	Smith River	15.7–83.7	T	S
Umpqua	Soup Creek	0–1.4	T	S
Umpqua	South Fork Smith River	0–7	T	S
Umpqua	South Sister Creek	0–8.6	T	S
Umpqua	Tom Folley Creek	0–8.2	T	S, 9/15–5/31
Umpqua	Umpqua River	1–6.7, 7.7–11.8	FC	Y
Umpqua	Umpqua River	11.8–109.3	T	S
Umpqua	Umpqua River	25.9–109.3	FC	W/Sp/F
Umpqua	Unnamed Waterbody	0–1.4	T	9/15–5/31
Umpqua	Unnamed Waterbody	0–1.6	T	S
Umpqua	West Branch North Fork Smith River	0–3.4	T	S

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Umpqua	West Fork Smith River	0–15.9	T	S
Umpqua	Wolf Creek	0–4	T	S
Umpqua	Wolf Creek	4–7.5	T	9/15–5/31
Umpqua	Yellow Creek	0–9.1	T	S, 9/15–5/31
Upper Rogue	Abbott Creek	0–2.1	T	S
Upper Rogue	Antelope Creek	0–19.7	EC	6/1–9/30
Upper Rogue	Antelope Creek	0–19.7	T	S
Upper Rogue	Big Butte Creek	0–11.6	DO	6/1–9/30
Upper Rogue	Big Butte Creek	0–11.6	T	S
Upper Rogue	Bitter Lick Creek	0–8.6	T	S
Upper Rogue	Burnt Canyon	0–3.2	T	S
Upper Rogue	Deer Creek	0–3.2	S	*
Upper Rogue	Elk Creek	0–13.3	T	S
Upper Rogue	Elk Creek	9.5–20.7	DO	6/1–9/30
Upper Rogue	Fish Lake/North Fork Little Butte Creek	15.9–17.6	ChlA, pH	S
Upper Rogue	Flat Creek	0–8.2	T	S
Upper Rogue	Foster Creek	0–4.9	T	S
Upper Rogue	Indian Creek	0–5.2	DO	6/1–9/30
Upper Rogue	Lake Creek	0–7.8	EC	6/1–5/31
Upper Rogue	Lake Creek	0–7.8	S	*
Upper Rogue	Lake Creek	0–7.8	T	S
Upper Rogue	Lick Creek	0–6.8	DO, EC	6/1–9/30
Upper Rogue	Little Butte Creek	0–16.7	DO	Sp/S, 10/1–5/31
Upper Rogue	Little Butte Creek	0–16.7	FC	Y
Upper Rogue	Little Butte Creek	0–16.7	S	*
Upper Rogue	Little Butte Creek	0–16.7	T	S
Upper Rogue	Lost Creek	0–8.4	S	*
Upper Rogue	Lost Creek	0–8.4	T	S
Upper Rogue	Nichols Branch	0–0.5	EC	6/1–9/30
Upper Rogue	North Fork Little Butte Creek	0–6.5	EC	6/1–9/30
Upper Rogue	North Fork Little Butte Creek	0–6.5	T	S
Upper Rogue	Reese Creek	0–3	DO, EC	6/1–9/30

Table C-1. (continued).

Coastal Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Upper Rogue	Salt Creek	0–9	EC	6/1–9/30
Upper Rogue	Soda Creek	0–5.6	S	*
Upper Rogue	Soda Creek	0–5.6	T	S
Upper Rogue	South Fork Little Butte Creek	0–16.4	S	*
Upper Rogue	South Fork Little Butte Creek	0–16.4	T	S
Upper Rogue	Trail Creek	0–10.7	DO	6/1–9/30
Upper Rogue	West Branch Elk Creek	0–7.4	T	S
Upper Rogue	West Fork Muir Creek	0–3.3	T	S
Upper Rogue	West Fork Trail Creek	0–8.4	DO	6/1–9/30
Upper Rogue	Willow Creek	0–4.5	T	S
Upper Rogue	Woodruff Creek	0–6.2	T	S
Wilson-Trask-Nestucca	Bewley Creek	0–2	DO	9/15–5/31
Wilson-Trask-Nestucca	Dougherty Slough	0–4.9	DO	Y
Wilson-Trask-Nestucca	Hall Slough	0–2.8	DO	Y
Wilson-Trask-Nestucca	Hathaway Slough	0–1.2	DO	Y
Wilson-Trask-Nestucca	Hoquarten Slough	0–3.1	DO	Y
Wilson-Trask-Nestucca	Kilchis River	3–8.5	DO	9/15–5/31
Wilson-Trask-Nestucca	Mill Creek	0–3	DO	9/15–5/31
Wilson-Trask-Nestucca	Mill Creek	0–3	Fe	Y
Wilson-Trask-Nestucca	Nestucca River	0–28.9	DO	9/15–5/31
Wilson-Trask-Nestucca	Tillamook River	6.4–18.5	DO	9/15–5/31
Wilson-Trask-Nestucca	Trask River	4.1–10.2	DO	9/15–5/31
Wilson-Trask-Nestucca	Wilson River	3.5–10.1	DO	9/15–5/31
Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Beaver South Fork	Beaverdam Creek	0–10.8	T	S
Beaver South Fork	Dipping Vat Creek	0–7.7	T	S, 10/1–6/30
Beaver South Fork	Dry Paulina Creek	0–13.1	T	S, 10/1–6/30
Beaver South Fork	North Wolf Creek	0–10.3	T	S
Beaver South Fork	Powell Creek	0–12.7	T	S
Beaver South Fork	Roba Creek	0–7.2	T	S, 10/1–6/30
Beaver South Fork	South Fork Beaver Creek	0–26.4	T	S, 10/1–6/30
Beaver South Fork	South Fork Crooked River	0–18	T	S, 10/1–6/30

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Beaver South Fork	Sugar Creek	0–11.5	T	S
Beaver South Fork	Wolf Creek	0–17.1	T	S, 10/1–6/30
Brownlee Reservoir	Aspen Creek	0–1.6	T	S
Brownlee Reservoir	Beecher Creek	0–2.4	T	S
Brownlee Reservoir	Big Elk Creek	0–2.1	T	S
Brownlee Reservoir	Clear Creek	0–8.7	T	S
Brownlee Reservoir	Connor Creek	0–6.7	T	S
Brownlee Reservoir	East Pine Creek	0–18.7	T	S
Brownlee Reservoir	Elk Creek	0–9.5	T	S
Brownlee Reservoir	Fox Creek	0–6.4	T	S, 3/1–5/31
Brownlee Reservoir	Lake Fork	0–10.4	T	S
Brownlee Reservoir	Meadow Creek	0–3.3	T	S
Brownlee Reservoir	Morgan Creek	0–6.1	T	S, 3/1–5/31
Brownlee Reservoir	Okanogan Creek	0–1.3	T	S
Brownlee Reservoir	Pine Creek	0–32.7	T	S
Brownlee Reservoir	Trail Creek	0–1.6	T	S
Bully	Bully Creek	0–12.8	ChlA, FC	S
Bully	Bully Creek	15.9–57.1	FC	S/F
Bully	Auburn Creek	0–6.6	T	S
Bully	Burnt River	0–77.3	T	S
Bully	Burnt River	45.1–77.3	ChlA	S
Bully	Camp Creek	0–6.9	S	*
Bully	China Creek	0–7.7	T	S
Bully	Cottonwood Creek	0–5	T	S, 3/1–5/31
Bully	Dark Canyon	0–5.9	T	S, 3/1–5/31
Bully	Dixie Creek	0–6.9	T	S, 3/1–5/31
Bully	East Camp Creek	0–8	T	S
Bully	Geiser Creek	0–4.9	S	*
Bully	Lawrence Creek	0–9.4	T	S, 3/1–5/31
Bully	North Fork Burnt River	1.9–28.7	T	S
Bully	North Fork Dixie Creek	0–11.2	T	S, 3/1–5/31
Bully	Patrick Creek	0–1.3	S	*
Bully	Patrick Creek	0–1.3	T	S

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Bully	Pine Creek	0–2.7	T	S, 3/1–5/31
Bully	South Fork Dixie Creek	0–9.6	T	S, 3/1–5/31
Burnt	Trout Creek	0–8.8	S	*
Burnt	Trout Creek	0–8.8	T	S
Clackamas	Bargfeld Creek	0–2.3	EC	S
Clackamas	Clackamas River	0–15	EC	6/1–9/30
Clackamas	Clackamas River	0–22.9	T	S
Clackamas	Cow Creek	0–2.6	EC	10/1–5/31
Clackamas	Cow Creek	0–2.6	T	S
Clackamas	Deep Creek	1.9–14.1	EC	S
Clackamas	Eagle Creek	0–20	T	S
Clackamas	Fish Creek	0–6.8	T	S
Clackamas	North Fork Deep Creek	0–9	EC	S
Clackamas	Rock Creek	0–6.1	EC	10/1–5/31
Clackamas	Sieben Drainage Ditch	0–1.8	EC	10/1–5/31
Clackamas	Tickle Creek	0–2.3	EC	S
Coast Fork Willamette	Brice Creek	0–11.2	T	S
Coast Fork Willamette	Camas Swale Creek	0–9.4	DO	10/1–5/31
Coast Fork Willamette	Coast Fork Willamette River	0–31.3	FC, Hg	Y
Coast Fork Willamette	Coast Fork Willamette River	0–31.3	T	S
Coast Fork Willamette	Cottage Grove Reservoir/ Coast Fork Willamette River	28.5–31.3	Hg	Y
Coast Fork Willamette	Dorena Lake/Row River	7.4–11.3	Hg	Y
Coast Fork Willamette	King Creek	0–1.6	T	S
Coast Fork Willamette	Laying Creek	0–7.7	T	S
Coast Fork Willamette	Martin Creek	0–3.4	T	S
Coast Fork Willamette	Mosby Creek	0–21.2	T	S
Coast Fork Willamette	Row River	0–7.4, 11.3–20.8	T	S
Coast Fork Willamette	Sharps Creek	0–12.5	T	S
Imnaha	Big Sheep Creek	0–36.6	T	S
Imnaha	Crazyman Creek	0–6.7	T	S
Imnaha	Dry Creek	0–4.2	T	8/1–7/15
Imnaha	Freezeout Creek	0–8.5	T	S

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Imnaha	Grouse Creek	0–17.3	T	S
Imnaha	Gumboot Creek	0–7.4	T	8/1–7/15
Imnaha	Imnaha River	0–72	T	S
Imnaha	Lightning Creek	0–24.8	T	S
Imnaha	Little Sheep Creek	0–29	T	S
Jordon	Antelope Reservoir/ Jack Creek	4.1–8.4	Hg	Y
Jordon	Jordan Creek	0–54.4	Hg	Y
Little Deschutes	Crescent Creek	0–26.1	T	S
Little Deschutes	Little Deschutes River	0–54.1	DO	9/1–6/30
Little Deschutes	Little Deschutes River	0–54.1	DO	7/1–8/31
Little Deschutes	Little Deschutes River	54.1–78	T	9/1–6/30
Little Deschutes	Paulina Creek	0–13.2	T	S
Lower Columbia Sandy	Beaver Creek	0–8.3	EC	S
Lower Columbia Sandy	Bull Run River	0–5	T	S
Lower Columbia Sandy	Cedar Creek	0–4.3	EC	S
Lower Columbia Sandy	Gordon Creek	0–10.5	T	9/15–6/30
Lower Columbia Sandy	Kelly Creek	0–4.8	EC	S
Lower Columbia Sandy	Salmon River	0–0.9	T	S
Lower Columbia Sandy	Sandy River	0–29.5	DO	9/15–6/30
Lower Columbia Sandy	Sandy River	0–29.5	T	S
Lower Columbia Sandy	Unnamed Waterbody	0–2.9	EC	S
Lower Crooked	East Fork Mill Creek	0–7.6	T	S
Lower Crooked	Harvey Creek	0–1.4	T	S
Lower Crooked	Little McKay Creek	0–6.7	T	S, 10/1–6/30
Lower Crooked	Marks Creek	0–17.1	T	S, 10/1–6/30
Lower Crooked	McKay Creek	0–19.5	T	S
Lower Crooked	McKay Creek	14.7–19.5	T	10/1–6/30
Lower Crooked	Mill Creek	0–11.5	T	S, 10/1–6/30
Lower Crooked	Ochoco Creek	0–36.4	T	S
Lower Crooked	West Fork Mill Creek	0–4.9	T	S
Lower Deschutes	Buck Hollow Creek	0–37.7	T	S
Lower Deschutes	Clear Creek	0–15.1	T	S

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Lower Deschutes	Gate Creek	0–14.3	S	*
Lower Deschutes	Gate Creek	0–14.3	T	S
Lower Deschutes	Oak Canyon	0–6.3	T	S
Lower Deschutes	Rock Creek	0–15.9	S	*
Lower Deschutes	Rock Creek	0–14.1	T	S
Lower Deschutes	Sixteen Canyon	0–3.7	T	S
Lower Deschutes	Tenmile Creek	0–0	T	S
Lower Deschutes	Threemile Creek	0–11.3	T	S
Lower Deschutes	Wapinitia Creek	0–14.4	T	S
Lower Deschutes	White River	0–12	T	S
Lower Deschutes	Willow Creek	0–21.4	T	S
Lower Grande Ronde	Chesnimnus Creek	0–26.4	S	*
Lower Grande Ronde	Chesnimnus Creek	0–26.4	T	S
Lower Grande Ronde	Courtney Creek	0–6.9	T	S
Lower Grande Ronde	Crow Creek	0–20.2	T	S
Lower Grande Ronde	Elk Creek	0–13.7	S	*
Lower Grande Ronde	Elk Creek	0–13.7	T	S
Lower Grande Ronde	Joseph Creek	8.3–48.1	T	S
Lower Grande Ronde	Mud Creek	0–23	T	S, 10/1–6/30
Lower Grande Ronde	Peavine Creek	0–5.3	T	S
Lower Grande Ronde	Salmon Creek	0–13.6	T	S
Lower Grande Ronde	Sickfoot Creek	0–7.5	T	S, 10/1–6/30
Lower Grande Ronde	Wenaha River	0–14.6	T	S, 10/1–6/30
Lower Grande Ronde	Wildcat Creek	0–15.9	T	S, 10/1–6/30
Lower John Day	Bear Creek	0–4.6	T	S
Lower John Day	Bridge Creek	0–28.7	T	S
Lower John Day	Gable Creek	0–7.7	T	S
Lower John Day	Grass Valley Canyon	0–39.8	T	S
Lower John Day	Henry Creek	0–7.1	T	S
Lower John Day	Nelson Creek	0–5.7	T	S
Lower John Day	Pine Creek	0–15.8	BC	*
Lower John Day	Sorefoot Creek	0–7.5	T	S
Lower John Day	Stahl Canyon	0–5.7	T	S

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Lower John Day	Thirtymile Creek	0–39.3	T	S, 10/1–6/30
Lower Malheur	Alder Creek	0–4.1	T	S
Lower Malheur	Cottonwood Creek	0–35.3	T	S
Lower Malheur	Pole Creek	0–6.3	T	S
Lower Malheur	Willow Creek	0–0.2	EC	6/1–9/30, 10/1–5/31
Lower Owyhee	Fletcher Street Drain	0–0	Cu, Fe, Pb, Mn	Y
Lower Owyhee	Overstreet Drain	0–0	Cu, Fe, Pb, Mn	Y
Lower Willamette	Blue Lake/Arata Creek	0–0.9	AW/A	*
Lower Willamette	Blue Lake/Arata Creek	0–0.9	pH	S
Lower Willamette	Bybee Lake	0.5–1.7	AW/A	*
Lower Willamette	Bybee Lake	0.5–1.7	pH	S
Lower Willamette	Columbia Slough	0–8.5	Fe	Y
Lower Willamette	Columbia Slough	0–8.5	Mn	Y
Lower Willamette	Columbia Slough	0–8.5	T	Sp/S/F
Lower Willamette	Columbia Slough	0–9.8	Fe, Mn	Y
Lower Willamette	Fairview Creek	0–1.7	EC	Y
Lower Willamette	Fairview Creek	0–1.7	FC	W/Sp/F
Lower Willamette	Fairview Creek	0–1.7	pH	Sp/S
Lower Willamette	Fairview Lake/Osburn Creek	2–2.8	pH	10/1–5/31
Lower Willamette	Johnson Creek	0–23.7	DDT, D, PCB, FC, PAH	Y
Lower Willamette	Kellogg Creek	0–5	EC	10/1–5/31
Lower Willamette	Mount Scott Creek	0–6.1	EC	10/1–5/31
Lower Willamette	Phillips Creek	0–1.2	EC	10/1–5/31
Lower Willamette	Smith Lake	1.7–3	AW/A	*
Lower Willamette	Smith Lake	1.7–3	pH	S
Lower Willamette	Spring Brook Creek	0–2.3	FC	Y
Lower Willamette	Tryon Creek	0–5	T	S
McKenzie	Blue River	0–1.8	T	Sp/S/F
McKenzie	Blue River	1.8–15.5	T	S
McKenzie	Deer Creek	0–8.3	T	S
McKenzie	French Pete Creek	0–12.9	T	S
McKenzie	Horse Creek	0–14.2	T	S

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
McKenzie	McKenzie River	0–34.1, 54.4–83	T	S
McKenzie	McKenzie River	34.1–54.5	T	Sp/S/F
McKenzie	Mill Creek	0–2.7	T	S
McKenzie	Mohawk River	0–25.4	DO	10/1–5/31
McKenzie	Mohawk River	0–25.4	T	S
McKenzie	Shotgun Creek	0–6.6	T	S
McKenzie	South Fork McKenzie River	0–4.5	T	Sp/S/F
McKenzie	Unnamed Waterbody	0–1.2	T	S
Middle Columbia Hood	Chenoweth Creek	0–7.9	T	S, 10/1–6/30
Middle Columbia Hood	Dry Creek	0–16.6	T	S, 10/1–6/30
Middle Columbia Hood	Eightmile Creek	0–22	T	S, 10/1–6/30
Middle Columbia Hood	Eightmile Creek	0–34.5	S	*
Middle Columbia Hood	Fifteenmile Creek	0–52.7	S	*
Middle Columbia Hood	Fifteenmile Creek	0–40	T	S, 9/15–6/30
Middle Columbia Hood	Fivemile Creek	0–17.9	S	*
Middle Columbia Hood	Fivemile Creek	0–17.9	T	S, 10/1–6/30
Middle Columbia Hood	Indian Creek	0–7.8	Cpf	Y
Middle Columbia Hood	Lenz Creek	0–1.5	Cpf, Zn	Y
Middle Columbia Hood	Mill Creek	0–7.7	T	S, 9/15–6/30
Middle Columbia Hood	Mitchell Creek	0–2.3	Zn	Y
Middle Columbia Hood	Mosier Creek	0–16.1	T	S
Middle Columbia Hood	Neal Creek	0–5.6	Cpf, G, Fe	Y
Middle Columbia Hood	North Fork Mill Creek	0–3.7	T	S, 10/1–6/30
Middle Columbia Hood	Ramsey Creek	0–13.2	S	*
Middle Columbia Hood	Ramsey Creek	0–5.4	T	S, 10/1–6/30
Middle Columbia Hood	Rock Creek	0–10.6	T	S, 10/1–6/30
Middle Columbia Hood	South Fork Mill Creek	0–8.5	T	S
Middle Columbia Hood	Threemile Creek	0–14.6	T	S, 10/1–6/30
Middle Columbia Hood	West Fork Mosier Creek	0–7.9	T	S
Middle Fork John Day	Big Creek	0–11.6	T	S
Middle Fork John Day	Camp Creek	0–15.6	T	S
Middle Fork John Day	Caribou Creek	0–3.6	T	S

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Middle Fork John Day	Clear Creek	0–12.7	T	S
Middle Fork John Day	Coyote Creek	0–2.5	T	S
Middle Fork John Day	Crawford Creek	0–3.5	T	S
Middle Fork John Day	Davis Creek	0–6.8	T	S
Middle Fork John Day	Dry Fork Clear Creek	0–11	T	S
Middle Fork John Day	Granite Boulder Creek	0–8.1	T	S
Middle Fork John Day	Little Boulder Creek	0–2.1	T	S
Middle Fork John Day	Little Butte Creek	0–2.6	T	S
Middle Fork John Day	Long Creek	0–36.7	T	S
Middle Fork John Day	Lunch Creek	0–4.1	T	S
Middle Fork John Day	Middle Fork John Day River	0–69.8	T	S, 9/15–7/15
Middle Fork John Day	Mill Creek	0–3.1	T	S
Middle Fork John Day	Placer Gulch	0–4.2	T	S
Middle Fork John Day	Ragged Creek	0–4.1	T	S
Middle Fork John Day	Squaw Creek	0–9.4	T	S
Middle Fork John Day	Summit Creek	0–8.6	T	S, 8/15–7/15
Middle Fork John Day	Unnamed Waterbody	0–2.4	T	S
Middle Fork John Day	Vinegar Creek	0–7.1	T	S
Middle Fork Willamette	Anthony Creek	0–4.3	DO	10/1–5/31
Middle Fork Willamette	Anthony Creek	0–4.3	DO	6/1–9/30
Middle Fork Willamette	Anthony Creek	0–4.3	T	S
Middle Fork Willamette	Bohemia Creek	0–4.4	T	9/15–6/30
Middle Fork Willamette	Coal Creek	0–8.9	T	S
Middle Fork Willamette	Fall Creek	0–7, 13–32.7	T	S
Middle Fork Willamette	Hills Creek	1.7–8.2	T	S
Middle Fork Willamette	Little Fall Creek	0–20.6	T	9/15–6/30
Middle Fork Willamette	Lost Creek	0–14.7	DO	6/1–5/31

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Middle Fork Willamette	Lost Creek	0–14.7	T	S, 9/15–6/30
Middle Fork Willamette	Middle Fork Willamette River	0–15.6, 52.5–64.1	T	S
Middle Fork Willamette	Mike Creek	0–2.2	T	S
Middle Fork Willamette	North Fork, Middle Fork Willamette River	0–14.1	T	S
Middle Fork Willamette	North Fork, Middle Fork Willamette River	14.1–49.4	T	9/15–6/30
Middle Fork Willamette	Packard Creek	0–5.2	T	S
Middle Fork Willamette	Portland Creek	0–3	T	S
Middle Fork Willamette	Salt Creek	0–13.6	T	S
Middle Fork Willamette	South Fork Winberry Creek	0–3.1	T	S
Middle Fork Willamette	Unnamed Waterbody	0–2.3	T	S, 9/15–6/30
Middle Fork Willamette	Winberry Creek	2.9–8	T	S
Middle Owyhee	North Fork Owyhee River	0–9.6	T	S
Middle Snake Payette	Shepherd Gulch	0–3.6	FC	Sp/S
Middle Snake Payette	South Fork Jacobsen Gulch	0–3	FC	Sp/S
Middle Willamette	Abernethy Creek	0–15.5	T	S
Middle Willamette	Bashaw Creek	0–4.8	FC	Y
Middle Willamette	Champoeg Creek	0–7.5	D	Y
Middle Willamette	Clark Creek	0–1.9	EC	*
Middle Willamette	Gibson Gulch	0–2.8	DO	10/1–5/31
Middle Willamette	Glenn Creek	0–7	DO	10/1–5/31
Middle Willamette	Mill Creek	0–25.7	FC	Y
Middle Willamette	Patterson Creek	0–7.2	T	S
Middle Willamette	Pringle Creek	0–6.2	Cu, D, Pb, Zn	Y
Middle Willamette	Pringle Creek	0–6.2	EC	*
Middle Willamette	Pringle Creek	0–6.2	T	S

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Middle Willamette	Rickreall Creek	0–24.9	T	S
Middle Willamette	Winslow Gulch	0–2.5	DO	10/1–5/31
Molalla-Pudding	Butte Creek	18.7–35.6	T	S
Molalla	Drift Creek	0–9.5	T	S
Molalla	Molalla River	0–25	FC	W/Sp/F
Molalla	Molalla River	0–48.2	T	S
Molalla	Pine Creek	0–1	T	S
Molalla	Pudding River	0–35.4	DDT	Y
Molalla	Pudding River	0–35.4	FC	Y
Molalla	Pudding River	0–61.7	T	S
Molalla	Silver Creek	0–5.9	FC, T	S
Molalla	Table Rock Fork Molalla River	0–12	T	S
Molalla	Zollner Creek	0–7.8	As, Cld, D, Fe, FC, Mn, N	Y
Molalla	Zollner Creek	0–7.8	T	S
North Fork John Day	Alder Creek	0–5.5	S	*
North Fork John Day	Baldy Creek	0–5	S	*
North Fork John Day	Bear Wallow Creek	0–7.4	T	S
North Fork John Day	Beaver Creek	0–6.1	T	S
North Fork John Day	Big Creek	0–10.7	T	S
North Fork John Day	Big Wall Creek	0–21.3	S	*
North Fork John Day	Big Wall Creek	0–21.3	T	S, 3/1–7/15
North Fork John Day	Bowman Creek	0–6.9	T	S
North Fork John Day	Bridge Creek	0–9	T	S
North Fork John Day	Buck Creek	0–1.6	T	S, 8/15–7/15
North Fork John Day	Bull Run Creek	0–9.3	S	*
North Fork John Day	Bull Run Creek	0–9.3	T	S
North Fork John Day	Cable Creek	0–7.1	T	S
North Fork John Day	Camas Creek	0–36.7	T	S, 3/1–7/15
North Fork John Day	Clear Creek	0–7.1	T	S
North Fork John Day	Cottonwood Creek	0–22.5	BC	*
North Fork John Day	Crane Creek	0–5.9	T	S
North Fork John Day	Desolation Creek	0–21.1	T	S

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
North Fork John Day	Ditch Creek	0–19.5	T	S
North Fork John Day	East Fork Cottonwood Creek	0–6.5	BC	*
North Fork John Day	Fivemile Creek	0–21.3	T	S
North Fork John Day	Frazier Creek	0–6.2	T	S
North Fork John Day	Granite Creek	0–11.2	T	S
North Fork John Day	Granite Creek	11.2–16.2	S	*
North Fork John Day	Hidaway Creek	0–16.2	T	S
North Fork John Day	Hog Creek	0–4.1	S	*
North Fork John Day	Indian Creek	0–5.4	T	S, 3/1–7/15
North Fork John Day	Lane Creek	0–7.1	T	S
North Fork John Day	Mallory Creek	0–14.3	T	S
North Fork John Day	Meadow Creek	0–10.4	T	S, 8/15–7/15
North Fork John Day	North Fork Cable Creek	0–7.5	T	S, 3/1–7/15
North Fork John Day	North Fork John Day River	0–31.7	T	S
North Fork John Day	North Fork John Day River	0–86.2	T	3/1–7/15
North Fork John Day	North Fork John Day River	31.7–97.1	T	S
North Fork John Day	Onion Creek	0–4.5	T	S
North Fork John Day	Owens Creek	0–14.8	T	S
North Fork John Day	Porter Creek	0–7.4	S	*
North Fork John Day	Potamus Creek	0–18.4	T	S
North Fork John Day	Rancheria Creek	0–5.1	T	S
North Fork John Day	Skookum Creek	0–12.4	T	S
North Fork John Day	South Fork Cable Creek	0–8.4	T	S, 3/1–7/15
North Fork John Day	South Trail Creek	0–6.6	T	S
North Fork John Day	Sponge Creek	0–2.7	T	S, 8/15–7/15
North Fork John Day	Stalder Creek	0–4.1	T	S
North Fork John Day	Swale Creek	0–11.1	S	*
North Fork John Day	Swale Creek	0–11.1	T	S
North Fork John Day	Trail Creek	0–1.9	T	S, 8/15–7/15
North Fork John Day	Wilson Creek	0–10.7	S	*
North Fork John Day	Wilson Creek	0–10.7	T	S
North Santiam	Bear Branch	0–9.8	T	S
North Santiam	Blowout Creek	0–11.9	T	S

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
North Santiam	Boulder Creek	0–2.4	T	S
North Santiam	Chehulpum Creek	0–7.1	T	S
North Santiam	Elkhorn Creek	0–7.4	T	S
North Santiam	Little North Santiam River	0–25.1	T	S
North Santiam	Marion Creek	0–6.2	T	S
North Santiam	North Santiam River	0–26.5	T	S, 9/1–6/30
North Santiam	Santiam River	0–12	DO	9/15–6/30
North Santiam	Santiam River	0–12	T	S, 9/15–6/30
North Santiam	Stout Creek	0–8.9	T	S
North Santiam	Unnamed Waterbody	0–2.8	T	S
Powder	Anthony Creek	0–16	T	S
Powder	California Gulch	0–4.4	T	S
Powder	Dean Creek	0.4–5.2	T	S
Powder	East Fork Goose Creek	0–2.7	Tb	Sp/S
Powder	Elk Creek	0–7.7	T	S
Powder	Indian Creek	0–5.2	T	S
Powder	North Powder River	0–18.3	T	S
Powder	Powder River	0–69	DO	S
Powder	Powder River	0–69, 71.9–130	FC	Y
Powder	Powder River	0–69, 71.9–115.6	T	S
Powder	Silver Creek	0–6.1	T	S
Powder	Sutton Creek	0–15.9	T	S, 3/1–5/31
Powder	West Fork Sutton Creek	0–3.3	T	S, 3/1–5/31
South Santiam	Beaver Creek	0–16	T	S
South Santiam	Crabtree Creek	0–32.1	T	S
South Santiam	Hamilton Creek	0–11.6	T	S
South Santiam	McDowell Creek	0–5.7	T	S
South Santiam	Middle Santiam River	5.3–37.1	T	S
South Santiam	Neal Creek	0–10	T	S
South Santiam	Quartzville Creek	3.3–26.8	T	S
South Santiam	South Santiam River	0–25.9 35.7–63.4	T	S, 9/15–6/30

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
South Santiam	Sucker Slough	0–9.8	T	S
South Santiam	Thomas Creek	0–26.1	T	S
South Santiam	Wiley Creek	0–17.2	T	S
Trout	Auger Creek	0–6.5	S	*
Trout	Auger Creek	0–6.5	T	S
Trout	Big Log Creek	0–5.5	S	*
Trout	Big Log Creek	0–5.5	T	S
Trout	Bull Cree	0–1.8	S	*
Trout	Bull Creek	0–1.8	T	S
Trout	Cartwright Creek	0–4.3	S	*
Trout	Cartwright Creek	0–4.3	T	S
Trout	Dick Creek	0–2.2	S	*
Trout	Dick Creek	0–2.2	T	S
Trout	Dutchman Creek	0–4.8	S	*
Trout	Dutchman Creek	0–4.8	T	S
Trout	Potlid Creek	0–5.2	S	*
Trout	Potlid Creek	0–5.2	T	S
Trout	Tenmile Creek	0–5.9	T	S, 10/1–6/30
Trout	Trout Creek	0–50.7	S	*
Trout	Trout Creek	0–50.7	T	S
Tualatin	Koll Wetland	0–0	CrHx, Cu, Pb, Ag, Zn	Y
Umatilla	Birch Creek	0–15.6	Fe	Y
Umatilla	Butter Creek	0–18	Fe	Y
Umatilla	Hermiston Ditch	0–2.7	pH	6/1–9/30
Umatilla	McKay Creek	0–15	Fe	Y
Umatilla	Umatilla River	0–32.1	DO	10/1–6/30
Umatilla	Umatilla River	0–32.1	Mn	Y
Umatilla	Umatilla River	0–56	Fe	Y
Umatilla	Unnamed Waterbod	0–3.1	N	Y
Umatilla	Wildhorse Creek	0–33.1	Fe	Y
Upper Crooked	Allen Creek	0–10.1	T	S
Upper Crooked	Bear Creek	0–34.3	T	S, 10/1–6/30

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Upper Crooked	Cow Creek	0–7.2	T	S
Upper Crooked	Crazy Creek	0–3.5	T	S
Upper Crooked	Deep Creek	0–10.6	T	S
Upper Crooked	Deer Creek	0.9–4	T	S
Upper Crooked	Double Corral Creek	0–5.4	T	S
Upper Crooked	Fox Canyon Creek	0–6.8	T	S, 10/1–6/30
Upper Crooked	Fox Creek	0–4.9	T	S
Upper Crooked	Gray Creek	0–6.7	T	S
Upper Crooked	Happy Camp Creek	0–6.7	T	S
Upper Crooked	Horse Heaven Creek	0–14	T	S
Upper Crooked	Howard Creek	0–9.5	T	S
Upper Crooked	Indian Creek	0–9.1	T	S
Upper Crooked	Jackson Creek	0–5.9	T	S, 10/1–6/30
Upper Crooked	Klootchman Creek	1–5.3	T	S
Upper Crooked	Little Horse Heaven Creek	0–2.9	T	S
Upper Crooked	Little Summit Creek	0–10	T	S, 10/1–6/30
Upper Crooked	Lookout Creek	0–1.5	T	S
Upper Crooked	Lytle Creek	0–4.2	T	S
Upper Crooked	North Fork Crooked River	0–44.7	T	S
Upper Crooked	Peterson Creek	0–10.7	T	S
Upper Crooked	Porter Creek	0–4.5	T	S, 10/1–6/30
Upper Crooked	Shotgun Creek	0–5.9	T	S
Upper Crooked	Wickiup Creek	0–8.6	T	S
Upper Crooked	Wildcat Creek	0–4.3	T	S, 10/1–6/30
Upper Deschutes	Brush Creek	0–2	T	Y
Upper Deschutes	Canyon Creek	0–11.4	T	Y
Upper Deschutes	First Creek	3.6–12.1	T	9/1–6/30
Upper Deschutes	Indian Ford	0–11.2	T	S
Upper Deschutes	Lake Creek	0–1.5	T	S
Upper Deschutes	Lava Lake	0–0	DO	6/1–9/30
Upper Deschutes	Odell Creek	0–11	T	S, 9/1–6/30
Upper Deschutes	Odell Lake/Odell Creek	11–16.3	pH	S
Upper Deschutes	Squaw Creek	0–21	T	9/1–6/30

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Upper Deschutes	Squaw Creek	1.6–21	T	S
Upper John Day	Badger Creek	0–9	T	S
Upper John Day	Battle Creek	0–7.3	T	S
Upper John Day	Bear Creek	0–10.1	T	S
Upper John Day	Canyon Creek	0–27.5	T	S
Upper John Day	Corral Creek	0–8.7	BC	*
Upper John Day	Cottonwood Creek	0–16.4	T	S
Upper John Day	Dads Creek	0–8.6	T	S
Upper John Day	Dans Creek	0–6	T	S
Upper John Day	Deardorff Creek	0–9.6	T	S
Upper John Day	Deer Creek	0–11.9	T	S
Upper John Day	Dog Creek	0–5.5	T	S
Upper John Day	East Fork Canyon Creek	0–9.2	T	S
Upper John Day	Ennis Creek	0–2.8	T	S, 10/1–6/30
Upper John Day	Fields Creek	0–10.2	T	S, 10/1–6/30
Upper John Day	Flat Creek	0–11.7	T	S, 10/1–6/30
Upper John Day	Grasshopper Creek	0–5.3	T	S, 10/1–6/30
Upper John Day	Grub Creek	0–13.5	T	S
Upper John Day	Indian Creek	0–6.1	T	S
Upper John Day	Little Pine Creek	0–5.1	T	S
Upper John Day	McClellan Creek	0–6.4	T	S
Upper John Day	Mountain Creek	0–21.7	T	S
Upper John Day	Murderers Creek	0–24.7	T	S
Upper John Day	North Fork Deer Creek	0–4.2	T	S
Upper John Day	Pine Creek	0–3.8	T	S
Upper John Day	Rail Creek	0–7.1	T	S
Upper John Day	Reynolds Creek	0–9.3	T	Y
Upper John Day	Rock Creek	0–24.7	T	S
Upper John Day	Slyfe Creek	0–6	T	S
Upper John Day	South Fork John Day River	0–57.3	T	S
Upper John Day	Strawberry Creek	0–5.8	T	S
Upper John Day	Sunflower Creek	0–8.7	T	S
Upper John Day	Tex Creek	0–6.9	T	S, 10/1–6/30

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Upper John Day	Tinker Creek	0–4.6	T	S
Upper John Day	Utley Creek	0–5.5	BC	*
Upper John Day	Utley Creek	0–5.5	DO	10/1–6/30
Upper Malheur	Bear Creek	0–14.7	T	S
Upper Malheur	Big Creek	0–6.1	T	S
Upper Malheur	Bluebucket Creek	0–12.1	T	S
Upper Malheur	Crane Creek	0–1.1	T	S
Upper Malheur	Dry Creek	0–8.3	T	S
Upper Malheur	Elk Creek	0–1	T	S
Upper Malheur	Lake Creek	0–11.9	T	S
Upper Malheur	Little Crane Creek	0–9.3	T	S
Upper Malheur	Little Malheur River	0–28.5	T	S
Upper Malheur	North Fork Malheur River	0–18	FC	Sp/S
Upper Malheur	North Fork Malheur River	20.8–59.3	T	S
Upper Malheur	Pine Creek	0–24.7	T	S
Upper Malheur	Stinkingwater Creek	0–27.8	T	S
Upper Malheur	Summit Creek	0–14.2	T	S
Upper Quinn	Indian Creek	0–8.4	T	S
Upper Quinn	McDermitt Creek	0–12.3	T	S
Upper Quinn	Sage Creek	0–5.2	T	S
Upper Willamette	A-3 Drain	0–0	As, DCE, Pb, Hg, TECE	Y
Upper Willamette	A-3 Drain	0–0	EC	6/1–5/31
Upper Willamette	Amazon Creek	0–22.6	As, Pb	Y
Upper Willamette	Amazon Creek	0–22.6	EC	6/1–5/31
Upper Willamette	Amazon Diversion Canal	0–1.8	DO	Sp/S/F
Upper Willamette	Amazon Diversion Canal	0–1.8	FC	Y
Upper Willamette	Calapooia River	0–42.8	FC	W/Sp/F
Upper Willamette	Calapooia River	0–42.8	T	S
Upper Willamette	Coyote Creek	0–26.2	DO	Sp/S/F
Upper Willamette	Coyote Creek	0–26.2	FC	Y
Upper Willamette	Ferguson Creek	0–10	T	S
Upper Willamette	Fern Ridge Reservoir/Long Tom River	24.2–31.8	FC	W/Sp/F

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	Water Body	River Mile	Impairment	Season
Upper Willamette	Fern Ridge Reservoir/Long Tom River	24.2–31.8	Tb	*
Upper Willamette	Long Tom River	0–24.2	FC	W/Sp/F
Upper Willamette	Long Tom River	0–24.2	T	S
Upper Willamette	Luckiamute River	0–31.7	FC	W/Sp/F
Upper Willamette	Marys River	0–13.9	DO	10/1–5/31
Upper Willamette	Marys River	0–13.9	FC	W/Sp/F
Upper Willamette	Marys River	0–13.9	T	S
Upper Willamette	Muddy Creek	0–33	T	S
Upper Willamette	Soap Creek	0–16.8	DO	10/1–5/31
Upper Willamette	South Fork Berry Creek	0–2.1	T	S
Upper Willamette	Willow Creek	0–2.8	As	Y
Walla Walla	Mill Creek	22.9–26	T	S
Walla Walla	North Fork Walla Walla River	0–18.7	T	S
Walla Walla	Pine Creek	0–37.8	Fe	Y
Walla Walla	South Fork Walla Walla River	0–27.1	T	S
Walla Walla	Walla Walla River	40.6–50.6	T	S
Wallowa	Bear Creek	0–7.5	S	
Wallowa	Bear Creek	0–24.1	T	S
Wallowa	Deer Creek	0–10.2	T	S
Wallowa	Fisher Creek	0–5.1	T	S, 10/1–6/30
Wallowa	Howard Creek	0–11	T	S
Wallowa	Howard Creek	0–11	T	10/1–6/30
Wallowa	Hurricane Creek	0–7.6	S	*
Wallowa	Little Bear Creek	0–8	T	S
Wallowa	Lostine River	0–9	S	*
Wallowa	Minam River	0–10.2	S	*
Wallowa	Minam River	0–10.2	T	S
Wallowa	Minam River	10.2–49.4	T	Y
Wallowa	Prairie Creek	0–12.5	DO	Sp/S
Wallowa	Prairie Creek	0–12.5	EC	6/1–9/30
Wallowa	Prairie Creek	0–12.5	FC	W/Sp/F
Wallowa	Prairie Creek	0–12.5	S	*

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Wallowa	Spring Creek	0–4.5	DO	Sp/S
Wallowa	Spring Creek	0–4.5	FC	W/Sp/F
Wallowa	Wallowa River	0–50	FC	Y
Wallowa	Wallowa River	0–50	pH	S
Wallowa	Wallowa River	0–50	S	*
Wallowa	Wallowa River	0–50	T	S, 10/1–6/30
Willow	Balm Fork	0–9.5	FC	S
Willow	Basin Creek	0–8.7	T	S, 3/1–5/31
Willow	Willow Creek	0–27.4	ChlA	S
Willow	Willow Creek	0–27.4	FC	Y
Willow	Willow Creek	0–51.7	pH	S
Willow	Willow Creek	0–72.6	T	S
Yamhill	Baker Creek	0–14.2	T	S
Yamhill	Cedar Creek	0–2.3	Fe	Y
Yamhill	Deer Creek	0–12	T	S
Yamhill	Deer Creek	0–20.4	FC	Y
Yamhill	Mill Creek	0–17	T	S
Yamhill	Mill Creek	0–22.2	FC	S
Yamhill	North Yamhill River	0–20.1	DO	10/1–5/31
Yamhill	North Yamhill River	0–20.1	FC	Y
Yamhill	North Yamhill River	0–32.4	T	S
Yamhill	Panther Creek	0–14	T	S
Yamhill	Salt Creek	0–32.8	ChlA, T, Mn	S
Yamhill	Salt Creek	0–32.8	DO	Sp/S/F
Yamhill	Salt Creek	0–32.8	FC	W/Sp/F
Yamhill	South Yamhill River	0–42.6	FC	W/Sp/F
Yamhill	South Yamhill River	18.1–61.7	FC	S
Yamhill	South Yamhill River	0–18.1	Fe	Y
Yamhill	South Yamhill River	0–42.6	T	S
Yamhill	Turner Creek	0–2.5	T	S
Yamhill	West Fork Palmer Creek	0–5.2	Cpf	Y
Yamhill	Willamina Creek	0–9.9	FC	W/Sp/F
Yamhill	Yamhill River	0–11.2	FC	W/Sp/F

Table C-1. (continued).

Columbia Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Yamhill	Yamhill River	0–11.2	Fe, Mn	Y
Crosses Basins				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Crosses Subbasins	Columbia River	0–142	As, DDTM, PCB	Y
Crosses Subbasins	Columbia River	0–142	T	S
Crosses Subbasins	Columbia River	142–303.9	PCB	Y
Crosses Subbasins	Columbia River	98–142	PAH	Y
Crosses Subbasins	Crooked River	0–51	FC, T	S
Crosses Subbasins	Crooked River	0–51, 82.6–109.2	pH	Y
Crosses Subbasins	Crooked River	51–70	TDG	*
Crosses Subbasins	Crooked River	82.6–109.2	T	S
Crosses Subbasins	Deschutes River	0–46.4, 168.2–189.4	T	S 9/1–6/30
Crosses Subbasins	Deschutes River	46.4–99.8	T	Y
Crosses Subbasins	Deschutes River	126.4–162.6	T	S
Crosses Subbasins	Deschutes River	126.4–162.6	T	9/1–6/30
Crosses Subbasins	Deschutes River	162.6–168.2	T	S, 9/1–6/30
Crosses Subbasins	Deschutes River	0–46.4, 162.6–168.2	pH	S
Crosses Subbasins	Deschutes River	126.4–162.6	pH	Y
Crosses Subbasins	Deschutes River	46.4–99.8	pH	W/Sp/F
Crosses Subbasins	Deschutes River	168.2–189.4	ChlA	6/1–9/30
Crosses Subbasins	Deschutes River	168.2–189.4	DO	7/1–6/30
Crosses Subbasins	Deschutes River	46.4–99.8, 189.4–222.2	DO	9/1–6/30
Crosses Subbasins	Deschutes River	168.2–222.2	S	*
Crosses Subbasins	Deschutes River	168.2–222.2	Tb	Sp/S
Crosses Subbasins	Grande Ronde River	36.3–80.7	S	*
Crosses Subbasins	Grande Ronde River	36.3–80.7	T	S
Crosses Subbasins	Grande Ronde River	80.7–162.4	FC	W/Sp/F
Crosses Subbasins	John Day River	0–181.7, 182–277.6	T	S

Table C-1. (continued).

Crosses Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Crosses Subbasins	John Day River	182–265	DO	Sp/S
Crosses Subbasins	John Day River	182–265	FC	Y
Crosses Subbasins	John Day River	36–40	pH	9/1–6/30
Crosses Subbasins	Klamath River	207–231, 250–251	T	S
Crosses Subbasins	Klamath River	231–250	Am	W/S
Crosses Subbasins	Klamath River	231–251	ChlA, pH	S
Crosses Subbasins	Klamath River	231–250	DO	Sp/S/F
Crosses Subbasins	Lake Billy Chinook/Deschutes River	110.1–116	ChlA	Sp/S/F
Crosses Subbasins	Lake Billy Chinook/Deschutes River	110.1–116	pH	S
Crosses Subbasins	Malheur River	0–67	ChlA	S
Crosses Subbasins	Malheur River	0–67	DDT, D, FC	Y
Crosses Subbasins	Malheur River	126.8–185.9	T	S
Crosses Subbasins	Malheur River	93.4–119.9	FC	S
Crosses Subbasins	Owyhee River	0–18	ChlA, FC	S
Crosses Subbasins	Owyhee River	0–18	DDT, D	Y
Crosses Subbasins	Owyhee River	104–120, 161–172	DO	3/1–5/31
Crosses Subbasins	Owyhee River	18–28.5	DO	Y
Crosses Subbasins	Owyhee River	71.2–142, 165.6–191.5	T	S, 3/1–5/31
Crosses Subbasins	Owyhee River	71.2–124.2	Hg	Y
Crosses Subbasins	Owyhee, Lake/Owyhee River	28.7–71	Hg	Y
Crosses Subbasins	Rogue River	0–27.2	pH	S
Crosses Subbasins	Rogue River	68.3–94.9	pH	W/Sp/F
Crosses Subbasins	Rogue River	0–94.9, 110.7–132.2	T	S
Crosses Subbasins	Rogue River	110.7–132.2	FC	W/Sp/F
Crosses Subbasins	Rogue River	68.3–110.7	FC	S
Crosses Subbasins	Simtustus, Lake/Deschutes River	102.3–106.3	ChlA	Sp/S/F

Table C-1. (continued).

Crosses Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Crosses Subbasins	Simtustus, Lake/Deschutes River	102.3–106.3	pH	S
Crosses Subbasins	Snake River	173–404	Hg	Y
Crosses Subbasins	Snake River	173–404	T	S
Crosses Subbasins	Willamette River	0–72	Ald, DDT, DDTM, D, PCB	Y
Crosses Subbasins	Willamette River	0–119.7	BC	*
Crosses Subbasins	Willamette River	0–148.8	FC	W/Sp/F
Crosses Subbasins	Willamette River	0–119.7	Fe	Y
Crosses Subbasins	Willamette River	0–24.8	Mn	Y
Crosses Subbasins	Willamette River	0–119.7, 148.8–186.4	Hg	Y
Crosses Subbasins	Willamette River	0–24.8	PCP	*
Crosses Subbasins	Willamette River	0–24.8	PAH	Y
Crosses Subbasins	Willamette River	0–186.4	T	S
Crosses Subbasins	Willamette River	54.8–148.8	DO	10/1–5/31
Crosses Subbasins	Willamette River	174.5–186.4	As	Y
Interior Drainages Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Alsea	Mercer Lake/Mercer Creek	0.6–2.5	ChlA	S
Alsea	North Fork Cascade Creek	0–2.7	T	S
Alsea	North Fork Yachats River	0–3.6	T	S
Alsea	Phillips Creek	0–2.1	T	S
Alsea	Preacher Creek	0–2.1	T	S
Alsea	School Fork	0–3.2	T	S
Alsea	South Fork Alsea River	0–17.2	T	S
Alsea	South Fork Lobster Creek	0–4.3	T	S
Alsea	Stump Creek	0–2	T	S
Alsea	Williamson Creek	0–2.7	T	S
Alsea	Yachats River	0–13	T	S
Alvord Lake	Big Trout Creek	0–16.6	T	S
Alvord Lake	Denio Creek	0–6.1	T	S
Alvord Lake	Little Wildhorse Creek	0–2.5	T	S

Table C-1. (continued).

Interior Drainages Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Alvord Lake	Van Horn Creek	0–8.2	T	S
Alvord Lake	Willow Creek	0–33.5	DO	6/1–9/30
Alvord Lake	Willow Creek	0–33.5	T	S
Donner and Blitzen	Ankle Creek	0–7.6	T	S
Donner and Blitzen	Big Indian Creek	0–7.1	T	S
Donner and Blitzen	Bridge Creek	0–2.2	T	S
Donner and Blitzen	Deep Creek	0–7.2	T	S
Donner and Blitzen	Donner and Blitzen River	45.3–77.3	T	S
Donner and Blitzen	Fish Creek	0–7.5	T	S
Donner and Blitzen	Indian Creek	0–4.2	T	S
Donner and Blitzen	Little Blitzen River	0–3.6	T	S
Donner and Blitzen	McCoy Creek	0–26.2	T	S
Donner and Blitzen	Mud Creek	0–4.8	T	S
Goose Lake	Bauers Creek	0–11.2	T	S
Goose Lake	Camp Creek	0–14.3	T	S
Goose Lake	Cox Creek	0–15.2	T	S
Goose Lake	Dent Creek	0–6.1	T	S
Goose Lake	Drews Creek	25.1–39.8	T	S
Goose Lake	East Branch Thomas Creek	0–4.9	Fe	Y
Goose Lake	East Camp Creek	0–4.9	T	S
Goose Lake	Hay Creek	0–12.8	T	S
Goose Lake	North Fork Cox Creek	0–4.5	T	S
Goose Lake	Quartz Creek	0–5.7	T	S
Goose Lake	Shingle Mill Creek	0–3.9	T	S
Goose Lake	Thomas Creek	0–12	DO	S
Goose Lake	Thomas Creek	0–12	DO	3/1–5/31
Goose Lake	Thomas Creek	0–35.9	T	S
Goose Lake	Thomas Creek	12–35.9	BC	*
Goose Lake	Thomas Creek	12–35.9	Fe	Y
Guano Nevada	Bond Creek	0–2.1	T	S
Guano Nevada	Home Creek	0–21.3	T	S
Guano Nevada	Rock Creek	12.4–52.5	T	S, 3/1–5/31
Guano Nevada	Skull Creek	0–13.3	T	S

Table C-1. (continued).

Interior Drainages Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Harney Malheur Lakes	Coffeepot Creek	0–10.3	T	S
Harney Malheur Lakes	Mill Creek	0–7.1	T	S
Harney Malheur Lakes	Paul Creek	0–10.2	T	S
Harney Malheur Lakes	Rattlesnake Creek	0–15.1	T	S
Harney Malheur Lakes	Riddle Creek	0–24.4	T	S
Illinois	Althouse Creek	0–7.5	T	S
Lake Abert	Augur Creek	0–2.7	T	S
Lake Abert	Bear Creek	0–9.5	T	S
Lake Abert	Ben Young Creek	0–8	T	S
Lake Abert	Chewaucan River	35.2–61.5	BC	*
Lake Abert	Chewaucan River	9–61.5	T	S
Lake Abert	Coffeepot Creek	0–10	T	S
Lake Abert	Dairy Creek	0–15.3	T	S
Lake Abert	Elder Creek	0–5.7	T	S
Lake Abert	Little Coffeepot Creek	0–4.3	T	S
Lake Abert	Morgan Creek	0–4.8	T	S
Lake Abert	Shoestring Creek	0–7	T	S
Lake Abert	South Creek	0–10.6	T	S
Lake Abert	Swamp Creek	0–6.2	T	S
Lake Abert	West Fork Shoestring Creek	0–3.4	T	S
Lake Abert	Willow Creek	0–15.3	T	S
Lost	Antelope Creek	2–3	T	S
Lost	Barnes Valley Creek	0–14	T	S
Lost	Klamath Strait	0–0	Am, ChlA, FC, pH, T	S
Lost	Klamath Strait	0–0	DO	Y
Lost	Lapham Creek	0–4	T	S
Lost	Long Branch Creek	0–4.6	T	S
Lost	Lost River	0–59.7	ChlA, T	S
Lost	Lost River	0–59.7	DO, FC	Y
Lost	Miller Creek	0–9.6	T	S
Lost	North Fork Willow Creek	0–2.3	T	S
Lost	Unnamed Waterbody	0–2.2	T	S

Table C-1. (continued).

Interior Drainages Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Silver	Claw Creek	0–15.1	T	S
Silver	Egypt Creek	0–8.9	T	S
Silver	Nicoll Creek	0–14.1	T	S
Silver	Salt Canyon	0–1.2	T	S
Silver	Sawmill Creek	0–10.7	T	S
Silver	Silver Creek	8.3–63.6	T	S
Silver	Wickiup Creek	0–9	T	S
Silvies	Hay Creek	0–12.3	T	S
Silvies	Little Bear Creek	0–5.7	T	S, 3/1–5/31
Silvies	Myrtle Creek	0–17.6	T	S
Silvies	Scotty Creek	0–9.5	T	S
Silvies	Silvies River	0–20	DO	3/1–5/31
Silvies	Silvies River	0–20	T	S, 3/1–5/31
Silvies	Skull Creek	0–5.9	T	S
Silvies	Snow Creek	0–2.8	T	S
Summer Lake	Silver Creek	5–21.2	T	S
Summer Lake	West Fork Silver Creek	0–8.3	T	S
Upper Klamath	Clover Creek	0–8.4	S	*
Upper Klamath	Grizzly Creek	0–3	T	S
Upper Klamath	Hoxie Creek	0.8–4.4	T	S
Upper Klamath	Jenny Creek	0–17.8	T	S
Upper Klamath	Johnson Creek	0–9.4	T	S
Upper Klamath	Keene Creek	0–9.7	T	S
Upper Klamath	Mill Creek	0–3.9	T	S
Upper Klamath	South Fork Keene Creek	0–3.1	T	S
Upper Klamath	Spencer Creek	0–18.9	BC	*
Upper Klamath	Spencer Creek	0–18.9	S	*
Upper Klamath	Unnamed Waterbody	0–4.3	S	*
Warner Lakes	Burnt Creek	0–9	BC	*
Warner Lakes	Burnt Creek	0–9	T	S
Warner Lakes	Camas Creek	0–18.7	T	S
Warner Lakes	Deep Creek	12–37.9	DO	3/1–5/31
Warner Lakes	Deep Creek	12–37.9	T	S

Table C-1. (continued).

Interior Drainages Basin				
ODEQ Subbasin	**Water Body**	**River Mile**	**Impairment**	**Season**
Warner Lakes	Drake Creek	0–12	T	S
Warner Lakes	Fifteenmile Creek	0–6.6	Ag	Y
Warner Lakes	Fifteenmile Creek	0–6.6	T	S, 3/1–5/31
Warner Lakes	Honey Creek	0–17.6	T	S
Warner Lakes	Horse Creek	0–10.3	T	S
Warner Lakes	Little Honey Creek	0–7.4	T	S
Warner Lakes	Mud Creek	0–8.8	T	S
Warner Lakes	North Fork Twelvemile Creek	0–3.6	T	S
Warner Lakes	Parsnip Creek	0–4.1	T	S
Warner Lakes	Polander Creek	0–2.6	T	S
Warner Lakes	Porcupine Creek	0–4	T	S
Warner Lakes	Twelvemile Creek	0–17.3	Ag	Y
Warner Lakes	Twelvemile Creek	0–13	T	S, 3/1–5/31
Warner Lakes	Twentymile Creek	0–28.9	As, Ag	Y
Warner Lakes	Twentymile Creek	0–28.9	T	S, 3/1–5/31
Warner Lakes	Unnamed Waterbody	0–2.5	T	S
Warner Lakes	Willow Creek	0–6.5	T	S

[1] *Impairments are Ag = silver, Ald = aldrin, Am = ammonia, As = arsenic, AW/A = aquatic weeds or algae, BC = biological criteria, Cd = cadmium, ChlA = chlorophyll a, Cpf = Chlorpyrifos, CrHx = chromium (hex), Cl = chlorine, Cld = chlordane, Cu = copper, D = dieldrin, DCE = dichloroethylene, DDT = dichloro-diphenyl-trichloroethane, DDTM = DDT metabolite, DO = dissolved oxygen, EC = E. coli bacteria, FC = fecal coliform, Fe = iron, G = guthion, Hg = mercury, Mn = manganese, N = nitrate, P = phosphorus, PAH = polynuclear aromatic hydrocarbon, Pb = lead, PCB = polychlorinated biphenol, PCP = pentachlorophenol, pH = hydrogen ion concentration, S = sedimentation, T = temperature, Tb = Turbidity, TDG = total dissolved gas, TECE = tetrachlorethylene, and Zn = zinc.*

[2] *Seasons are Sp = spring, S = summer, F = fall, W = winter, Y = year round, and * = not reported.*

Source: ODEQ 2002

REFERENCES

ODEQ. 2002. *Oregon Final 303(d) List of Impaired Waters.* Oregon Department of Environmental Quality. Available via http://www.deq.state.or.us/WQ/assessment/rpt02/view303dlist.asp. Accessed June 26, 2009.

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APPENDIX D
RECREATIONAL RESOURCES

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APPENDIX D—RECREATIONAL RESOURCES

Table D-1 of this appendix lists recreational features located in the region of influence (ROI) of the proposed Oregon Conservation Resource Enhancement Program (CREP). Features include national forests, national grassland, national monuments, a national park, national wildlife refuges, recreation areas, State forests, and wilderness areas. Table D-2 lists wild, scenic, and recreational rivers in the ROI.

Table D-1. National forests, national grassland, national monuments, national park, national wildlife refuges, recreation areas, State forests, and wilderness areas in the ROI.

Feature	Name
National Forest	Deschutes
	Fremont
	Klamath
	Malheur
	Mount Hood
	Ochoco
	Rogue River
	Siskiyou
	Siuslaw
	Umatilla
	Umpqua
	Wallowa-Whitman
	Willamette
	Winema
National Grassland	Crooked River
National Monument	John Day Fossil Beds
	Newberry National Monument
	Oregon Caves
National Park	Crater Lake
National Wildlife Refuge	Ankeny
	Bandon Marsh
	Baskett Slough
	Bear Valley
	Cape Meares
	Cold Springs
	Deer Flat
	Eagle Creek National Fish Hatchery

Table D-1. (continued).

Feature	Name
National Wildlife Refuge (continued)	Hart Mountain National Antelope Refuge
	Klamath Marsh
	Lewis and Clark
	Lower Klamath
	Malheur
	McKay Creek
	McNary
	Nestucca Bay
	Oregon Islands
	Sheldon
	Siletz Bay
	Tualatin River
	Umatilla
	Upper Klamath
	Warm Springs National Fish Hatchery
	William L. Finley
Recreation Area	Columbia River Gorge National Scenic Area
	Diamond Craters Recreation Area
	Hells Canyon National Recreation Area
	Oregon Cascades Recreation Area
	Oregon Dunes National Recreation Area
State Forest	Clatsop
	Elliott
	Santiam
	Sun Pass
	Tillamook
Wilderness Area	Badger Creek
	Black Canyon
	Boulder Creek
	Bridge Creek
	Bull of the Woods
	Columbia
	Cummins Creek
	Diamond Peak

Table D-1. (continued).

Feature	Name
Wilderness Area (continued)	Drift Creek
	Eagle Cap
	Gearhart Mountain
	Grassy Knob
	Hells Canyon
	Kalmiopsis
	Menagerie
	Middle Santiam
	Mill Creek
	Monument Rock
	Mountain Lakes
	Mount Hood
	Mount Jefferson
	Mount Thielsen
	Mount Washington
	North Fork John Day
	North Fork Umatilla
	Olallie
	Red Buttes
	Rock Creek
	Rogue-Umpqua Divide
	Salmon Huckleberry
	Sky Lakes
	Steens Mountain
	Strawberry Mountain
	Table Rocks
	Three Arch Rocks
	Three Sisters
	Waldo Lake
	Wenaha-Tucannon
	Wild Rogue

Source: Great Outdoor Recreation Pages [GORP] 2004, Oregon Department of Forestry [ODF] 2004

Table D-2. Wild, scenic, and recreational rivers in the ROI.

Name	Location	Total (miles)	Wild (miles)	Scenic (miles)	Recreational (miles)
Big Marsh Creek	Deschutes National Forest (NF)	15	0	0	15
Chetco River	Siskiyou NF	44.5	22.5	8	11
Clackamas River	Mount Hood NF	47	0	20	27
Crescent Creek	Deschutes NF	10	0	0	10
Crooked River	Ochoco NF	15	0	0	15
Crooked River, North Fork	Ochoco NF	32.3	11.1	9.5	11.7
Deschutes River	Deschutes NF	173.4	0	30	143.4
Donner und Blitzen River	Bureau of Land Management (BLM), Burns District	72.7	72.7	0	0
Eagle Creek	Wallowa-Whitman NF	27	4	6	17
Elk River	Siskiyou NF	19	2	0	17
Grande Ronde River	Umatilla NF, Wallowa-Whitman NF	43.8	26.4	0	17.4
Illinois River	Siskiyou NF	50.4	28.7	17.9	3.8
Imnaha River	Wallowa-Whitman NF	77	15	4	58
John Day River	Malheur NF, Umatilla NF, and Wallowa-Whitman NF	147.5	0	0	147.5
John Day River, North Fork	Umatilla NF, Wallowa-Whitman NF	54.1	27.8	10.5	15.8
John Day River, South Fork	Malheur NF	47	0	0	47
Joseph Creek	Wallowa-Whitman NF	8.6	8.6	0	0
Klamath River	BLM, multiple districts	11	0	11	0
Little Deschutes River	Deschutes NF	12	0	0	12
Lostine River	Wallowa-Whitman NF	16	5	0	11
Malheur River	Malheur NF	13.7	0	7	6.7
Malheur River, North Fork	Malheur NF	25.5	0	25.5	0
McKenzie River	Willamette NF	12.7	0	0	12.7
Metolius River	Deschutes NF	28.6	0	17.1	11.5
Minam River	Wallowa-Whitman NF	39	39	0	0
North Powder River	Wallowa-Whitman NF	6	0	6	0
Owyhee River	BLM, Vale District	120	120	0	0
Owyhee River, North Fork	BLM, Vale District	9.6	9.6	0	0
Owyhee River, West Little	BLM, Vale District	56.7	56.7	0	0
Powder River	BLM, Vale District	11.7	0	11.7	0

Table D-2. (continued).

Name	Location	Total (miles)	Wild (miles)	Scenic (miles)	Recreational (miles)
Quartzville Creek	Willamette NF	12	0	0	12
Rapid River	Hells Canyon National Recreation Area	26.8	26.8	0	0
Roaring River	Mount Hood NF	13.7	13.5	0	0.2
Rogue River	Siskiyou NF	84.5	34	7.5	43
Rogue River, Upper	Rogue River NF	40.3	6.1	34.2	0
Salmon River, Oregon	Mount Hood NF	33.5	15	4.8	13.7
Sandy River	Mount Hood NF	24.9	4.5	3.8	16.6
Smith River, North Fork	Siskiyou NF	13	8.5	4.5	0
Snake River	Hells Canyon National Recreation Area	66.9	32.5	34.4	0
Sprague River, North Fork	Fremont NF	15	0	15	0
Squaw Creek	Deschutes NF	15.4	6.6	0	8.8
Sycan River	Fremont NF, Winema NF	59	0	50.4	8.6
Umpqua River, North	Umpqua NF	33.8	0	0	33.8
Wenaha River	Umatilla NF	21.55	18.7	2.7	0.15
White River	Mount Hood NF	46.5	0	24	22.5
Willamette River, North Fork of the Middle Fork	Willamette NF	42.3	8.8	6.5	27
Source: GORP 2004					

REFERENCES

GORP. 2009. Resources. Great Outdoor Recreation Pages. Available http://gorp.away.com/gorp/resource/us_national_park/main.htm. Accessed June 26, 2009.

ODF. 2007. State Forests Management. Oregon Department of Forestry. Available via http://www.oregon.gov/ODF/STATE_FORESTS/state_forest_management.shtml. Accessed August 25, 2009.

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APPENDIX E
NET PRESENT VALUE ANALYSIS

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Buffers (includes CP22, CP29, and CP30)

Year	Discount Factor	Buffers (Total Acres Enrolled)	Cost Share (FSA)	Incentive Payment	Practive Incentive Payment (FSA)	Signing Incentive Payment (FSA)	Cumulative Impact Incentive	Rental Rate	Maintenance	State Cost Share	Lost Jobs Income	Lost Sales	Sum	NPV
2005	1.00	12495	2,391,231	562,275	1,912,985	1,561,875	1,124,550	1,124,550	93,713	1,195,615	-454,318	-1,538,884	7,973,591	7,973,591
2006	0.95	24990	2,391,231	1,124,550	1,912,985	1,561,875	1,124,550	2,249,100	187,425	1,195,615	-908,636	-3,077,768	7,760,926	7,372,879
2007	0.90	37485	2,391,231	1,686,825	1,912,985	1,561,875	1,124,550	3,373,650	281,138	1,195,615	-1,362,955	-4,616,653	7,548,261	6,812,305
2008	0.86	49980	2,391,231	2,249,100	1,912,985	1,561,875	1,124,550	4,498,200	374,850	1,195,615	-1,817,273	-6,155,537	7,335,596	6,289,356
2009	0.81	62475	2,391,231	2,811,375	1,912,985	1,561,875	1,124,550	5,622,750	468,563	1,195,615	-2,271,591	-7,694,421	7,122,931	5,801,672
2010	0.77	74970	2,391,231	3,373,650	1,912,985	1,561,875	1,124,550	6,747,300	562,275	1,195,615	-2,725,909	-9,233,305	1,145,385	886,277
2011	0.74	87465	2,391,231	3,935,925	1,912,985	1,561,875	1,124,550	7,871,850	655,988	1,195,615	-3,180,227	-10,772,189	370,446	272,311
2012	0.70	92960	1,051,606	4,183,200	841,285	686,875	494,550	8,366,400	697,200	525,803	-3,380,026	-11,448,954	-3,216,867	-2,246,458
2013	0.66	92960		4,183,200				8,366,400	697,200		-3,380,026	-11,448,954	-5,765,379	-3,824,870
2014	0.63	92960		4,183,200				8,366,400	697,200		-3,380,026	-11,448,954	-5,765,379	-3,633,627
2015	0.60	92960		4,183,200				8,366,400	697,200		-3,380,026	-11,448,954	-5,765,379	-3,451,945
2016	0.57	92960		4,183,200				8,366,400	697,200		-3,380,026	-11,448,954	-5,765,379	-3,279,348
2017	0.54	80465		3,620,925				7,241,850	603,488		-2,925,707	-9,910,069	-4,990,439	-2,696,634
2018	0.51	67970		3,058,650				6,117,300	509,775		-2,471,389	-8,371,185	-4,215,499	-2,163,993
2019	0.49	55475		2,496,375				4,992,750	416,063		-2,017,071	-6,832,301	-3,440,560	-1,677,875
2020	0.46	42980		1,934,100				3,868,200	322,350		-1,562,753	-5,293,417	-2,665,620	-1,234,958
2021	0.44	30485		1,371,825				2,743,650	228,638		-1,108,435	-3,754,533	-1,890,680	-832,139
2022	0.42	17990		809,550				1,619,100	134,925		-654,116	-2,215,648	-1,115,740	-466,513
2023	0.40							0	0		0	0	0	0
2024	0.38													0
2025	0.36												0	0
TOTAL			**17,790,220**	**49,951,125**	**14,232,176**	**11,620,000**	**8,366,400**	**99,902,250**	**8,325,188**	**8,895,110**	**-40,360,509**	**-136,710,679**	**-5,339,786**	**9,900,031**
NPV per Acre														**495**

Wetlands

Year	Discount Factor	Wetlands (Total Acres Enrolled)	Cost Share (FSA)	Incentive Payment	Practive Incentive Payment (FSA)	Signing Incentive Payment (FSA)	Cumulative Impact Incentive	Wetlands Incentive Payment	Rental Rate	Maintenance	State Cost Share	Lost Jobs Income	Lost Sales	Sum	NPV
2005	1.00	3000	244,500	135,000			270,000	216,000	270,000	22,500	122,250	-109,080	-369,480	801,690	801,690
2006	0.95	5000	163,000	225,000			180,000	144,000	450,000	37,500	81,500	-181,800	-615,800	483,400	459,230
2007	0.90	5000		225,000					450,000	37,500		-181,800	-615,800	-85,100	-76,803
2008	0.86	5000		225,000					450,000	37,500		-181,800	-615,800	-85,100	-72,963
2009	0.81	5000		225,000					450,000	37,500		-181,800	-615,800	-85,100	-69,314
2010	0.77	5000		225,000					450,000	37,500		-181,800	-615,800	-310,100	-239,949
2011	0.74	5000		225,000					450,000	37,500		-181,800	-615,800	-310,100	-227,952
2012	0.70	5000		225,000					450,000	37,500		-181,800	-615,800	-310,100	-216,554
2013	0.66	5000		225,000					450,000	37,500		-181,800	-615,800	-310,100	-205,727
2014	0.63	5000		225,000					450,000	37,500		-181,800	-615,800	-310,100	-195,440
2015	0.60	5000		225,000					450,000	37,500		-181,800	-615,800	-310,100	-185,668
2016	0.57	5000		225,000					450,000	37,500		-181,800	-615,800	-310,100	-176,385
2017	0.54	2000		90,000					180,000	15,000		-72,720	-246,320	-124,040	-67,026
2018	0.51											0	0	0	0
2019	0.49											0	0	0	0
2020	0.46											0	0	0	0
2021	0.44											0	0	0	0
2022	0.42											0	0	0	0
2023	0.40											0	0	0	0
2024	0.38													0	0
TOTAL			**407,500**	**2,700,000**	**0**	**0**	**450,000**	**360,000**	**5,400,000**	**450,000**	**203,750**	**-2,181,600**	**-7,389,600**	**-1,264,950**	**-472,862**
NPV per Acre															**-24**

Filter Strips

Year	Discount Factor	Filter Strips (Total Acres Enrolled)	Cost Share (FSA)	Incentive Payment	Practive Incentive Payment (FSA)	Signing Incentive Payment (FSA)	Cumulative Impact Incentive	Rental Rate	Maintenance	State Cost Share	Lost Jobs Income	Lost Sales	Sum	NPV
2005	1.00	255	7,140	5,738	5,712	31,875	22,950	22,950	1,913	3,570	-9,272	-31,406	61,169	61,169
2006	0.95	510	7,140	11,475	5,712	31,875	22,950	45,900	3,825	3,570	-18,544	-62,812	51,092	48,537
2007	0.90	765	7,140	17,213	5,712	31,875	22,950	68,850	5,738	3,570	-27,815	-94,217	41,014	37,015
2008	0.86	1020	7,140	22,950	5,712	31,875	22,950	91,800	7,650	3,570	-37,087	-125,623	30,937	26,524
2009	0.81	1275	7,140	28,688	5,712	31,875	22,950	114,750	9,563	3,570	-46,359	-157,029	20,859	16,990
2010	0.77	1530	7,140	34,425	5,712	31,875	22,950	137,700	11,475	3,570	-55,631	-188,435	-30,784	-23,820
2011	0.74	1785	7,140	40,163	5,712	31,875	22,950	160,650	13,388	3,570	-64,903	-219,841	-46,599	-34,254
2012	0.70	2040	7,140	45,900	5,712	31,875	22,950	183,600	15,300	3,570	-74,174	-251,246	-62,414	-43,586
2013	0.66	2040		45,900				183,600	15,300		-74,174	-251,246	-126,521	-83,936
2014	0.63	2040		45,900				183,600	15,300		-74,174	-251,246	-126,521	-79,740
2015	0.60	2040		45,900				183,600	15,300		-74,174	-251,246	-126,521	-75,753
2016	0.57	2040		45,900				183,600	15,300		-74,174	-251,246	-126,521	-71,965
2017	0.54	1785		40,163				160,650	13,388		-64,903	-219,841	-110,706	-59,821
2018	0.51	1530		34,425				137,700	11,475		-55,631	-188,435	-94,891	-48,711
2019	0.49	1275		28,688				114,750	9,563		-46,359	-157,029	-79,076	-38,563
2020	0.46	1020		22,950				91,800	7,650		-37,087	-125,623	-63,260	-29,308
2021	0.44	765		17,213				68,850	5,738		-27,815	-94,217	-47,445	-20,882
2022	0.42	510		11,475				45,900	3,825		-18,544	-62,812	-31,630	-13,225
2023	0.40							0	0		0	0	0	0
2024	0.38												0	0
TOTAL				**545,063**	**45,696**	**255,000**	**183,600**	**2,180,250**	**181,688**	**28,560**	**-880,821**	**-2,983,551**	**-867,816**	**-433,328**
NPV per Acre														-22

Net Present Value	
Buffers	9,900,031
Wetlands	-472,862
Filter Strips	-433,328
Total	**8,993,840**

Assumptions:

1) 5% discount rate
2) $90/acre for rental
3) 25% incentive fee on top of rental fee
4) Cost share includes 50% of eligible costs
5) Estimated eligible costs for Filter Strips (CP21) is $56/acre
6) Estimated eligible costs for Riparian Buffer (CP22) is $333/acre
7) Estimated cost for Wetlands Restoration (CP23) is $163/acre
8) Estimated cost for Wildlife Habitat Buffer (CP29) is $532/acre
9) Estimated cost for Wetland Buffer (CP30) is $532/acre
10) Practice incentive payment is 40% of eligible costs per acre
11) Signing incentive payment is equal to $10 x the acres x the number of contract years
12) Maintenance is estimated at $7.50 per acre
13) CP29 and CP30 make up 1/4 of the total buffer acres
14) Average eligible costs for buffers is $382.75/acre
15) Estimated that 25% of CREP acres will meet the requirements for cumulative impact incentive payments
16) Contracts will average 12.5 years
17) The acreage in buffer is 94.7 % of total non-wetland acres
18) The acreage in filter strips is 5.3% of total non-wetland acres

APPENDIX F
PROGRAM BIOLOGICAL ASSESSMENT FOR THE OREGON CONSERVATION RESERVE ENHANCEMENT PROGRAM

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PROGRAM BIOLOGICAL ASSESSMENT

for the

OREGON CONSERVATION RESERVE ENHANCEMENT PROGRAM

October 2008

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EXECUTIVE SUMMARY

The Conservation Reserve Enhancement Program (CREP) is a cooperative program administered by the U.S. Department of Agriculture FSA and the State of Oregon. CREP provides financial incentives and technical assistance for landowners to restore riparian areas along agricultural lands, benefiting fish and wildlife habitat as well as water quality.

The Oregon CREP began in 1997 with an agreement between USDA and the state of Oregon. In 1998, the FSA submitted a Biological Assessment to the National Marine Fisheries Service and U.S. Fish and Wildlife Service (jointly, the Services) evaluating the impacts of CREP projects to federally listed threatened and endangered species. The Services issued a Biological Opinion in 1998 determining that CREP projects would not jeopardize the continued existence of threatened and endangered species or adversely modify designated critical habitat. Since the 1998 Biological Opinion, CREP programmatic and geographic area changes, species delistings, new species listings, and additional critical habitat designations have occurred, prompting this re-initiation of consultation.

CREP projects will take place throughout Oregon on agricultural lands along streams, rivers, and other waterbodies. Participants may enroll land in CREP to be restored through one of several practices, including riparian forest buffer, filter strip, marginal pastureland wildlife buffer, and marginal pastureland wetland buffer. Technical agencies prepare a plan for the CREP area and provide specifications for the restoration actions needed to complete the CREP practice.

CREP actions have the potential to affect many threatened and endangered species because these species occur in streams or adjacent habitats. Some of Oregon's threatened and endangered species will not be affected because they occur in habitats that are not eligible for CREP.

Over the long-term, CREP actions should be highly beneficial to threatened and endangered species. CREP projects will increase riparian habitat, enhance water quality, and provide large woody debris for streams. Some actions needed to install CREP practices may have short-term effects to certain threatened and endangered species. Best Management Practices are identified for both individual species and for all CREP projects to minimize effects.

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1. INTRODUCTION

1.1 How this Document is Organized

This introductory chapter provides some history and rationale for the development of the Oregon Conservation Reserve Enhancement Program (CREP), describes the roles and responsibilities of each agency involved in the program, reviews the objectives and accomplishments of the program, and introduces the species evaluated and potentially affected geographic area. Chapter 2 describes the program and actions covered by this Biological Assessment. It provides an overview of the CREP enrollment, project implementation, and maintenance and monitoring process. It describes CREP actions that are specifically included in this consultation; more detail is provided about some of the actions in Appendix A. Section 2.4 lists BMPs that are part of the action. The BMPs will be used to minimize potentially adverse environmental impacts and adverse affects on listed species and their critical habitats from CREP activities.

Chapter 3 describes the federally listed threatened and endangered species covered by the Biological Assessment, including the status of each species. Some species that were initially considered were eliminated from the consultation (see Table 3), A discussion about each of those species and the rationale behind eliminating them is included in Appendix F. Chapter 4 provides analyses of potential effects from the various CREP project activities. In addition to the narrative in Chapter 4, Appendix B includes detailed tables listing possible effects to each of the species covered in this assessment along with references to FOTG practices that are applicable to the various actions. Chapter 5 provides analyses of the potential effects for each of the threatened and endangered species and their critical habitats, and includes the effect determinations. A summary of the species considered in this consultation along with our effect determinations is provided in section 1.9.

Appendix C includes critical habitat maps for species with designated critical habitat.

1.2. Overview of the Oregon CREP

The U.S. Department of Agriculture (USDA) and the State of Oregon (State) signed an agreement in 1998 creating the Oregon CREP, a subset of USDA's Conservation Reserve Program (CRP). The purpose of CREP is to enroll and restore up to 100,000 acres of agricultural land along streams to improve fish and wildlife habitat and water quality. Agricultural landowners can enroll eligible riparian lands into a 10- to 15-year contract and receive annual rental payments, reimbursement for 75% of the costs of riparian restoration practices, and other financial incentives.

At the federal level, the USDA Farm Service Aagency (FSA) administers the program, and USDA Natural Resources Conservation Service (NRCS) provides technical assistance. At the state level, the Oregon Watershed Enhancement Board (OWEB) oversees and coordinates program implementation. The Oregon Department of Forestry (ODF) prepares or approves specifications for all riparian forest buffers. Soil and water conservation districts (SWCDs) provide technical assistance and outreach. Other partners such as Oregon State University

Extension Service (OSU Extension) and watershed councils also promote the program and may provide technical assistance to implement CREP.

In April 1998, the State of Oregon submitted a CREP proposal to USDA to enhance riparian habitat on agricultural lands along streams that provide important habitat for salmon and trout species listed under the Federal Endangered Species Act (ESA). On October 17, 1998, the Governor of Oregon and the Secretary of Agriculture signed an agreement setting forth the provisions of the Oregon CREP.

The agreement was modified in November, 2004, to include all streams in areas covered by Agricultural Water Quality Management Area Plans, benefiting water quality and riparian habitat in additional regions of the state. Agricultural Water Quality Management Area Plans now cover virtually all of Oregon. The amendment to the agreement also added two new practices targeted toward riparian areas and wetlands.

In a precedent-setting move for Oregon, the 2004 amendment added a new partner in Clean Water Services (CWS), a municipal sewage district division of Washington County, State of Oregon. CWS agreed to provide additional incentives to eligible producers in Washington County who enrolled in CREP and established forested riparian buffers along the Tualatin River. This special version of the program is referred to as the Tualatin Watershed Option.

1.3 Consultation History for the Oregon CREP

The federal ESA requires any federal agency to consult with the National Marine Fisheries Service and/or the U.S. Fish and Wildlife Service (jointly, the Services) when an action may impact a federally listed threatened or endangered species. On December 22, 1998, FSA filed a Biological Assessment with the Services describing the impact of Oregon CREP practices on federally listed threatened and endangered anadromous and resident fish species. In response, the Services prepared a formal Biological Opinion (BiOp) and Incidental Take Statement (ITS) on the CREP program, stating that the Oregon CREP would not jeopardize listed species.

Since the 1998 BiOp was completed, programmatic changes, geographical CREP program boundary changes, new species listings, species delistings, and additional critical habitat designations have occurred, prompting this re-initiation of consultation.

1.4. Objectives of the Oregon CREP

The stated objectives of Oregon CREP are:

- Restoration of 100 percent of the area enrolled for the riparian forest practice to a properly functioning condition in terms of distribution and growth of woody plant species, filtration of nutrients and sediment from agricultural runoff, shade, and stabilization of stream banks under normal non-flood conditions as provided for by FSA Handbook and the NRCS electronic Field Office Technical Guide (eFOTG).

- Provide a way for farmers and ranchers to voluntarily meet the water quality requirements established under federal law and under Oregon's agricultural water quality laws.
- Subject to other limitations, attain enrollments up to the following annual enrollment targets, including those within the existing Oregon CREP enrollment, for the following geographic regions within Oregon during the duration of this agreement:

  Coastal Basins
  - 1250 acres of riparian forest buffer
  - 1000 acres of restored wetland
  - 2250 total acres (180 total stream miles) of riparian forest, wetland, and wildlife buffers.

  Columbia Basin:
  - 8,000 acres of riparian forest buffer and filter strips
  - 1,000 acres of restored wetland
  - 9,000 total acres (700 stream miles) of riparian forest, wetland, and wildlife buffers.

  Interior Drainages
  - 3,500 acres of riparian forest buffer and filter strips
  - 1,000 acres of restored wetland
  - 4,500 total acres (375 stream miles) of riparian forest, wetland, and wildlife buffers

Conduct effectiveness monitoring of CREP projects in each of the three regions.

1.5. Accomplishments of CREP

From the time CREP became available in 1999 through January 2008, 32,650 acres have been enrolled around the state of Oregon. CREP plantings have restored riparian vegetation along over 1,150 miles of stream. Landowner interest and enrollment around Oregon continues to increase.

1.6. Agency Responsibilities

The State of Oregon and USDA FSA jointly administer the Oregon CREP. Below is a summary of the responsibilities of the various federal and state agencies to implement CREP.

- FSA has developed, and will continue to update, recommendations for soil rental rates; work with the Oregon Department of Fish and Wildlife (ODFW), the Services, and Oregon Department of Agriculture (ODA) to determine streams eligible for inclusion in the program; determine eligibility for the cumulative impact payments and approve and administer CRP contracts.
- NRCS provides the technical determination of whether lands are eligible and suitable for CREP; participates in development and approval of all conservation plans; develops specifications, provides oversight during installation, certifies completion of filter strips and wetland restoration practices; and completes required status reviews.

- OWEB coordinates the overall monitoring effort by the various state agencies and provides additional specified financial support for the program including funding for additional technical assistance.
- ODF develops or reviews all tree planting plans and specifications, including recommendations for tree species, site preparation, and invasive species control, provides oversight during installation, and certifies the completion of all installation of forested riparian buffers.
- Oregon Department of Agriculture works with OWEB and Soil and Water Conservation Districts to promote and implement CREP.
- SWCDs provide outreach on the program and assist landowners in the development of conservation plans.
- The Oregon Water Resources Department (OWRD) approves the leasing of landowner water rights for instream use.

1.7. Geographic Scope and Affected Habitats

CREP projects will take place primarily in riparian areas and wetlands on agricultural lands throughout the State of Oregon. Wetlands enrolled in CREP will generally be along streams and rivers. Some supporting actions, such as spring developments, may take place in upland areas or springs on agricultural lands.

Throughout Oregon, agricultural lands (cropland and grazing land) are generally located along the lower portions of river basins where stream gradients are low and valleys are formed primarily by alluvial deposits.

Oregon's agricultural production is highly regionalized. In coastal areas, pasture and dairy operations are the predominant agricultural uses. The Willamette Valley is Oregon's most diverse agricultural region, with over 200 different crops grown. Crops include nursery products, grass seed, hazelnuts, berries, hops, and wine grapes. Along the Columbia Plateau, major crops include dryland wheat, orchard crops, and irrigated field crops. Wheat is also an important crop in northeast Oregon, along with grass seed, hay, cattle and calves, and irrigated field crops. In southeastern Oregon, hay, irrigated field crops, and cattle and calves are predominant. Southwestern Oregon crops include orchard crops, wine grapes, cattle and calves, and cranberries.

Riparian areas play a critical role in the life cycles of many of Oregon's threatened and endangered species. Riparian vegetation provides shade, streambank stability, and filtration of pollutants from overland flow, protecting water quality for salmonids and other aquatic animals. Litter fall and insect drop from riparian vegetation contributes to the food supply of aquatic animals. Riparian soils provide habitat for many threatened and endangered plants. Several species of birds depend on riparian areas for food, nesting areas, and shelter. Riparian areas also serve as migration corridors for many species.

In general, riparian areas and wetlands eligible to be enrolled in CREP have been significantly modified so they are no longer providing all of the riparian functions that benefit fish and wildlife and water quality. On grazing lands, impacts from livestock use are often concentrated in riparian areas, since animals are drawn to these areas for forage and water. Concentrated livestock use of riparian areas, if improperly managed, eliminates riparian vegetation, prevents vegetation from reestablishing, and causes streambank erosion. Bank trampling and livestock activity in streams have increased sediment and manure runoff to streams, impacting aquatic life. On cropland, removal of riparian vegetation and cropping in the riparian area has reduced shade, prevented streamside vegetation from reestablishing, and caused streambank erosion. In addition, cleaning out or straightening streams along cropland or pastureland has reduced the amount and quality of instream and riparian habitat available for fish and wildlife.

Oregon has a long history of proactively and cooperatively addressing natural resource issues. To address problems with watershed health and declining salmon and steelhead runs, Oregon developed the Oregon Plan for Salmon and Watersheds and established OWEB to fund watershed restoration projects. The Oregon CREP has been a critical tool to the success of the Oregon Plan for Salmon and Watersheds and is mentioned in several threatened and endangered species recovery plans as necessary for recovery.

In addition, Oregon has several regulatory programs to protect water quality and watershed health on a variety of land uses. The Agricultural Water Quality Act, passed in 1993 by the Oregon Legislature, created the Agricultural Water Quality Program at ODA. The program depends largely on voluntary efforts by agricultural landowners to proactively address water quality issues on their lands, but administrative rules also provide a regulatory backstop if a landowner repeatedly refuses to take steps to protect water quality. The department worked with Local Advisory Committees of affected landowners and other citizens to develop administrative rules for 39 different management areas of Oregon. Each set of rules addresses local water quality issues and fits the local agriculture within the area.

The Oregon CREP project area includes private agricultural lands along the streams in Oregon that provide habitat for 14 species of salmon, 2 species of trout, 3 species of sucker, 3 species of chub and 1 species of dace which are listed under the ESA. Restoration of riparian habitat is a key element in the recovery of these species in Oregon.

To encourage the enrollment of riparian areas which are considered high environmentally sensitive areas, additional incentives have been built into Oregon CREP. These incentives include increased rental rates for irrigated land, a 50% increase in the annual payment on CP22, CP29 and CP30, a cumulative impact incentive payment and increased cost share assistance for conservation practices. In areas where Oregon CREP will pay irrigated rental rates based on a history of irrigation and a certified water right exists, that portion of the existing water right appurtenant to the enrolled acreage shall be dedicated for instream flow pursuant to the laws of the State of Oregon for the duration of the CREP contract. Under State law, these leases can only be for a duration of 5 years and therefore will have to be renewed once or twice during the life of the contract. At the end of the CRP contract, water right holders will have several options: 1) resume the right for the authorized purpose on all lands to which it is appurtenant, 2) continue leasing the water for instream use, 3) transfer the instream right to the State, 4) transfer the right to other lands or 5) abandon the water right.

Significant habitat restoration is only possible where a sufficient number of adjacent landowners elect to enroll in the CREP, thereby providing for reestablishment of contiguous areas of riparian vegetation. The average size of a riparian buffer contract in Oregon is 28 acres. Assuming that the average width of these buffers is 100 feet, each contract provides stream buffering along 2.31 stream miles. Scattered participation by individual landowners, each protecting 2.31 miles of stream will not be sufficient to achieve the desired water quality and habitat benefits. The joint USDA/EPS Rural Clean Water Study, suggests that it requires participation of about 76% of the landowners in small watersheds in order to achieve measurable water quality benefits. If confined animal feeding operations are an important aspect of the agricultural activities within the watershed, participation rates may need to be even higher.

Therefore, Oregon CREP contains a cumulative impact incentive payment which is designed to encourage adjacent farmers and ranchers to enter the program. Under this incentive system USDA will make a one-time payment to all enrollees when a sufficient number of landowners agree to participate along a particular stream. This incentive payment is made in any case where a total of at least 50% of the streambank within a 5- mile stream segment is enrolled in this program. The incentive is 4 times the annual base rental rate (without inclusion of any other incentives) for each acre enrolled.

The cumulative impact incentive serves a dual purpose. It provides an incentive to concentrate the use of restoration practices, thereby increasing the effectiveness of those practices. It also provides a mechanism to encourage landowners to communicate with one another about the program.

1.8. Listed Species Considered in this Programmatic Consultation

The Oregon CREP is implemented on agricultural lands statewide. Therefore, this consultation addresses all federally-listed species in Oregon, except marine species and several that will not be affected by CREP activities. Those species that were considered in this biological assessment are shown below. Note that some of these species have been eliminated from the consultation, as shown in section 1.9 and discussed in Appendix F.

Mammals		
Gray wolf	*Canis lupus*	E
Canada lynx	*Felis lynx canadensis*	T
Columbian white-tailed deer	*Odocoileus virginianus leucurus*	E
Birds		
Marbled murrelet	*Brachyramphus marmoratus*	CH T
Western snowy plover (coastal pop.)	*Charadrius alexandrinus nivosus*	CH T
Northern spotted owl	*Strix occidentalis caurina*	CH T
Fish		
FWS jurisdiction:		
Warner sucker	*Catostomus warnerensis*	CH T
Shortnose sucker	*Chasmistes brevirostris*	PCH E
Lost River sucker	*Deltistes luxatus*	PCH E
Hutton tui chub	*Gila bicolor* ssp.	T
Borax Lake chub	*Gila boraxobius*	CH E
Lahontan cutthroat trout	*Oncorhynchus clarki henshawi*	T
Oregon chub	*Oregonichthys crameri*	E
Foskett speckled dace	*Rhinichthys osculus* ssp.	T
Bull trout (Columbia River Basin)	*Salvelinus confluentus*	CH T
Bull trout (Klamath River Basin)	*Salvelinus confluentus*	CH T
Modoc sucker	*Catostomus microps*	CH E
NOAA jurisdiction:		
Chum salmon (Columbia River)	*Oncorhynchus keta*	CH T
Coho salmon (S. OR/N. CA Coast)	*Oncorhynchus kisutch*	CH T
Coho salmon (Lower Columbia River)	*Oncorhynchus kisutch*	T
Steelhead (Lower Columbia River)	*Oncorhynchus mykiss* ssp.	CH T
Steelhead (Snake River Basin)	*Oncorhynchus mykiss* ssp.	CH T
Steelhead (Middle Columbia River)	*Oncorhynchus mykiss* ssp.	CH T
Steelhead (Upper Columbia River)	*Oncorhynchus mykiss* ssp.	CH E
Steelhead (Upper Willamette River)	*Oncorhynchus mykiss* ssp.	CH T
Sockeye salmon (Snake River)	*Oncorhynchus nerka*	CH E
Chinook salmon (Lower Columbia River)	*Oncorhynchus tshawytscha*	CH T
Chinook salmon (Upper Columbia River)	*Oncorhynchus tshawytscha*	CH E
Chinook salmon (Upper Willamette River)	*Oncorhynchus tshawytscha*	CH T
Chinook salmon (Snake River-Spring/Summer Run)	*Oncorhynchus tshawytscha*	CH T
Chinook salmon (Snake River-Fall Run)	*Oncorhynchus tshawytscha*	CH T
Invertebrates		
Vernal pool fairy shrimp	*Branchinecta lynchi*	CH T
Fender's blue butterfly	*Icaricia icarioides fenderi*	CH E
Oregon silverspot butterfly	*Speyeria zerene hippolyta*	CH T
Plants		
Macdonald's rockcress	*Arabis macdonaldiana*	E

Applegate's milk-vetch	*Astragalus applegatei*	E
Golden Indian paintbrush	*Castilleja levisecta*	T
Willamette daisy	*Erigeron decumbens* var. *decumbens*	CH E
Gentner mission-bells	*Fritillaria gentneri*	E
Howellia	*Howellia aquatilis*	T
Western lily	*Lilium occidentale*	E
Large-flowered wooly meadowfoam	*Limnanthes floccosa* ssp. *grandiflora*	E
Bradshaw's lomatium	*Lomatium bradshawii*	E
Cook's lomatium	*Lomatium cookii*	E
Kincaid's lupine	*Lupinus sulphureus* var. *kincaidii*	CH T
MacFarlane's four o'clock	*Mirabilis macfarlanei*	T
Rough popcorn flower	*Plagiobothrys hirtus*	E
Nelson's checker-mallow	*Sidalcea nelsoniana*	T
Spalding's campion	*Silene spaldingii*	T
Malheur wire-lettuce	*Stephanomeria malheurensis*	E
Howell's spectacular thelypody	*Thelypodium howellii* ssp. *spectabilis*	T

(E) - Listed Endangered
(T) - Listed Threatened
(CH) - Critical Habitat has been designated for this species

1.9 Summary of Effect Determinations and Consultation Request

CREP actions are likely to adversely affect (LAA) the listed species and designated and proposed crtitical habitats as shown in Table 1. Formal consultation is requested for these species and their designated critical habitats. Conferencing is requested for proposed critical habitats for the shortnose and Lost River suckers. LAA determinations were made for all species under the ESA jurisdiction of NOAA Fisheries, and are included in this table. Effect determinations for species under the jurisdiction of the U.S. Fish and Wildlife Service varied, as shown in Tables 1 through 3.

Table 1. Listed species likely to be adversely affected by CREP activities

Species	Critical Habitat	Effect Determination
Fender's blue butterfly, *Icaricia icarioides fenderi*	Yes	LAA
Golden Indian paintbrush, *Castilleja levisecta*	No	LAA
Bradshaw's lomatium, *Lomatium bradshawii*	No	LAA
Nelson's checker-mallow, *Sidalcea nelsoniana*	No	LAA
Willamette daisy, *Erigeron decumbens* var. *decumbens*	Yes	LAA, LAA CH
Kincaid's lupine, *Lupinus sulphureus* var. *kincaidii*	Yes	LAA, LAA CH
Warner sucker, *Catostomus warnerensis*	Yes	LAA, LAA CH
Bull trout (Columbia River Basin), *Salvelinus confluentus*	Yes	LAA, LAA CH
Bull trout (Klamath River Basin), *Salvelinus confluentus*	Yes	LAA, LAA CH
Lahontan cutthroat trout, *Oncorhynchus clarki henshawi*	No	LAA
Oregon chub, *Oregonichthys crameri*	No (proposed CH due 3/1/09)	LAA
Shortnose sucker, *Chasmistes brevirostris*	Proposed	LAA, LAA PCH
Lost River sucker, *Deltistes luxatus*	Proposed	LAA, LAA PCH
Modoc sucker, *Catostomus microps*	Yes (but not in OR)	LAA, No effect on CH
Chum salmon (Columbia River), *Oncorhynchus keta*	Yes	LAA; LAA CH
Coho salmon (S. OR/N. CA Coast), *Oncorhynchus kisutch*	Yes	LAA; LAA CH
Coho salmon (Lower Columbia River), *Oncorhynchus kisutch*	Under development	LAA
Steelhead (Lower Columbia River), *Oncorhynchus mykiss* ssp	Yes	LAA; LAA CH
Steelhead (Snake River Basin), *Oncorhynchus mykiss* ssp.	Yes	LAA; LAA CH
Steelhead (Middle Columbia River), *Oncorhynchus mykiss* ssp.	Yes	LAA; LAA CH
Steelhead (Upper Columbia River), *Oncorhynchus mykiss* ssp.	Yes	LAA; LAA CH
Steelhead (Upper Willamette River), *Oncorhynchus mykiss* ssp.	Yes	LAA; LAA CH
Sockeye salmon (Snake River), *Oncorhynchus nerka*	Yes	LAA; LAA CH
Chinook salmon (Lower Columbia River), *Oncorhynchus tshawytscha*	Yes	LAA; LAA CH
Chinook salmon (Upper Columbia River), *Oncorhynchus tshawytscha*	Yes	LAA; LAA CH
Chinook salmon (Upper Willamette River), *Oncorhynchus tshawytscha*	Yes	LAA; LAA CH
Chinook salmon (Snake River-Spring/Summer Run), *Oncorhynchus tshawytscha*	Yes	LAA; LAA CH
Chinook salmon (Snake River-Fall Run), *Oncorhynchus tshawytscha*, CH T	Yes	LAA; LAA CH

CREP actions may affect, but are not likely to adversely affect (NLAA) the species and designated crtitical habitat shown in Table 2. Informal consultation is requested for these listed species and vernal pool fairy shrimp critical habitat.

Table 2. Listed species not likely to be adversely affected by CREP activities

Species	**Critical Habitat**	**Effect Determination**
Columbian white-tailed deer, *Odocoileus virginianus leucurus*	No	NLAA
Applegate's milk-vetch, *Astragalus applegatei*	No	NLAA
Gentner mission-bells, *Fritillaria gentneri*	No	NLAA
Howellia, *Howellia aquatilis*	No	NLAA
Western lily, *Lilium occidentale*	No	NLAA
Large-flowered wooly meadowfoam, *Limnanthes floccosa* ssp. *grandiflora*	No	NLAA
Cook's lomatium, *Lomatium cookie*	No	NLAA
MacFarlane's four o'clock, *Mirabilis macfarlanei*	No	NLAA
Rough popcorn flower, *Plagiobothrys hirtus*	No	NLAA
Spalding's campion, *Silene spaldingii*	No	NLAA
Howell's spectacular thelypody, *Thelypodium howellii* ssp. *spectabilis*	No	NLAA
Vernal pool fairy shrimp, *Branchinecta lynchi*	Yes	NLAA; NLAA CH

The species and critical habitats shown in Table 3 have been eliminated from this consultation. The rationale for eliminating them is discussed for each species in Appendix F. If any projects arise on sites where any of the elminated listed species or their critical habitat may be affected, individual consultation(s) will be initiated if needed.

Table 3. Species that have been eliminated from the CREP consultation

Species	**Critical Habitat**	**Effect Determination**
Canada lynx, *Felis lynx Canadensis*	No	No effect
Gray wolf, *Canis lupus*	No	No effect
Marbled murrelet, *Brachyramphus marmoratus*	Yes	No effect on the species or CH
Western snowy plover (coastal pop.), *Charadrius alexandrinus nivosus*	Yes	No effect on the species or CH
Northern spotted owl, *Strix occidentalis caurina*	Yes	No effect on the species or CH
Hutton tui chub, *Gila bicolor* ssp.	No	No effect
Borax Lake chub, *Gila boraxobius*	Yes	No effect on the species or CH
Foskett speckled dace, *Rhinichthys osculus* ssp.	No	No effect
Oregon silverspot butterfly, *Speyeria zerene hippolyta*	Yes	No effect on the species or CH
Mcdonald's rockcress, *Arabis macdonaldiana*	No	No effect
Malheur wire-lettuce, *Stephanomeria malheurensi*	Yes	No effect on the species or CH

2. ACTIONS PROPOSED UNDER THE OREGON CREP

2.1. Overview of the CREP Program Administration

2.1.1. Outreach and Education

Landowners learn about CREP in a variety of ways. Probably the most common way for a landowner to learn about CREP is through a neighbor who is already enrolled in the program. In addition, agencies and organizations involved in CREP promote the program to landowners through direct mailings, workshops, newspaper and newsletter articles, and presentations to landowner groups. The state has developed an Oregon CREP brochure that provides landowners an overview of the program and some examples of the payments and practices involved.

2.1.2. Application Process

To enroll a riparian area in CREP, a landowner must complete an application at the local FSA office. FSA staff determine whether the landowner meets agricultural producer eligibility requirements and verify the cropping or grazing history of the property. Technical agency staff then visit the property with the landowner to verify that the riparian area is not already fully functioning as a buffer. The NRCS, ODF, FSA, or SWCD staff may participate in these site visits. Table 4 summarizes key eligibility criteria for the Oregon CREP.

Staff discuss with the landowner the width of the buffer they wish to enroll in the program, and consider whether conditions on the site require a buffer wider than the usual 180 foot average maximum width. For example, a floodplain subject to frequent scour erosion may benefit from a wider buffer.

The Natural Resources Conservation Service (NRCS) has purchased the database containing rare, threatened or endangered plants, animals, fungi, and plant community information from the Oregon Natural Heritage Information Center (ORNHIC). NRCS has an employee in charge of the database who responds to requests from conservation planners for endangered and threatened species information. For listed species other than plants, the database is queried for the township, range and section of the proposed project and then the query is expanded a section out, in all directions, from the proposed project to take into account any species in an adjacent section, but which may be located immediately on the section border. A spreadsheet is provided to the planner with the results of the query for every conservation plan done in Oregon for NRCS and FSA.

A query is also made in the database for any known plant locations for the county and Major Land Resource Area (MLRA) within which the project is located. If there are listed plant species records in the County and MLRA proposed project area, the technician may need to conduct a field (on-the-ground) plant survey at the appropriate timing (blooming season) according to the agreed-to plant survey protocol between NRCS and USFWS (Appendix D includes the survey form). In some cases, the technician will only need to survey if certain habitat types are present (e.g. deep vernal pools for water howellia or within four miles of the Pacific Ocean for Western lily) or if certain soil types are present (e.g. Nelson’s checkermallow, Bradshaw's lomatium, Cook's lomatium only occur where hydric soil types are present, therefore a technician would only survey hydric soil types for these species). These specific habitat and soil conditions are indicated on the listed plant table that the planner receives and are also reiterated at the front section of the listed plant survey form.

After the initial site visit, technical staff complete an OR-EVT-1 (Environmental Evaluation Worksheet and Resource Inventory Checklist). This form indicates resource concerns, documents the analysis tools used to determine whether or not a resource concern meets NRCS quality criteria in the benchmark condition, and is used as a tool to indicate how those resource concerns are solved in the different alternatives developed by the conservation planner. The OR-EVT-1 documents compliance with special environmental concerns and laws, including the ESA. This form also determines what NEPA document that the conservation planner is tiering to or whether an environmental assessment is needed. The OR-EVT-1 is available at http://www.or.nrcs.usda.gov/technical/conservation_planning.html. The technician will also complete a "NRCS Biological Evaluation Summary Data for FSA" to indicate if the actions will be consistent with the current CREP Biological Opinion.

After receiving the results of the technical evaluations, FSA staff meet with the landowner and explain policies, rental rates, estimated cost-share rates, maintenance responsibilities and permitted and prohibited actions. In addition, the FSA staff will cover non-compliance ramifications which include payment reductions or, in severe cases, termination of contracts with required refund of all payments plus interest plus liquidated damages. Non-compliance may include failure to maintain the cover, not following the Conservation Plan of Operation on establishment of cover, or unauthorized disturbance during the primary nesting/brood rearing season or prohibited use of the contract acres (harvesting of any crop or grazing of livestock).

Table 4. Eligibility Criteria for the Oregon CREP

Eligible lands	• Land must have been cropped 2 of the last 5 years or be pasture that can be planted to a riparian buffer. • Land must be along a stream where threatened or endangered salmonids, sucker, chub, or dace are present or were historically present (excludes lands above permanent barriers to fish passage); be along a stream within an area with an Agricultural Water Quality Management Area Plans, or be along a stream on reservation or tribal trust land. • Riparian area must be in poor condition. For example, riparian area could be cropped to the water's edge, or could have small patches of vegetation interspersed with bare, heavily grazed ground. • To receive the irrigated rental rate, land must have been irrigated for 2 of the last 5 years, and landowners must lease their water right to the Oregon Water Resources Department for the length of their CREP contract.
Eligible practices and practice components	• To enroll in the program, a landowner must agree to complete one of the following **practices**: o Riparian forest buffer o Wetland restoration o Filter strip (only in areas with no historic tree distribution) o Marginal pastureland wildlife habitat buffer o Marginal pastureland wetland buffer • Landowners may complete several **components** as part of the practices listed above and receive cost-share for each component. Components include: o Tree and shrub planting o Seeding native vegetation o Fencing o Livestock watering developments

2.1.3. Financial Incentives Available Through CREP

CREP pays participants rent for the acreage enrolled and cost-share for conservation practices. Some bonus payments are also available depending on the practices implemented and the amount of riparian area enrolled. Table 5 describes CREP payments in more detail.

Table 5. Summary of incentive payments available through the Oregon CREP

Payments to landowners	**Annual Payments** • Landowners receive an annual per acre payment that includes a base rental rate, a bonus incentive rate, and maintenance rate. • For cropland, the base rental rate is calculated by the cash agricultural value of the three predominant soil types at the site. • For marginal pasture, a seasonal and perennial stream base rental rate has been established for each county. **Cost-Share Payments** • Landowners receive cost-share payments for restoration practices, such as riparian forest buffers and fencing, once the practices are completed. Landowners are reimbursed for 75% of the practice costs (50% provided by USDA, 25% provided by the State) provided they do not exceed average costs for that activity. [1] **One-Time Payments** • Landowners receive a Signing Incentive Payment (SIP) for contracts that include a filter strip or riparian forest buffer. SIP = years in contract x $10 x number of acres. • Landowners receive a Practice Incentive Payment (PIP) once all the practices in the contract are completed, if the contract includes a filter strip or riparian forest buffer. PIP = total eligible practices cost x .40. • If a landowner or multiple landowners enroll over 50% of the streambank in a 5-mile segment of stream into CREP, they receive a Cumulative Impact Payment (CIP). CIP = base rental rate x 4 x number of acres.
Landowner responsibilities	• Landowner pays 25% of the cost to establish the riparian buffer, fencing, etc. • Landowners are responsible to complete and maintain practices.

2.1.4. Restoration Plan and Contract Development

Once the CREP partner agencies determine a landowner and site are eligible for CREP, technical staff will work with the landowner to develop a restoration plan for the site. The plan specifies the area to be restored, the practice(s) the landowner will implement (i.e., riparian forest buffer or wetland restoration) and the components necessary to complete the practice (fencing, planting, etc). The landowner will also receive an offer from the FSA that includes rental payments, estimated cost-share payments for restoration practices, and estimated bonus payments.

Before a landowner signs their conservation plan, federal agency staff must conduct a survey for threatened and endangered species. After reviewing a list of threatened and endangered species known to occur in that county, staff conduct onsite surveys. Surveys for threatened and endangered plants take place during the flowering period. If listed species colonize a site after CREP practices are completed, they may not be identified because surveys are not typically conducted once CREP practices are completed. However, activities are not expected on the CREP land that would adversely affect listed species once practices have been completed.

[1] Example: average cost of building a fence is $3.00. The cost share will be 50% of the actual cost not-to-exceed $1.50/ft. (50% X $3.00) for the FSA and $.75/ft for the State cost-share.

FSA staff develop a CREP contract, which is signed by the landowner and approved by a committee of landowners elected in each county to advise FSA on farm program implementation.

The technician will continue to work toward completion of a Conservation Plan of Operation (CPO) which will include the selected practice (for example, CP22), the actions (trees and planting), the timeline (suggested month and year), and specifications for the actions taken from the NRCS eFOTG. The conservation planner continues to fill out the OR-EVT-1 with information as it is obtained or analyzed. Also, at this time, the technician, and/or the Stewardship Forester, creates a planting plan if trees are included in the practice. If the Stewardship Forester does not write the plan, he/she must review and sign off on it. Trees and shrubs native to the site are required in the plan. If the site and practice are outside of the current CREP BiOp and a listed species is identified in the area, a request will be submitted to the FSA State Office for informal consultation. The FSA Conservation Specialist will then consult with the appropriate agency to gain concurrence on the proposed action.

Once the CPO is completed, the participant(s) will review it with the technician and/or FSA Staff and, by signing, agrees to all practices, components and stipulations. The CPO is then approved by the local SWCD and the local NRCS representative. The FSA County Committee will then review and sign the CPO. Once the CPO is signed by all required parties, the CRP-1, Conservation Reserve Program Contract is signed by the participant and, if all other eligibility requirements are met (completion of conservation compliance forms, determining the number of people eligible for payment and determining if the participants fit under the current income limit), is approved by the FSA County Committee or its representative.

2.1.5. Implementation of CREP practices

Once a landowner's contract is signed and the CPO is completed, he or she typically has one-three years to complete all restoration practices. The timeline to complete practices and their components is specified in the landowner's restoration plan and contract.

Technical staff provide conservation practice and component specifications to the landowner before he or she implements each practice. For example, the Oregon Department of Forestry provides tree planting recommendations to each landowner, including species, site preparation, and follow-up treatments for competing vegetation. Soil and Water Conservation District or Natural Resources Conservation Service staff provide recommendations for planting shrubs and other vegetation. Technical staff also provide fencing specifications, including types of acceptable construction materials and exact fencing location.

Technical staff usually conduct site visits as a landowner or his or her contractor completes a practice component and also inspect and certify each component once it is complete. For example, ODF or other agency staff visit a site during tree planting and dig up a few trees to make sure they are planted correctly.

When the practice installation is complete and certified, the participant will indicate to the FSA office that the work is done and will submit invoices to verify reimbursable expenses. The participant is then reimbursed for eligible costs by both USDA/FSA, the State of Oregon and, in some cases, a third party where Enhanced CREP is present. Enhanced CREP refers to areas where a third party, such as a city or other political subdivision, has been introduced as a partner in CREP to provide additional landowner incentives. The practices and actions in those areas are still guided and restricted by FSA procedures.

There will be CREP contracts on which the participants will receive a higher rental rate by agreeing to lease back for in-stream use the water rights that are in place on the acreage under the CREP. There is an additional requirement for these participants to secure an in-stream lease from the OWRD that covers the years the land will be under the CREP contract. This involves no new water right but a transfer of use from irrigation to in-stream.

CREP has not been in place for enough time to predict what will occur once the contract expires. The history of the Standard CRP (which has been in place over 15 years) suggests that participants will be interested in reenrolling the acreage covered by the CREP contract. Whether statute will allow this is unknown at this time.

2.1.6. Maintenance and monitoring of CREP practices

After a landowner completes the CREP practices, he or she is required to maintain them for the life of the contract. Typical maintenance activities include controlling invasive weeds and repairing fence or livestock watering facilities.

Failure to maintain the practice may lead to requiring replanting at the participants' expense, reduction of annual rental payment due to non-compliance, or contract termination because of lack of cover. Any maintenance must be done outside of the primary nesting and brood rearing season, which is currently set as April 1 through June 15. In addition, management activities that enhance the practice are required at least once during the life of the contract. These activities include such things as interplanting to increase habitat value, creation of wildlife structures such as snags and nest boxes, creation of meadows and food sources, and light disking of grass plantings to invigorate the grass and reduce thatching.

Agency staff conduct annual onsite status reviews for the first five years of every CREP project.

2.1.7. Monitoring of the Oregon CREP

This section describes monitoring tailored specifically to CREP projects as well as several ongoing state monitoring efforts to document the implementation and evaluate the effectiveness of the Oregon Plan for Salmon and Watersheds, including CREP.

CREP projects are monitored at least annually for their first five years by SWCD, NRCS, or FSA staff. Staff conduct these site visits to document that CREP practices are completed and maintained. After the first five years, staff conduct random spot checks of CREP projects to ensure the projects are still maintained.

Technical agency staff typically take photo points of CREP projects before and after tree planting. As part of the CREP monitoring effort, staff will identify photo points along CREP streams and take photos annually during the first five years of each project, at the ten-year mark, and at fifteen years (if applicable). The photo monitoring will document changes in streamside vegetation over time as well as stream channel conditions.

To evaluate the effectiveness of a variety of restoration efforts in Oregon beyond CREP, several state agencies, tribes, and organizations collect data about watershed health in agricultural areas. CREP projects will likely influence most of these monitoring efforts.

- The Oregon Department of Environmental Quality (DEQ) collects ambient water quality data at 151 sites on over 50 large rivers in Oregon, representing all major rivers and providing geographic representation as well (DEQ, 2005). DEQ collects data at these sites for about 20 water quality parameters, including dissolved oxygen, temperature, bacteria, turbidity, and pH. Toxics monitoring is limited to small areas with known or highly suspected risks.
- OWEB maintains a watershed restoration database with all projects that receive OWEB funding.
- ODFW monitors fish populations as well as instream habitat conditions throughout Oregon.
- ODA collects riparian condition data on a 5-year rotating basis for 39 regions of Oregon. About 5% of riparian land in agricultural use is selected randomly for evaluation. Stream segments receive a score based on vegetative cover, allowing a stream to be compared against itself over time.
- Several watershed councils and other organizations collect water quality monitoring data that are uploaded to a database managed by DEQ.

2.2. Practices Available Through the Oregon CREP

The eligible Conservation Practices (CP) under this program are filter strips (CP21), riparian forest buffer (CP22), wetland restoration (CP23), marginal pastureland wildlife habitat buffer (CP29), and marginal pastureland wetland buffer (CP30). Section 2.3 and Appendix A include more detailed description of the components and actions that may occur as part of each of these practices. However, some of the activities (e.g., breaching dikes/levies, dike setbacks without water control structures, animal trapping and animal removal of invasive species) mentioned in Appendix A are not typically funded through the CREP. Therefore, they are not further described or considered to be covered activities under this programmatic consultation. If CREP projects arise that involve these activities on sites where listed species may occur, individual consultations will be completed as needed.

Conservation practices are to be installed in accord with all applicable CRP statutes (16 USC 3831 *et seq)* and regulations (7 Code of Federal Regulations Part 1410). In addition, the practices are to be consistent with the specifications outlined in the applicable NRCS Field Office Technical Guide (FOTG). The CRP practice from the FSA national policy handbook is available at http://www.fsa.usda.gov/FSA/webapp?area=home&subject=lare&topic=hbk and Oregon exhibits to that handbook are available from the Oregon State FSA office. Information on the current FOTG can be found on the NRCS website at www.**nrcs**.usda.gov/technical/efotg/.

Funds may only be used to install conservation practices on eligible cropland and marginal pastureland; therefore, no instream work will be undertaken, except for the installation of livestock crossings across small streams and off-stream watering facilities for livestock, planting of vegetation, and controlling competing vegetation. However, some streambank shaping may occur 30 linear feet or less to prepare a site for planting.

2.2.1. Filter Strip – Conservation Practice 21

CP 21, Filter Strip, has been available to CREP participants in Oregon since the program began in 1999. It has not been a popular practice; at the end of January 2008, out of the state's total CREP acreage of 32,650, only 90 acres had been enrolled and planted to filter strips.

Filter strips can only be used on cropland. Some of the benefits of filter strips include filtration of pollutants from surface runoff and increased cover for wildlife habitat. If a CREP participant selects a filter strip for their CREP land, the width can range from 20 feet to 120 feet wide.

Once land is enrolled in CREP and the landowner selects the filter strip practice, the enrolled area must be seeded to grasses. The landowner must control weeds after the filter strip is established.

2.2.2. Riparian Forest Buffer - Conservation Practice 22

The riparian forest buffer (CP22) is the most popular practice available through the Oregon CREP. It is available on both pastureland and cropland. It is the only practice available for landowners participating in the Tualatin Watershed Option. Benefits of riparian forest buffers include filtration of pollutants from surface runoff, moderation of solar heating of the streams by providing shade, large woody debris input to streams, wildlife food and cover, and streambank stability.

Riparian forest buffers typically range from 35 to 180 feet wide. The maximum width of the riparian buffer may exceed 180 feet if technical staff determine a wider buffer is necessary to prevent scour erosion or address other natural resource concerns.

Riparian forest buffers may consist of three zones. Zone 1, which is at least 15 feet wide, begins at the streambank and must be native trees and shrubs. Zone 2 begins at the outer edge of Zone 1 and must also be predominantly native trees and shrubs, although it may be grass and shrubs in areas with less than 25 inches annual precipitation. Zone 3 consists of grasses and forbs.

To establish a riparian forest buffer, landowners may select to plant the buffer, allow the buffer to establish through natural regeneration, or a mixture of these two options. If the landowner selects natural regeneration, the riparian buffer must establish itself within three years of enrollment.

The ODF prepares or approves the tree planting specifications on riparian forest buffers. Technical staff (either NRCS or the SWCD technician) usually provide the recommendations for shrubs, grasses and forbs.

Landowners must exclude livestock from the enrolled area, so riparian forest buffers along pastures generally include fencing and off-stream watering for livestock.

2.2.3. Wetland Restoration – Conservation Practice 23

This practice is available on croplands that were historically wetlands within the 100-year floodplain of a permanent river or stream. If a technician determines that an additional buffer is necessary, a buffer outside of the floodplain may also be enrolled. Benefits of wetland restorations include increased storage capacity of flood flows, increased habitat for wetland plants and animals, filtration of pollutants from runoff, and reduction of scour erosion.

Wetland restoration activities covered in this Biological Assessment include breaking or plugging drain tile, excavating new, shallow vernal pools, and planting trees, shrubs, grasses and/or forbs.

2.2.4. Marginal Pastureland Wildlife Habitat Buffer – Conservation Practice 29

CP 29, Marginal Pastureland Wildlife Habitat Buffer, became available through national revisions to CRP in 2003. To be eligible to be enrolled under CP 29, a site must be adjacent to a stream or other eligible waterbody, the site must be currently not functioning as a riparian buffer, and the natural vegetation for the site must be primarily a mix of grasses, shrubs, and forbs. The site must have also been used for pasturing livestock.

Landowners must exclude livestock from the enrolled area, so typically install fencing and off-stream watering for livestock. The landowner must then establish native grasses and forbs in the enrolled area, either through seeding or through controlling weeds to promote native vegetation.

2.2.5. Marginal Pastureland Wetland Buffer – Conservation Practice 30

This practice also became available through national revisions to CRP in 2003. To be eligible to be enrolled under CP 30, a site must be adjacent to a stream or other eligible waterbody, the site must be currently not functioning as a riparian buffer, and the natural vegetation for the site must be primarily a mix of grasses, shrubs, and forbs. The site must also have been used to pasture livestock.

Landowners must exclude livestock from the enrolled area, so typically install fencing and off-stream watering for livestock. The landowner must then establish wetland vegetation in the enrolled area, either through seeding or through controlling weeds to promote native vegetation.

2.2.6. Enrollment Criteria for Filter Strips, Marginal Pastureland Wildlife Habitat Buffers, and Marginal Pastureland Wetland Buffers

This section describes the situations in which CP21, CP 29, or CP 30 will be used to restore riparian areas enrolled in CREP. These practices warrant discussion because they do not *require* tree planting (although tree planting may occur), and special considerations come into play when determining when these practices are appropriate.

At a minimum, a landowner is required to seed a riparian area enrolled into CREP as CP21, CP 29 or CP 30 with a mixture of grasses and forbs native to the site.

Where the soil survey and other information indicate the native vegetation includes trees and/or shrubs, the landowner will be strongly encouraged to plant native trees and/or shrubs appropriate to the site as well and will be eligible for cost-share for the planting. If the landowner chooses not to plant trees or shrubs as part of the buffer, he or she will be strongly encouraged to allow volunteer native trees and shrubs to establish and develop. Volunteer native vegetation cannot be sprayed out or otherwise removed once it comes in unless it threatens to outcompete the more biodiverse plantings.

Some sites in Oregon are simply too dry to support the trees that must be planted in the first 15 feet of a buffer as is required for CP22, the riparian forest buffer practice. Even if a site is capable of supporting a narrow band of trees adjacent to the channel, it will not qualify for enrollment as a CP22 if it cannot support trees out to at least 15 feet from the channel. For most of these sites, the vegetation for the site's soil type will be described in the area soil survey and other vegetation mapping tools as predominantly grasses, shrubs, and forbs.

Although planting and establishing trees is not possible at some of these sites, CP21 and CP 29 can provide many of the same benefits as CP22. Grasses, forbs, and shrubs such as willow and wild rose provide riparian functions of streambank stabilization and nutrient and sediment filtration from surface runoff. In addition, on many smaller streams in eastern and southern Oregon, grasses, forbs, and shrubs provide shade, facilitate development of overhanging banks for fish cover, and provide insect habitat.

In addition to sites that lack trees as part of the historic vegetation, some sites in arid (less than 25 inches of annual precipitation) areas have been significantly altered to a point where they cannot currently support trees. These arid sites are often severely downcut as a result of historical land management practices. While ceasing harmful land management practices will normally help the stream channel aggrade over time, raising the water table and providing more moisture to sustain trees, it is often not appropriate to plant trees at these sites at the beginning of a CREP contract.

For example, if cottonwoods historically grew at a now-downcut site but are planted on the first 15 feet of a streambank as required for CP22, and those 15 feet are located at the top of the cliff above a severely downcut stream, the seedlings will not have the access to the water table they need and will probably die. Instead, it may be more appropriate to enroll the site as a filter strip or marginal pastureland wildlife habitat buffer, encourage tree and shrub growth along the waterline of the existing channel, and help the channel gradually aggrade over the life of the contract to a condition where it can support trees again.

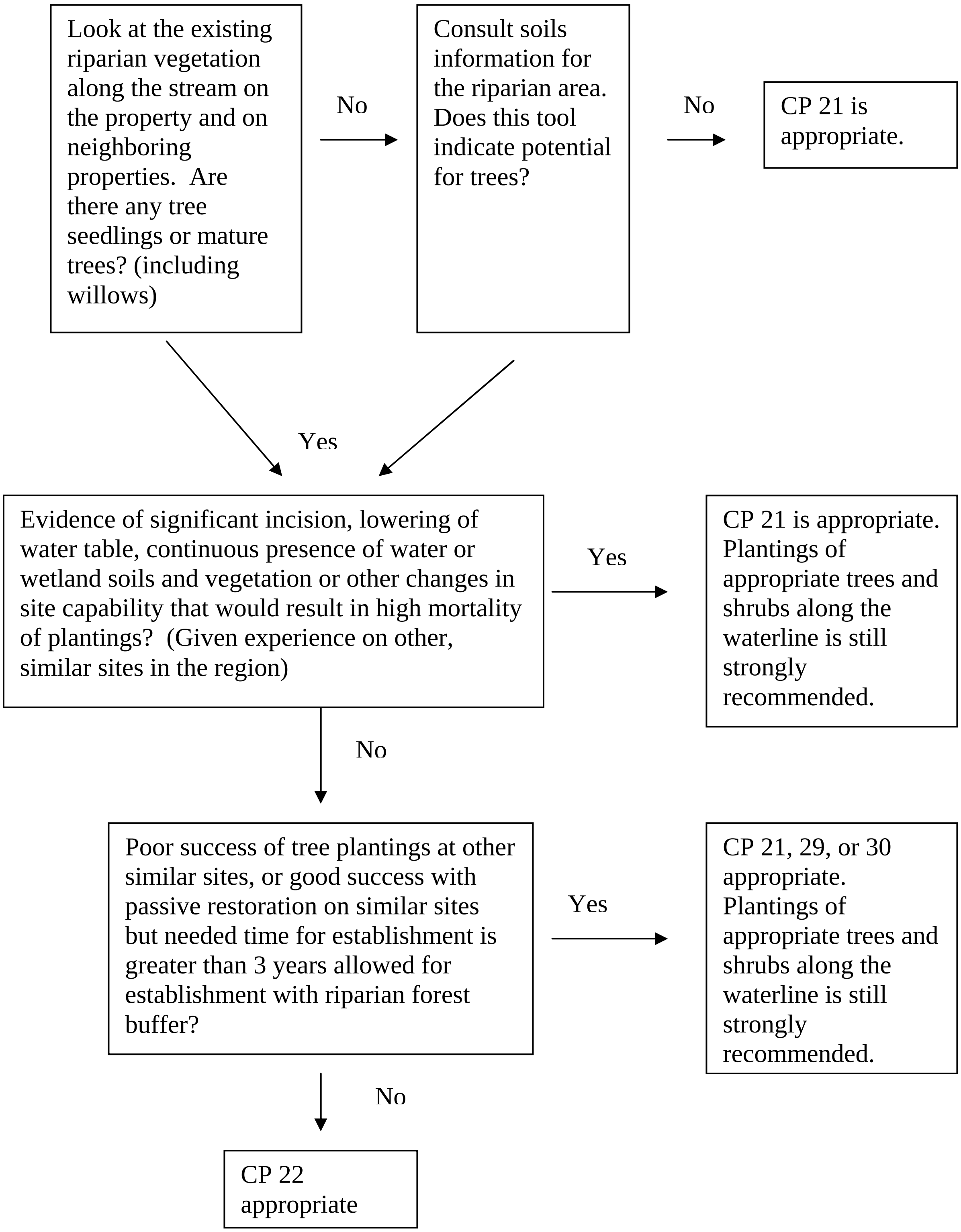
Conversely, historic wetland and estuarine areas may be too wet to support the treed 15-foot buffer required by CP22. The soil may be heavy impermeable clay, forming a water-filled basin year round, or may be tidally influenced, as is much of the pastureland along Oregon's coast. Rather than requiring installation of a riparian forest buffer with a likelihood of failure due to tree death, it may be more appropriate to enroll the site as a wetland wildlife habitat buffer, encouraging appropriate vegetative growth along the perimeter of the site.

Figure 1 shows the process for deciding when CP21, CP29 or CP30 is appropriate rather than CP22.

a. Best case scenario - site enrolled as riparian forest buffer (CP22).
b. If site did not historically support enough trees to meet minimum CP22 specs as shown through soil survey and/or historic vegetation information, or if the site is too downcut to support trees that would have historically grown there, enroll site under CP21, CP29 or CP30. Landowner is required to seed the area with native grasses and forbs. Landowner will be strongly encouraged to plant native trees and/or shrubs appropriate to the site along the water line.

If landowner does not wish to plant trees and/or shrubs as part of CP21, CP29 or CP30, he or she will be strongly encouraged to allow volunteer shrubs to establish and develop. If the site supports listed species that rely on non-forested habitats, such as certain listed plants and invertebrates, CREP projects will maintain and enhance needed habitat to support those species and help with recovery where possible.

Figure 1. Decision Aid for Choosing Conservation Practice 21, 29 or 30 for Riparian Restoration on Cropland



2.3. Components and Actions Associated with CREP Practices

To complete any of the **practices** described in Section 2.2., a landowner and his or her contractor(s) must complete several practice **components**, such as fence installation, tree and shrub planting, off-stream watering facilities, or seeding. Each component involves several **actions**, such as digging post holes, ripping an area before tree planting, or excavating a trench as part of a spring development to feed a livestock watering trough. This section describes the components and actions that may take place as part of the CREP program in accordance with this programmatic consultation. Sections 2.4 and 2.5 list BMPs that will be followed to avoid or minimize potential negative impacts to species and habitats.

Note: Appendix A provides a summary table listing the components used to carry out each practice, as consistent with CREP program terminology. It is included as a tool for cross-referencing the official list of practices and components with actions that are typically involved in implementation and any applicable FOTGs and BMPs related to national program policies and guidance. Appendix A is for reference only; all CREP program activities and mitigating measures that are relevant to the proposed action, species effects analyses, and effect determinations for activities that are covered in this consultation are more fully described in the main body of the Biological Assessment.

2.3.1. Tree and Shrub Planting

Both the riparian forest buffer and wetland restoration practice may involve tree and shrub establishment. The NRCS FOTG has three sets of standards and specifications that apply to this component (Practice code 391A, Riparian Forest Buffer; Practice code 612; Tree and Shrub Establishment; Practice code 490, Forest Site Preparation).

The ODF either prepares or reviews site preparation and tree planting plans. NRCS and SWCD technical staff recommend shrub, grass and forb species.

The landowner or contractor may complete several site preparation activities prior to planting, depending on the condition of the site. These activities include the following.

- Disking – using a tractor and disk attachment to eliminate competing vegetation in the planting area.
- Ripping – using a tractor and attachment with 3 to 4-foot deep shanks to break up compacted soil layers, increase infiltration of water, and allow tree roots to grow deeper into the soil.
- Herbicide application – applying herbicide to reduce competition with new plantings (this activity is described in more detail in section 2.3.2.).
- Mechanical and manual clearing – using equipment or hand tools to clear a field of heavy weeds or to clear circles around spots where trees will be planted. Depending on the site conditions, heavy equipment, small mechanical equipment, or hand tools may be used.

Once the site is prepared for planting, the landowner or contractor will either hand-plant or machine-plant trees and shrubs. For a bare-root seedling, the tree planter or planting machine create a hole for the plant, spread out the roots and fill in the hole. Stakes are usually pounded or shoved into the ground without digging. However, if the planting occurs in a very rocky site, the tree planter may use other equipment to dig holes for bareroot seedlings or stakes.

After the planting, the landowner or contractor may reduce competing vegetation to increase planting survival by manually, mechanically or chemically treating vegetation around the plantings. This activity may be done anytime during the life of the CREP contract. Landowners may also irrigate the plantings for the first three years of establishment if they have valid water rights. Pipelines may be installed using mechanical equipment or manual methods (i.e., a shovel or pick) to dig trenches for the placement of pipes. Water may be delivered from a bucket, hose, water truck, handlines, pipes, sprinkler heads, spray guns or microsprinklers. The water source may be a stream, well, or water truck.

Moisture conservation measures, such as placing geo-textile fabric or mulch around plants, may be used to help ensure survival of plantings. Temporary animal control measures are sometimes used to protect the plants in areas where they may be damaged due to browsing or grazing. Tree protection may involve putting cages, netting or tubes around the plants. Repellents such as bloodmeal and human hair may also be used to keep target animals away from plants while they are becoming established.

Oregon Department of Forestry or other technical staff conduct annual site reviews, and certify the tree and shrub establishment as complete when the plants are in a "free to grow" condition. In other words, they are no longer in danger of dying because of competing vegetation.

2.3.2 Herbicide Applications

Herbicides may be used for site preparation, short-term management during the period when revegetated areas are becoming established, and site maintenance as needed during the life of the CREP contract (generally 10 to 15 years) to control invasive plants.

The following section includes a general description of each herbicide that may be used, the formulations used on CREP projects, and the application methods and equipment used. Application methods and equipment are described below by zones along streams, lakes, and ponds, and are shown in the diagram provided in Appendix G.

The use of specific equipment within different zones along streams is designed to minimize potential effects to some of the listed fish species and their critical habitats. Later in this section, additional BMPs and application zones that will be used to minimize effects to listed terrestrial species and some of the other inland fish and their critical habitats are discussed. In areas where BMPs may conflict, the more restrictive BMP applies.

2.3.2.1. Herbicides Proposed for CREP Projects

2.3.2.1.1. Aminopyralid

Description

Aminopyralid is a new selective systemic herbicide that has been developed for the control of broadleaf weeds in rangeland, non-crop areas, and grazed areas. In addition to non-agricultural applications, aminopyralid is also registered for applications to wheat.

Use Zones, Application Equipment, and Application Methods

Aminopyralid may be applied upland from the high water mark of lakes, ponds, and flowing streams using wick/wipe, spot spray, and patch spray methods. Squirt bottles, hand pump sprayers, or hand pump backpack sprayers would be used for these applications. The hand pump backpack sprayer is the preferred equipment to apply aminopyralid in this zone and the spot spray is the preferred application method.

Beyond 15 feet to the outer edge of the CREP project, hand application, spot spraying and ground broadcast sprays may be used to apply aminopyralid. Equipment used would be squirt bottles, hand pump sprayers, hand pump backpack sprayers, boomless sprayers, or boom sprayers.

Aminopyralid may be applied across ephemeral channels, intermittent channels, and ditches.

2.3.2.1.2. Chlorsulfuron

Description

Chlorsulfuron is used for preemergent and early postemergent control of many annual, biennial, and perennial broadleaf weeds.

Use Zones, Application Equipment, and Application Methods

Chlorsulfuron may be applied upland from the high water mark as spot spray and patch spray, using a hand pump sprayer or hand pump backpack sprayer. From the area beyond 25 feet upland of the high water mark to the outer edge of the project, it may be applied to spot spray, patch spray, or ground broadcast spray, using a hand pump backpack sprayer, boomless sprayer, or boom sprayer. The same zones will apply to ephemeral channels, intermittent channels, and ditches.

2.3.2.1.3. Clopyralid

Description

Clopyralid is a selective herbicide used primarily in the control of broadleaf weeds. It is effective on the sunflower, legume, nightshade, knotweed and violet families. It is also particularly effective at treating thistles. It has little effect on grasses as well as members of the mustard family.

Use Zones, Application Equipment, and Application Methods

Clopyralid may be applied upland from the high water mark of lakes, ponds, and flowing streams using wick/wipe and spot spray methods. Squirt bottles, hand pump sprayers, or hand pump backpack sprayers would be used for these applications. The hand pump backpack sprayer is the preferred equipment to apply clopyralid in this zone and the spot spray is the preferred application type.

Beyond 15 feet to the outer edge of the CREP project, spot spraying and ground broadcast sprays may be used to apply clopyralid. Equipment used would be squirt bottles, hand pump sprayers, hand pump backpack sprayers, boomless sprayers, or boom sprayers.

The same zones apply to ephemeral channels, intermittent channels, and ditches.

2.3.2.1.4. Dicamba

Description

Dicamba is recommended for the control of a variety of broadleaf weeds and woody vegetation.

Use Zones, Application Equipment, and Application Methods

This herbicide will only be used when absolutely necessary to control weeds that cannot be controlled for another herbicide. It will be used in eastern Oregon.

Dicamba may be used beyond 15 feet upland from the high water mark extending to the outer edge of the project, using spot spray, patch spray, or ground broadcast spray. Equipment used would be hand pump, hand pump backpack, boomless sprayer, or boom sprayer. Dicamba may also be applied across ephemeral channels, intermittent channels, and ditches as long as allowed on the label for the specific formulation.

2.3.2.1.5. Glyphosate

Description

Glyphosate is a non-selective systemic herbicide. It is the general herbicide of choice for use in the 15-foot zone along the high water mark for the plant species that it will effectively control.

Use Zones, Application Equipment, and Application Methods

Glyphosate may be applied upland from the water's edge of lakes, ponds, and flowing streams by wick/wipe, cut surface, hack & squirt/injection, stem injection, spot spray, or patch spray. Emergent plants may be treated by wick/wipe, cut surface, stem injection, or spot spray. Squirt bottles, hand pump sprayers, or hand pump backpack sprayers would be used for application.

Beyond 15 feet to the outer edge of the project, cut surface, hack & squirt injection, stem injection, spot spray, patch spray, or ground broadcast sprays may be used. Application equipment would be squirt bottle, hand pump sprayer, hand pump backpack sprayer, boomless sprayer, or boom sprayer.

When using the stem injection method, applicators must carefully monitor application rates to make sure glyphosate is applied within the allowable limits.

Glyphosate may be applied across ephemeral channels, intermittent channels, and ditches.

2.3.2.1.6. Hexazinone

Description

Hexazinone is a triazine herbicide that comes in granular and liquid formulations. The dry granule is spot applied around pine trees.

Use Zones, Application Equipment, and Application Methods

Hexazinone will not be used within 15 feet of the high water mark. Between 15 feet and 25 feet upland from the high water mark of lakes, ponds, and flowing streams, spot spray and patch spray methods may be used to apply hexazinone. Squirt bottles, hand pump or hand pump backpack sprayers would be used. Beyond 25 feet to the outer edge of the project, cut surface, hack & squirt injection, stem injection, spot spray, patch spray, or ground broadcast sprays may be used. Application equipment would be squirt bottle, hand pump sprayer, hand pump backpack sprayer, boomless sprayer, or boom sprayer.

In addition, the granular form (i.e., Pronone) may be spot applied around pine trees between 15 feet from the high water mark to the outer edge of the project. To apply the granular form, the applicator uses a hand-held meter device that deposits the dry granules around each tree. The herbicide is applied to an area of approximately 4 X 4 feet, with the amount being regulated by the application device. During application, the granules fall straight to the ground and are not subject to offsite drift. This method is required for establishment of pine on many sites in central and eastern Oregon. One application is often sufficient to get the pine established.

Hexazinone may be applied across ephemeral channels, intermittent channels, and ditches.

2.3.2.1.7. Imazapic

Description

Imazapic is used in the control of grasses, broadleaves, and vines, and for turf height suppression in non-cropland areas.

Use Zones, Application Equipment, and Application Methods

Upland from the high water mark of lakes, ponds, and flowing streams, imazapic may applied with wick/wipe, cut surface, hack & squirt/injection, spot spray, or patch spray, using squirt bottles, hand pump sprayers, or hand pump backpack sprayers. Hand pump backpack sprayers are the preferred equipment, and cut surface, hack & squirt injection, spot spray, and patch spray are the preferred methods.

From the zone 15 feet upland from the high water mark to the outer edge of the project, imazapic may be applied through cut surface, hack & squirt/injection, spot spray, patch spray, or ground-based broadcast application. Application equipment used would be squirt bottles, hand pump sprayer, hand pump backpack sprayer, boomless sprayer, or boom sprayer.

Imazapic may be applied directly across ephemeral channels, intermittent channels, and ditches.

2.3.2.1.8. Imazapyr

Description

Imazapyr is a systemic plant growth inhibitor. The primary use is on woody vegetation as a foliar spray, applying to cut stumps or injecting into the plant.

Use Zones, Application Equipment, and Application Methods

Imazapyr may be applied upland from the water's edge of lakes, ponds, and flowing streams using wick/wipe, cut surface, stem injection, or spot spray methods. Aquatic formulations may be applied to emergent plants. Equipment used would be squirt bottles, hand pump sprayer, or hand pump backpack sprayer. When using the stem injection method, applicators must carefully monitor application rates to make sure imazapyr is applied within the allowable limits.

From the zone 25 feet upland from the high water mark to the outer edge of the project, imazapyr may be applied through cut surface, hack & squirt/injection, stem injection, spot spray, patch spray, or ground based broadcast application. Application equipment includes squirt bottle, hand pump sprayer, hand pump backpack sprayer, boomless sprayer, or boom sprayer.

Imazapyr may be applied directly across ephemeral channels, intermittent channels, and ditches.

2.3.2.1.9. Metsulfuron methyl

Description

Metsulfuron methyl is a selective pre-emergence and post-emergence sulfonyl urea herbicide used primarily to control many annual and perennial weeds and woody plants.

Use Zones, Application Equipment, and Application Methods

Upland from the high water mark of lakes, ponds, and flowing streams, spot spray or patch spray may be used. Hand pump or hand pump backpack sprayers would be used.

Beyond 25 feet upland from the high water mark to the outer edge of the project, spot spray, patch spray or ground broadcast sprays may be used, using hand pump, hand pump backpack, boomless sprayers, or boom sprayers.

The same zones apply to ephemeral channels, intermittent channels, and ditches.

2.3.2.1.10 Picloram

Description

Picloram is an herbicide used in the control of a number of broadleaf weeds and undesirable brush.

Use Zones, Application Equipment, and Application Methods

This herbicide will only be used when absolutely necessary to control weeds that cannot be controlled with another herbicide. It will be used in eastern Oregon.

Picloram will not be used in the area within 15 feet of the high water mark. It may be used beyond 15 feet upland from the high water mark of lakes, ponds, and flowing streams and extending to the outer edge of the project, using spot spray, patch spray, or ground broadcast spray. Equipment used would be hand pump, hand pump backpack, boomless sprayer, or boom sprayer.

Picloram may be applied in ephemeral channels using cut-stump, hack & squirt, or injection methods. Application equipment would be squirt bottles, hand pump sprayers, or hand pump backpack sprayers.

2.3.2.1.11. Sethoxydim

Description

Sethoxydim is used as a selective post-emergent herbicide for the control of annual or perennial grass weeds.

Use Zones, Application Equipment, and Application Methods

Upland from the high water mark of lakes, ponds, and flowing streams, sethoxydim may be applied with a hand pump sprayer or hand pump backpack sprayer for spot spraying, patch spraying, or wick/wipe treatments. Beyond 15 feet upland of the high water mark to the outer edge of the project, spot spray, patch spray, and ground broadcast sprays may be conducted with hand pump sprayers, hand pump backpack sprayer, boomless sprayer, or boom sprayer.

The same zones will apply to ephemeral channels, intermittent channels, and ditches.

2.3.2.1.12. Sulfometuron methyl

Description

Sulfometuron methyl is a broad-spectrum pre- and post-emergent herbicide. It is less selective than chlorsulfuron or metsulfuron methyl and is effective against broadleaf and grass species. It has residual activity and is an important tool on sites where it is critical to get long-term weed control with one application.

Use Zones, Application Equipment, and Application Methods

Beginning at the high water mark of lakes, ponds, and flowing streams and extending 25 feet out, spot spray and patch spray will be used to apply sulfometuron methyl. Hand pump backpack and hand pump sprayers will be used.

Beyond 25 feet upland of the high water mark to the outer edge of the project, spot spray, patch spray, and ground based broadcast application methods will be used. Hand pump backpack, boomless sprayers, or boom sprayers would be the application equipment.

The same zones will apply to ephemeral channels, intermittent channels, and ditches.

2.3.2.1.13. Triclopyr

Description

Triclopyr (used in Garlon) is a selective systemic herbicide. It is used on broadleaf and woody species.

Use Zones, Application Equipment, and Application Methods

Triclopyr BEE:
Triclopyr BEE will not be used within 25 feet of the high water mark. Beyond 25 feet upland from the high water mark of lakes, ponds, and flowing streams and extending to the outer edge of the project, triclopyr BEE may be applied using cut surface, hack & squirt/injection, basal bark spray, spot spray and patch spray. Application equipment is hand pump sprayer or hand pump backpack sprayer. Broadcast spray of triclopyr BEE will not occur.

The same zones will apply to ephemeral channels, intermittent channels, and ditches.

Triclopyr Amine:
Beginning at the water's edge of lakes, ponds, and flowing streams, triclopyr amine may be applied using squirt bottles, hand pump sprayers, or backpack sprayers. Application methods would be spot spray, cut-stump or injection, basal spray, and hack & squirt. Aquatic labeled triclopyr amine may also be applied to emergent vegetation using hand/select methods and equipment such as wicking-wiping, squirt bottles, or hand pump sprayers.

Beyond 25 feet upland of the high water mark to the outer edge of the project, spot spray, patch spray, and ground based broadcast application methods will be used. Hand pump backpack, boomless sprayers, or boom sprayers would be the application equipment. Broadcast spray would be used when deemed essential on relatively flat, large acreage sites.

Triclopyr amine may be applied directly across ephemeral channels, intermittent channels, and ditches using spot spray and hand application methods. Broadcast spray may occur beyond 25 feet upland of the high water mark.

2.3.2.1.14. 2,4-D

Description

2,4-D is used to control a variety of broadleaf weeds. Both the amine and ester forms will be used in CREP projects.

Use Zones, Application Equipment, and Application Methods

2,4-D will be used only when absolutely necessary to control weeds that cannot be effectively controlled by other herbicides. It will be used primarily in Eastern Oregon.

From the high water mark of lakes, ponds, and flowing streams, 2,4-D amine and ester may be applied with a squirt bottle, hand pump or hand pump backpack sprayer in spot spray or patch spray treatments.

Beyond 15 feet upland of the high water mark to the edge of the project, 2,4-D may be applied as a spot spray, patch spray, or ground broadcast spray, using hand pump, hand pump backpack, or boom sprayer.

The same zones will apply to ephemeral channels, intermittent channels, and ditches.

2.3.2.2. Description of Application Methods

BKP (Hand pump back pack sprayer) -- general discussion and description:
The BKP is equivalent to a HP (hand pump sprayer) except that it is more efficient and effective. The BKP is more efficient because it has more fluid capacity. This allows the worker to make fewer trips back to the mixing and storage site. This way the worker can use most of his/her energy and concentration in carefully applying the herbicide. It will also avoid the temptation to move the storage/ mixing area down closer to the application area to save time and energy in refilling the sprayer. This provides further assurance that the herbicide container is kept a safe distance from the streamside zone.

BKP's are easier for the worker to operate since the pressure can be maintained (with the side mounted hand pump) without having to balance the sprayer on the ground and pump it from the top (as is done with the smaller hand pump style). This also reduces the hazard of a spill since the BKP does not need to be put on the ground to pump up the pressure. The nozzle size on the

BKP is similar (or the same in some cases) as that of the HP. The nozzle on both types of sprayers can be adjusted to get the spray pattern and droplet size required to prevent off target drift.

The BKP is commonly available to contractors and landowners and is relatively easy to operate and maintain. Requiring contractors and landowners to purchase special herbicide application equipment (HP vs. BKP) for CREP projects would create an unnecessary added cost and a disincentive to participate in the program.

BKP (Hand pump back pack sprayer) used for BB (Basal Bark application) description: This method may be used for site preparation or to "release" existing trees and shrubs from competing vegetation. With this method, a BKP is used to apply herbicide directly to the bark (from ground level up eighteen inches) at the base of the plant. The herbicide is pre-mixed with crop (vegetable) oil - the oil allows the herbicide to stick to and penetrate into the bark of the plant. The BKP nozzle is held approximately four to twelve inches from the stem as the herbicide is applied. This method is effective in treating difficult to control woody species (such as Scotch broom) that have stems from two to six inches in diameter. This method is used where other methods such as SS or PS would not be feasible or effective.

BKP (Hand pump back pack sprayer) used for PS (Patch Spray application) description: With this method a back pack sprayer to apply herbicide onto patches of noxious weeds or competing vegetation to prepare an area for tree / shrub planting or control vegetation competing vegetation around existing tree / shrub plantings. The herbicide is directed away from desirable vegetation. A continuous weed patch might be from 0.01 acre up to 0.3 acre.

This treatment method is required in situations commonly found on many riparian rehabilitation areas. For example, many sites (particularly in Western Oregon) are covered with patches of Himalayan blackberries. To get and maintain adequate control of this aggressive brush species it is often necessary to treat brush patches at least once to allow the desirable trees / shrubs to become established. Failure to control the larger brush patches results narrow individual "silos" around desirable trees / shrubs. The trees and shrubs often struggle to get adequate light to survive as the adjacent brush patch continues to grow and dominate the site.

On some sites, there may be patches of noxious weeds that (per CREP program requirements) must be controlled in addition to controlling the weeds immediately adjacent each tree / shrub planting location.

BKP (Hand pump back pack sprayer) used for SS (Spot Spray application) description: With this method, planting spots (of approximately 4 ft x 4 ft) are treated for site preparation before trees / shrubs are planted. An area of about the same size is treated to release existing desirable tree / shrub from competing vegetation. Research has shown generally that competing vegetation in an area of at least 3 ft x 3 ft must be controlled to allow establishment of desirable vegetation.

Approximately 80% of the time, the vegetation controlled will be non-native, invasive and/or noxious. Some native grasses and perennials will need to be controlled since they also compete with desirable trees and shrubs for moisture and nutrients. Competing native vegetation will be controlled only to the extent necessary to allow trees / shrubs to become established.

SS is needed because application methods such as WKP (wicking or wiping) are extremely labor intensive (and expensive). WKP can be effective and feasible on very small (typically less than one acre) projects. However, virtually all CREP projects are greater than one acre - the average project size is approximately 22 acres. Individual plant treatments (such as WKP) are not feasible on most CREP projects because of the amount of time it would take to apply herbicide on each acre.

<u>CS (Cut surface application) description</u>:
With this method, the stems of the weeds are cut several inches above the ground. Soon after the stems are cut, the herbicide is applied directly to the cut surface using squirt bottle, brush, wick or equivalent technique. The herbicide is absorbed into the stem by the effect of plant "wicking" and gravity. Most herbicides are usually applied at a relatively high concentration. Depending on the weed species involved and product to be used, application of undiluted herbicide may be required. With this method, the herbicide has contact with the cut surface (top) of the weed, and, to some degree, with the side of the stem.

This method is used where other methods such as SS, PS, or BB are not feasible or effective.

<u>HS/I (Hack & Squirt / Injection application) description</u>:
With this method, herbicide is placed inside the stem of the weed. This is accomplished using an injection device (Hypohatchet, 22 shell injector, or a simple hatchet and squirt bottle). The end result is the injection of a small volume of herbicide into one or two puncture boles in the plant stem. The volume injected is approximately one to four milliliters per puncture. That would be about the same volume that would be in four "eye-dropper" drops. Depending on the product being used, the herbicide concentration may range from 50% diluted to undiluted. Using this method the herbicide remains inside the plant.

<u>BM (Boom or boomless sprayer) for GBC (ground broadcast spray application) description</u>:
BM - GBC is using a boom sprayer to apply a herbicide in strips or across continuous areas. With a boom sprayer, a boom spray device is attached to an ATV or farm tractor such that swaths of six to twelve feet wide can be sprayed on each pass. With a boomless sprayer, spray nozzles are attached directly to the back of an ATV.

This treatment is often done to prepare a site prior planting trees / shrubs. This treatment is required where the project area consists of very long and/or wide relatively flat areas that are dominated by continuous cover of noxious, invasive, or other highly competitive weeds. (Typically these are low laying annual / perennial grasses and/or broadleaves.)

This treatment method is particularly important on some sites in Central and Eastern Oregon because:

1) some CREP projects can be two (or more) miles long;
2) many landowners have the boom spray equipment;

3) many landowners do not have the time to use slower application methods
4) many landowners are not willing to pay someone else to use slower application methods
5) there is a limited number of contractors available to do back pack applications

SS - Pronone (Spot application with dry granule) description:
With this method, a dry granule form of Hexazinone (Pronone) is applied using a hand-held meter device that deposits the dry granules around each tree. The herbicide is applied to an area of approximately 4 ft x 4 ft, with the amount being regulated by application device. During application, the granules fall straight to the ground and are not subject to off site drift. This method is required for establishment of pine on many sites in Central and Eastern Oregon. One application is often sufficient to get the pine established.

WKP - (Wick / Wipe application) description:
With this method, herbicide is applied using any device that transfers the herbicide by direct contact to the weed foliage.

2.3.3. Seeding

Seeding may occur on any of the CREP conservation practices to establish wildlife habitat and provide for filtration of pollutants from runoff. Two NRCS practice codes may apply (Filter Strip; Riparian Herbaceous Cover). NRCS or SWCD staff prepare seeding recommendations for landowners to implement this component.

Seeding activities may include plowing or disking the riparian area, rolling or packing the soil, and mechanically seeding the area or hand-broadcasting seed. A no-till drill may also be used to plant the seed and lessen soil disturbance. Plugs may also be planted.

Competing vegetation, including weeds, may be chemically treated before or after the seeding. The landowner must continue to control weeds on the seeding throughout the life of the CREP contract.

2.3.4. Fence Installation

Fencing may be built on any CREP practice except for wetland restoration. NRCS practice code 382 (Fence) applies to this activity.

CREP participants may build either a 4-strand barbed wire or smooth-wire fence. If they wish to construct a woven-wire or other fence, they may receive cost-share only up to the cost of the 4-strand wire fence.

To install the fence, participants must either hand-dig post holes or use equipment such as an auger, then string the wire. The fence must be maintained to exclude livestock from the CREP area for the life of the contract.

2.3.5. Livestock and Wildlife Watering Facilities

Livestock watering facilities may be built on any CREP practice except for wetland restoration. Wildlife watering facilities may be built on any CREP practice. Several NRCS practice codes may apply to the livestock and wildlife watering facility components (Practice Code 574, Spring Development; Practice Code 614, Trough or Tank; Practice Code 614, Watering Facility; Practice Code 648, Wildlife Watering Facility; Practice Code 441, Pipeline; Practice Code 776, Aluminum Pipe).

To construct a spring development, the landowner or contractor would manually or mechanically excavate into the spring, level the area, install a spring box, and install a pipe that feeds from the spring box to the livestock trough or tank. Vegetation may need to be cleared from around the spring. A trench is dug from the spring box to the trough and a pipe is installed in the trench to feed the trough. A fence is also constructed around the spring development to protect it from livestock trampling.

Alternatively, the trough or tank may be fed from a stream or river. The landowner installs a pump with a fish screen into the stream, withdrawing water to feed the trough or tank. In some cases, machinery is used to shape a section of the bank (i.e., less than 30 linear feet) as needed to install the pump and piping.

Livestock troughs are usually installed above-ground and are equipped with a float valve. Manual labor or a tractor is used to excavate and level the site. A concrete pad is then poured into a form created on-site, and the trough or tank and pump are bolted onto the concrete pad. Facilities include escape ramps to prevent wildlife from being trapped in the troughs. To prevent mud from accumulating around the trough, it is surrounded with a concrete pad, gravel, and/or geotextile fabric.

2.3.6. Wetland Restoration

A wetland restoration component is only conducted on the wetland restoration practice (CP 23). NRCS practice code 657 (Wetland Development or Restoration) applies to this component.

The only wetland restorations included in this BA will involve breaking drain tiles, excavating to create new shallow vernal pools, and reestablishing native wetland vegetation. Some wetland restoration activities mentioned in Appendix A, such as drainage tile removal, breaching dikes and levies and dike setbacks without water control structures, will be addressed through separate consultations as needed.

To break drain tile, small holes will be dug along drain tile pathways to break the tile, and holes will then be filled in with soil. New vernal pools may be constructed, typically in disturbed areas dominated by non-native species. To construct vernal pools, the existing vegetation would be scraped away and shallow, small pools will be constructed no more than a few inches deep. Generally, natural topography will be restored. Native vegetation would be established through tree and shrub planting (2.3.1) or seeding (2.3.2).

2.3.7. Livestock Crossings

Livestock crossings may be installed on all CREP practices except wetland restorations. The NRCS practice standard for Animal Trails and Walkways (575) applies to this component.

Some livestock crossings involve minimal bank shaping (i.e., less than 30 linear feet), vegetation clearing, and installing rock and/or geotextile on the bank and in the stream channel to minimize erosion at the crossing site. Fencing is installed, and may be placed across the creek to keep livestock within the crossing area. These livestock crossings are included in this BA.

Crossings that involve culvert installation within habitat for fish species under NMFS jurisdiction and that meet the NMFS criteria outlined in the Standard Localized Operating Procedures for Endangered Species (SLOPES) BiOp are also included in this BA. Crossings that involve culvert or bridge installation that are outside the terms and conditions of the SLOPES BiOp, or that are within habitat for fish species under USFWS jurisdiction, will not be included in this BA and will require individual consultations.

2.3.8 Upland Wildlife Habitat Management

In addition to revegetation of native plant communities to enhance upland wildlife habitat, structures such as nesting platforms, snags and bird and bat boxes may be installed to benefit local wildlife. Mechanical augers may be used to dig holes to install structures, and blasting charges or chain saws may be used to create snags. In some cases, hand tools may be used to prune trees. Meadows may be maintained, created or improved by clearing or thinning trees or other vegetation using hand saws, chain saws or machetes. Light disking may be used as a strategy to promote plant species desirable to upland wildlife or promote plant species of concern. Projects involving disking in areas where listed plants or their designated critical habitats occur are not included in this consultation, and will be addressed as needed through separate consultations.

2.4. Activity-Based Best Management Practices

Following are BMPs that will help avoid adverse impacts to multiple taxa. The BMPs in this section are organized by type of action. Additional BMPs for specific listed species that may occur within the vicinity of CREP projects are discussed in section 2.5. In areas where BMPs may conflict, the more restrictive BMP applies.

2.4.1. General BMPs

- Technical staff will determine which listed species may occur in the area prior to completing the CREP conservation plan for a site. Surveys for listed species that may occur within the area to be affected will be conducted whenever possible; if information is not available about potential location(s) of listed species and surveys cannot be conducted for species that may occur, it will be assumed that species that may occur are present.
- Technical staff will work with landowners to plan construction and other activities to minimize or eliminate adverse effects to listed species and to follow all applicable BMPs.

- Exploring opportunities to benefit listed species and support their recovery is encouraged on CREP project sites that may provide potentially suitable habitat.
- Sediments will be removed from behind work isolation structures or stabilized before structures or erosion controls are removed.
- Existing roads or travel paths will be used to access project sites whenever possible; vehicular access ways to project sites will be planned ahead of time and will provide for minimizing impacts on riparian corridors and areas where listed species or their critical habitats may occur.
- Vehicle use and human activities, including walking in areas occupied by listed species, will be minimized to reduce damage or mortality to listed species.
- Vehicles will not enter or cross streams except in cases where no alternative exists. Where stream crossings are required, the number of crossings will be minimized. Vehicles and machinery will cross streams at right angles to the main channel whenever possible. The use of equipment in or adjacent to a stream channel will be minimized to reduce sedimentation rates and channel instability.
- Removal of native vegetation will be limited to the amount that is absolutely necessary to complete a construction activity.
- Slash materials will be gathered by hand or with light machinery to reduce soil disturbance and compaction. Avoid accumulating or spreading slash in upland draws, streams, and springs. Slash control and disposal activities must be conducted in a manner that reduces the occurrence of debris in aquatic habitats.
- Disturbed areas will be reseeded or planted with apropriate vegetation.

2.4.2. BMPs for Planting

- Vegetative planting techniques must not cause major disturbances to soils or slopes.
- Hand planting is the preferred technique for all plantings, except for filter strips.
- Planting will occur during the appropriate seasonal period for the respective plant species involved.
- Only native species will be used for CREP projects whenever feasible. Where use of native vegetation is not feasible, similar species which are functional equivalents and are known not to be aggressive colonizers may be substituted.
- All materials must be from an appropriate seed zone and certified as disease-free.
- Seeding to establish riparian buffers will use seed that is certified weed-free.

2.4.3. BMPs for Herbicide Applications

The following BMPs are in addition to the measures discussed under "Use Zones, Application Equipment, and Application Methods" for each specific herbicide in section 2.3.2. Additional BMPs may be required where certain listed species occur, as discussed in section 2.5. In areas where BMPs may conflict, the more restrictive BMP applies.

2.4.3.1. BMPs for all herbicide applications

- All herbicide label requirements will be followed.

- Herbicides will not be applied if precipitation is likely within 24 hours unless using soil-activated herbicides, which can be applied as long as label is followed.
- When consistent with label instructions, water will be used when diluting herbicides prior to application. When oil carriers are needed, only crop oils will be used. Use of diesel oil is prohibited.
- A spill cleanup kit will be available whenever herbicides are used, transported, or stored. The cleanup kit will include, at a minimum, the herbicide Material Safety Data Sheet, the herbicide label, emergency phone numbers, and absorbent material such as cat litter to contain the spill.
- Anyone that applies herbicides on a CREP project is required to provide FSA with a written herbicide application summary. The summary will indicate who applied the herbicide, what was applied, how it was applied, when it was applied, the location of the application on the project map, and the rate of application.
- All herbicide applications will be reported to the Oregon Department of Agriculture (PURS) as required by state law.
- When adjuvants are added to a herbicide formulation, Agri-dex and LI-700 will be the only adjuvants used within 200 feet of the high-water mark.

2.4.3.2. BMPs for herbicide applications along streams, lakes, and ponds

BMPs for Basal Bark herbicide applications from HWM to outer edge of project

- Dilute herbicide with a crop oil (vegetable oil). (Use of diesel oil is prohibited).
- Avoid unnecessary run off when applying herbicide to stems of undesirable vegetation.
- Apply using lowest nozzle pressure that will allow adequate stem coverage.
- Apply spray from the stream bank into the project area (applicator should have back to the stream).
- Do not apply during periods of rain, snow, or melting snow.

BMPs for spot spraying or patch spraying herbicide within 15 feet of HWM:

- If possible, spraying is to take place only during calm periods (no breeze), except when a temperature inversion exists. Temperature inversions may increase the likelihood of off-target drift. Read and follow all product label requirements related to temperature inversions.
- Spraying may take place IF there is a breeze of 6 mph or less AND the direction of the breeze is away from the creek or other sensitive resources.
- Allow post-application rain free period according to herbicide label requirements.
- Herbicide will be applied such that the spray is directed towards the project area away from the creek [person applying the spray will generally have their back to the creek or other sensitive resource.]
- Nozzles will be adjusted [to minimize fine particle size] such that spray does not drift off of the project site or away from the target vegetation.
- The spray nozzle will be kept within four feet of the ground when herbicide is being applied.
- To the extent possible, the spray will be directed away from all desirable vegetation.

BMPs for spot spraying or patch spraying herbicide from 15 feet to outer edge of project:

Same as requirements as "within 15 feet of HWM" except that herbicide can be applied with nozzle that is held up to six feet above the ground if needed to treat taller clumps of competing vegetation.

BMPs for ground broadcast spraying herbicide from 15 feet out from HWM to outer limit of project boundary.

- If possible, spraying is to take place only during calm periods (no breeze).
- Spraying may take place IF there is a breeze of 6 mph or less AND the breeze is blowing away from the creek or other sensitive resource.
- Allow post-application rain free period according to herbicide label requirements
- Spray will be applied in swaths parallel to the creek.
- Spray boom will be mounted such that nozzles are no more than four feet above the ground.
- Nozzles will be adjusted to minimize fine particle size such that spray does not drift off of project site.
- Nozzle pressure will be the adjusted to the lowest practical level (psi) while still providing for reasonable spray converge.
- Drift control agents will be used if necessary to prevent any spray from drifting off of the project site.

BMPs for Cut Surface application from HWM to outer edge of project boundary.

- Applications will be made in a manner that prevents herbicide runoff onto the ground.
- Do not apply herbicide during periods of rain, snow, or melting snow.

BMPs for Hack & Squirt / Injection application from HWM to outer edge of project boundary.

- Applications will be made in a manner that prevents herbicide runoff onto the ground.
- Do not apply during herbicide during periods of heavy rainfall.

BMPs for spot application of dry granule [Pronone].

Same as "BMPs for spot or patch spraying herbicide from 15 feet to outer edge of project" with the following exception:
Applications can be accomplished during a breeze of up to 10 mph IF the direction of the breeze is away from the creek or other sensitive resources.

2.4.4. BMPs for Chemical Effects

Please refer to section 2.4.3. for BMPs specifically related to herbicide use. Other chemicals that may be used on CREP projects are associated with mechanical equipment, vehicle or pump use. These chemicals include fuels and other fluids normally needed to operate farm equipment or other vehicles.

To minimize potential impacts from pollutants, the following BMPs will be used.

- Appropriate materials and supplies (e.g., shovels, disposal containers, absorbent materials, first aid supplies, and clean water) will be available on-site to cleanup any small accidental spills in accordance with product Material Safety Data Sheets and labels. Significant hazardous spills will be reported to the Oregon Emergency Response System at 1-800-452-

0311 (system available 24 hours a day). (Also see ODEQ emergency response web site at http://www.deq.state.or.us/wmc/cleanup/spl0.htm for more information.) The Oregon Poison Control Center will be contacted at 1-800-222-1222 (24 hours) for assistance in responding to emergency exposures. Project managers will ensure that each applicator is familiar with spill response procedures before commencing herbicide application operations.

- Locate staging and refueling areas at least 150 feet from any stream or other waterbody.
- Limit the size of staging and refueling areas and only store enough supplies, materials, and equipment onsite to complete the project.
- All equipment must be cleaned to remove external oil, grease, dirt, and mud before beginning operations below the high water mark of a stream.
- All equipment operated within 150 feet of an aquatic habitat must be inspected daily for fuel leaks before leaving the equipment staging area. All detected leaks must be repaired in the staging area before the equipment resumes operation.
- All stationary power equipment (e.g., generators) operated within 150 feet of any aquatic habitat must be diapered to prevent leaks and/or enclosed in a containment device (e.g., non permeable drip plan) of adequate capacity to retain equipment fluids (e.g., gasoline, diesel fuel, and oil) if a leak occurs.

2.4.5. BMPs for Fence Installation

- Where wildlife movement is a concern, maximum fence height is 42 inches.

2.4.6. BMPs for Riparian, Instream and Streambank Work

To prevent disturbances to fish and wildlife and their habitats from riparian, instream and streambank work, the following BMPs will be used.

- Whenever possible, livestock will be excluded from streams and riparian areas altogether.
- There will be no instream work except for installation of livestock crossings and installation of offstream livestock watering facilities.
- Oregon guidelines for the timing of in-water work will be followed for each affected stream reach, unless the ODFW approves an extension based on current year site-specific conditions. In reaches where the current ODFW timing restrictions for instream construction activities conflicts with the needs for resident listed fish, ODFW should be contacted for a waiver to the timing restrictions to avoid impacts to listed fish.
- Streambank shaping may be implemented where streambank stability is extremely poor or where necessary to restore riparian functions. Streambank modification for planting purposes will be thoroughly documented.
- On each CREP contract where more than 30 linear feet of streambank is shaped by mechanical equipment, USDA will consult with the Services (this consultation only covers projects that involve shaping of up to 30 linear feet of streambank).
- Bank shaping will be done from the top of bank.
- Design of all streambank modification projects will recognize the important wildlife values provided along naturally eroding outside meander curves.
- Any soil control structures will be bio-engineered to the extent possible.
- No riprap will be used under this program for streambank stabilization.

- No streambank stabilization activity will reduce natural stream functions or floodplain connection.
- Sedimentation and erosion controls will be implemented on all project sites where the implementation of restoration activities has the potential to deposit sediment into a stream or waterbody. Structures/techniques must be placed and/or anchored appropriately to prevent adverse impacts to down slope habitats. Control structures/techniques may include, but are not limited to, silt fences, straw bale structures, seeding by hand and hydro-seeding, jutte mats, and coconut logs. Grading and shaping will generally restore natural topography and hydrology.

2.4.7. BMPs for Mechanical Activities

To minimize potential impacts of mechanical activities on sensitive species and habitats, the BMPs below will be followed.

- The project boundary must be flagged to prevent soil disturbance to areas outside the site.
- Construction impacts will be confined to the minimum area necessary to complete the project.
- Filter strips will be left between disturbed areas and streams.
- To prevent the spread of noxious weeds and non-native plants, all vehicles and heavy construction equipment will be cleaned to remove mud, debris, and vegetation prior to entering the project area; all equipment must be cleaned to remove external oil, grease, dirt, and mud before beginning operations below the high water mark elevation of a stream.
- All equipment operated within 150 feet of an aquatic habitat must be inspected daily for fuel leaks before leaving the equipment staging area. All detected leaks must be repaired in the staging area before the equipment resumes operation.

(See BMPs for Chemical Effects in section 2.4.4 for additional measures that apply to mechanical activities.)

2.4.8. BMPs for Livestock Watering Facilities and Spring Developments

- Whenever possible, livestock will be excluded from streams and riparian areas altogether.
- Springs will always be fenced when spring developments are constructed to provide off-stream watering for livestock.
- Watering facilities will be equipped with float valves, and protection will be used around troughs and other watering sources as needed to prevent mud and sediment delivery to streams.
- Pumps must be screened to meet NOAA Fisheries' fish screen criteria, be self-cleaning or regularly maintained (by removing debris buildup), and a responsible party must be designated to ensure proper operation (i.e., regular inspection and as-needed maintenance to ensure pumps and screens are properly functioning). On CREP projects where listed suckers or Oregon chub may be affected, pumps may be installed under this BA if water delivery is under 0.5 cfs (minor volume diversions).
- All pumps must be sized to only use water amounts that fall within the allowances of the landowner's documented or estimated historic water use and legal water right(s).
- Water withdrawals for watering facilities or irrigation must not dewater habitats, or cause or exacerbate low stream flow conditions that could impact listed fish.

- Escape ramps will be installed on all livestock and wildlife watering facilities.
- Off-channel livestock watering facilities will not be located in areas where compaction and/or damage could occur to sensitive soils, slopes, or vegetation due to congregating livestock.
- Livestock stream crossings will only be constructed on the smallest streams, generally 10 feet or less in width at mean high water level. Crossings will not be placed on the mid- to downstream end of gravel point bars. Crossings will generally be 30 feet or less in width.
- Livestock stream crossings will be appropriately rocked to stabilize soils/slopes and prevent erosion. Fords will be placed on bedrock or stable substrates whenever possible.
- Crossings that involve culvert or bridge installation within habitat for listed fish under NOAA Fisheries' jurisdiction must meet the criteria outlined in the SLOPES BiOp. Crossings that involve culvert or bridge installation that are outside the terms and conditions of the SLOPES BiOp, or that are within habitat for fish species under the jurisdiction of the U.S. Fish and Wildlife Service require individual consultations.

2.5. Listed Species-Specific Best Management Practices

For projects that involve sites where listed species may be affected by CREP activities, the pertinent species-specific BMPs will be followed in addition to all other BMPs that may apply to the project activities or area. In areas where BMPs may conflict, the more restrictive BMP applies. Some of the BMPs below are repeated because they apply to more than one listed species category.

2.5.1. BMPs for Anadromous Fish

General BMPs for Anadromous Fish:

- Oregon guidelines for the timing of in-water work will be followed for each affected stream reach, unless the Oregon Department of Fish and Wildlife approves an extension based on current year site-specific conditions. In reaches where the ODFW in-water work period conflicts with the needs for resident listed fish, ODFW should be contacted for a waiver to the timing restrictions.
- Crossings that involve culvert or bridge installation within habitat for listed fish under NOAA Fisheries' jurisdiction must meet the criteria outlined in the SLOPES BiOp. Crossings that involve culvert or bridge installation that are outside the terms and conditions of the SLOPES BiOp, or that are within habitat for fish species under the jurisdiction of the U.S. Fish and Wildlife Service require individual consultations.
- Potential spawning habitat will be surveyed for listed species within 300 feet downstream of a proposed stream crossing. Stream crossings will not be constructed at known or suspected spawning areas, or within 300 feet upstream of such areas if spawning areas may be affected.
- Spring development projects will not occur from springs where listed species occur, and water will not be redirected from springs where listed species occur.
- On CREP projects where listed anadromous species, bull trout or Lahontan cutthroat trout may be affected, pumps must be screened to meet NOAA Fisheries' fish screen criteria, be self-cleaning or regularly maintained (by removing debris buildup), and a responsible party must be designated to ensure proper operation (i.e., regular inspection and as-needed maintenance to ensure pumps and screens are properly functioning).

- Water withdrawals for watering facilities or irrigation must not dewater habitats, or cause or exacerbate low stream flow conditions that could impact listed fish.

Herbicide-related BMPs for Anadromous Fish:
- See BMPs listed in section 2.4.3.

2.5.2. BMPs for Listed Inland Fish

The following BMPs will be used to avoid or minimize effects on listed inland fish.

General BMPs for Listed Inland Fish:
- Oregon guidelines for the timing of in-water work will be followed for each affected stream reach, unless the Oregon Department of Fish and Wildlife approves an extension based on current year site-specific conditions. In reaches where the ODFW in-water work period conflicts with the needs for resident listed fish, ODFW should be contacted for a waiver to the timing restrictions.
- Stream crossings involving culverts or bridges within habitat for listed fish under the jurisdiction of the U.S. Fish and Wildlife Service require individual Section 7 consultations.
- Potential spawning habitat will be surveyed for listed species within 300 feet downstream of a proposed stream crossing. Stream crossing will not be constructed at known or suspected spawning areas, or within 300 feet upstream of such areas if spawning areas may be affected.
- Spring development projects will not occur from springs where listed species occur, and water will not be redirected from habitat where listed species occur.
- On CREP projects where listed anadromous species, bull trout or Lahontan cutthroat trout may be affected, pumps must be screened to meet NOAA Fisheries' fish screen criteria, be self-cleaning or regularly maintained (by removing debris buildup), and a responsible party must be designated to ensure proper operation (i.e., regular inspection and as-needed maintenance to ensure pumps and screens are properly functioning).
- On CREP projects where listed suckers or Oregon chub may be affected, pumps may be installed under this BA if water delivery is under 0.5 cfs (minor volume diversions). Pumps must be screened to meet NOAA Fisheries' fish screen criteria, be self-cleaning or regularly maintained (by removing debris buildup), and a responsible party must be designated to ensure proper operation (i.e., regular inspection and as-needed maintenance to ensure pumps and screens are properly functioning).
- Water withdrawals for watering facilities or irrigation must not dewater habitats, or cause or exacerbate low stream flow conditions that could impact listed fish.
- CREP project sites with spring habitats that may support the Hutton tui chub or Foskett speckled dace within Lake County, Oregon will be surveyed for these species if the springs may be affected. An individual ESA Section 7 consultation should be initiated if needed. If springs will not be affected but there is potential for either of these species to occur on CREP project sites, the Oregon Department of Fish and Wildlife and/or U.S. Fish and Wildlife Service may be contacted to investigate the possibility that unknown populations exist if landowners are agreeable.

Herbicide-related BMPs for Listed Inland Fish:

Herbicide BMPs for Bull trout:

- The same herbicide-related BMPs that apply to anadromous fish. See section 2.4.3.

Herbicide BMPs for listed suckers, Oregon chub and Lahontan cutthroat trout

Shortnose, Lost River, Warner and Modoc suckers, Oregon chub and Lahontan cutthroat trout all have fairly limited distributions in Oregon, and all but the Warner sucker and Lahontan cutthroat trout are listed as endangered. To reduce the risk of potential adverse affects to these species and their proposed and designated critical habitats, the following added precautions will be taken when applying herbicides on or near habitats where they may occur:

- Herbicides used along streams and ponds is limited to the following chemicals, with the restrictions in parenthesis:
    - Aminopyralid
    - Clopyralid
    - Dicamba (beyond 25' of the HWM only at no more than the typical rate of 0.3 lbs/acre)
    - Glyphosate (at no more than the typical application rate of 2 lbs/acre)
    - Imazapic (beyond 50' of the HWM only)
    - Imazapyr (beyond 25' of the HWM only at no more than the typical rate of 0.45 lbs/acre)
    - Picloram (at no more than the typical application rate of 0.35 lbs/acre in areas with annual rainfall levels below 50" only)
- Only Aminopyralid may be used in ditches and intermittent channels, and only in segments of ditches and channels where listed species do not occur.
- Only Glyphosate may be used in perennial channel instream areas (i.e., dry areas within channel and emergent knotweed) using spray, wick or wipe application methods at a rate of no more than 0.5 lbs/acre or using the injection method in accordance with label requirements.
- Applicable application methods, use zones and BMPs described in sections 2.3.2. and 2.4.3. shall be followed; in the event that measures conflict, the more restrictive measure shall be followed.

These BMPs were developed based on the combined results of all of the related analyses for the various scenarios discussed in section 4.3.1. The specific herbicides, application rates, rainfall levels and distances from aquatic resources described in the BMPs are below threshold risk levels found in the analyses for fish as well as aquatic invertebrates, algae, and aquatic macrophytes, which are related to the primary constituent elements (PCEs) for designated and proposed critical habitats and food resources for listed fish.

2.5.3. BMPs for Columbian white-tailed deer

The following BMPs will be used to avoid or minimize effects on Columbian white-tailed deer.

General BMPs for Columbian white-tailed deer:

- On sites where deer occur, landowners will be encouraged to use manual and mechanical methods to control competition around newly planted trees to reduce the need for herbicides.

- Project personnel will be instructed to reduce vehicle speed around project sites where Columbian white-tailed deer occur to avoid vehicle-deer collisions. Care should be taken during times of limited visibility (e.g., sunset through sunrise) when driving in or near occupied Columbian white-tailed deer habitat. If deer are observed, vehicle speed should be reduced to account for the actions of the visible deer as well as the likelihood that other deer are nearby.
- Restoration activities that would create noise and activity above ambient levels will not occur in fawning areas from June 1 to July 15.
- On sites where deer occur, maximum fence height will be 42 inches.
- Project personnel will be instructed not to approach adults or fawns at any time.

Herbicide-related BMPs for Columbian white-tailed deer:
- On sites where listed Columbian white-tailed deer may occur, herbicide applications will be avoided or minimized to the extent practicable while still achieving project goals.
- When used, herbicides will be limited to the following:
    - Aminopyralid
    - Chlorsulfuron
    - Clopyralid (no higher than typical application rate of 0.35 lb/acre)
    - Glyphosate (no higher than typical application rate of 2 lbs/acre)
    - Hexazinone (Pronone, the granular form only)
    - Imazapic
    - Imazapyr
    - Metsulfuron methyl
    - Sethoxydim

This BMP is based on the analyses discussed in section 4.3.1.1. The herbicides and application rates listed above include only those that were found in the SERA assessments to be below both the acute and chronic NOAELs for large herbivorous mammals.

2.5.4. BMPs for Vernal Pool Fairy Shrimp

The following BMPs will be used to avoid or minimize effects on vernal pool fairy shrimp.

General BMPs for Vernal Pool Fairy Shrimp:
- CREP actions will not occur within vernal pools in counties where vernal pool fairy shrimp may occur.
- Activities such as fencing may occur on sites with vernal pool fairy shrimp as long as they do not disturb vernal pools.
- No activity shall be allowed that causes the excess movement of soils that could be deposited into the vernal pool.
- At no time will the vernal pools be used for either equipment parking or storage, or for preparatory staging for use at another location.
- For projects located in the vicinity of vernal pool habitat, restoration activities shall not disrupt the impermeable subsurface soil layer needed to maintain the vernal pool.
- Project personnel will avoid traveling either on-foot or by vehicle through the vernal pool.

Herbicide-related BMPs for Vernal Pool Fairy Shrimp:

- Herbicides will not be applied on project areas that may support the vernal pool fairy shrimp.

2.5.5. BMPs for Fender's blue butterfly

The following BMPs will be used to avoid or minimize effects on Fender's blue butterfly.

General BMPs for Fender's blue butterfly

- If possible, CREP sites with potential Fender's blue butterfly habitat will be surveyed for Fender's blue butterfly host plants (i.e., *Lupinus sulphureus spp. kincaidii, L. arbustus, L. albicaulis)* during the optimal survey period (May and June, or otherwise when in bloom between late April and July). If suitable lupine habitat is present, Fender's blue butterfly surveys will be conducted during the mid-May to early July flight period. Surveys will be conducted by a qualified biologist or individual trained to conduct surveys for this species, and may include observations for presence of the species and non-destructive egg or larvae counts. If it is not possible to conduct surveys or otherwise document that Fender's blue butterfly is absent from the site, it will be assumed that the site is occupied.
- Soil disturbing activities, such as disking, tillage and fence building, will not take place in locations that could cause physical harm to the Fender's blue butterfly or listed plants.
- With the exception of mowers used for mowing in accordance with the BMPs below, vehicles and machinery will not be driven where Fender's blue butterfly or listed plants could be impacted.
- Invasive plants may be removed using a variety of manual methods and hand tools, including hoeing, grubbing, pulling, clipping, digging or cutting. Tools that may be used include shovels, hoes, weed wrenches, lopping shears, trowels, machetes, weed wackers, hand saws and chain saws. Removal using these methods may occur year-round, as long as precautions are taken to prevent negative effects to listed species.
- Trees and shrubs will only be planted outside of habitats where the Fender's blue butterfly or listed prairie plants may occur, and outside of their critical habitats.
- CREP projects may include actions designed to benefit the butterfly, such as planting native nectar and host plants on sites that may support Fender's blue butterfly if food sources or host species are lacking and could be added to enhance habitat.
- If there are opportunities to support Fender's blue butterfly recovery efforts on CREP project sites where landowners may be interested, partners such as the U.S. Fish and Wildlife Service may be invited to provide additional technical and possible financial assistance.[2]

Mowing BMPs for Fender's Blue Butterfly Habitats

[2] The U.S. Fish and Wildlife Service is developing a programmatic consultation for Western Oregon prairie restoration activities that is designed to simplify the section 7 consultation process for their internal programs, as well as external restoration programs like the CREP that fund projects that could benefit listed prairie species on non-federal lands. CREP project proponents may be able to conduct activities outside the bounds of this consultation that are specifically aimed at prairie species recovery efforts by entering into a conservation agreement with the U.S. Fish and Wildlife Service. For more information, the Oregon Fish and Wildlife Office in Portland, Oregon should be contacted at (503) 231-1670.

- Mowing may be conducted throughout sites with Fender's blue butterflies when lupine and nectar plants have completed seed production, lupine have not yet re-emerged and the butterflies are in diapause (i.e. generally August 15 to February 28).
- Mowing at any time of year, including early spring mowing (i.e. March 1 to May 15), may be used for management purposes in unoccupied Fender's blue butterfly habitat; note that BMPs in section 2.5.6 for sites with Kincaid's lupine or other listed plants may be applicable.
- After the butterfly flight season but before lupine senescence (generally June 30 through August 15), tractor mowing may occur no closer than 2 meters (m) (6 feet) from the nearest lupine host plants.
- Mowing with hand-held mowers may be implemented during the Fender's blue butterfly flight season (generally May 1 to June 30), as long as a buffer of at least 8 m (25 feet) is maintained between the mower and any individual of a lupine host plant. Spring tractor mowing will not occur at sites with Fender's blue butterflies.
- Mowers will be rubber-tracked and the mowing deck will be set sufficiently high to avoid soil gouging (generally at least 15 centimeters) (6 inches) to reduce potential impacts to butterfly larvae and low-stature native plants.

Herbicide-related BMPs for Fender's Blue Butterfly

- Only the following herbicides may be applied on sites with Fender's blue butterfly: glyphosate, imazapyr, clopyralid, triclopyr BEE, and triclopypr TEA; no more than one type of herbicide will be used at a time (i.e., herbicides will not be mixed).
- On sites where Fender's blue butterfly may occur, herbicide spraying will only occur while larvae are in diapause (i.e., generally August 15 through February 28).
- Host plants (i.e., Kincaid's, sickle-keeled, and spur lupine) will be covered during spraying, even if they have senesced, to protect butterfly larvae that may be on the plant or on the ground in the immediate vicinity; plants will be uncovered immediately after spraying has been completed.

2.5.6. BMPs for Listed Plants

The following BMPs will be used to avoid or minimize effects on listed plants.

General BMPs for Listed Plants

- All CREP sites will be surveyed for any listed plants that may occur in the project area; surveys will be conducted by a botanist or otherwise qualified individual following a standardized or otherwise appropriate protocol during the known flowering period for the specific plant.
- Soil disturbing activities, such as disking, tillage and fence building, will not take place in locations that could cause physical harm to the Fender's blue butterfly or listed plants.
- With the exception of mowers used for mowing in accordance with the BMPs below, vehicles and machinery will not be driven where Fender's blue butterfly or listed plants could be impacted.
- Trees and shrubs will only be planted outside of habitats where the Fender's blue butterfly or listed prairie plants may occur, and outside of their critical habitats.

Mowing BMPs for Listed Plants

Project sites occupied by listed native prairie plants species in the Willamette Valley may be mowed to control or remove woody vegetation or invasive non-native vegetation, as follows:

- Mowing may occur when listed plants are dormant and seeds have been dispersed (generally August 15 through February 28).
- Spring mowing with tractor or hand-held mowers may occur where necessary to control overwhelming weed infestations, except at sites with Fender's blue butterflies. Spring mowing at sites with listed plants will maintain a buffer of 2 m (6 feet) from nearest listed plants. However, if needed to control serious infestations of weeds that mainly reproduce by seed (e.g., meadow knapweed [*Centaurea x pratensis*]), up to one half of the listed plant population at a site may be mowed in an effort to reduce seed set by non-native weeds.
- Rubber-tracked mowers vs. wheeled mowers will be encouraged whenever possible/practical and the mowing deck should be set sufficiently high to avoid soil gouging and impacting listed plants and butterfly larvae, but low enough to remove weed flowers (generally at least 15 centimeters [cm]) (6 inches).
- All mowing equipment will be cleaned of invasive and non-native plant materials before entering an occupied site to prevent the dispersal of unwanted seeds or other reproductive plant parts.

Herbicide-related BMPs for Listed Plants

Only the following herbicides will be applied on listed plant sites: glyphosate, imazapyr, clopyralid, triclopyr BEE, triclopypr TEA. We believe this subset of herbicides will provide effective control of weeds while minimizing impacts to sensitive plants. Application will occur in accordance with the BMPs below.

BMPs for Wick/Wipe herbicide applications from edge of listed plant site to outer edge of project

- Glyphosate and clopyralid may be hand-applied up to or within the plant patch to control competing vegetation.
- A 10-foot buffer will be maintained between the plant patch and the hand-application area for imazapyr, 2,4-D, and the triclopyrs to reduce the risk of herbicide movement through the soil and uptake by the roots of listed plants.

BMPs for Basal Bark herbicide applications from edge of listed plant site to outer edge of project

- Dilute herbicide with a crop oil (vegetable oil). (Use of diesel oil is prohibited).
- Avoid unnecessary run off when applying herbicide to stems of undesirable vegetation.
- Apply using lowest nozzle pressure that will allow adequate stem coverage.
- Applicator should apply facing away from plant site.
- Do not apply during periods of rain, snow, or melting snow.
- A 10-foot buffer will be maintained between the plant patch and the hand-application area for imazapyr, 2,4-D, and the triclopyrs to reduce the risk of herbicide movement through the soil and uptake by the roots of listed plants.
- Listed plants will be physically shielded (e.g., covered with buckets or some other barrier that will not harm the plants) as needed to protect them from drift, unless they are dormant; plants will be uncovered immediately after spraying has been completed.

BMPs for spot spraying or patch spraying herbicide from edge of listed plant site out 50 feet

- If possible, spraying is to take place only during calm periods (no breeze).
- Spraying may take place IF there is a breeze of 3 mph or less AND the direction of the breeze is away from the sensitive resource.
- Allow post-application rain free period according to herbicide label requirements.
- Herbicide will be applied such that the spray is directed towards the project area away from the sensitive resource [person applying the spray will generally have their back to the plant site or other sensitive resource.]
- Nozzles will be adjusted to minimize fine particle size such that spray does not drift off of the project site or away from the target vegetation.
- The spray nozzle will be kept within four feet of the ground when herbicide is being applied within 50 feet of listed plants; beyond 50 feet, the nozzle may be held up to six feet above ground if needed to treat taller clumps of competing vegetation.
- To the extent humanly possible, the spray will be directed away from all desirable vegetation.
- A 10-foot buffer will be maintained between the plant patch and the spray application area for imazapyr, 2,4-D and the triclopyrs to reduce the risk of herbicide movement through the soil and uptake by the roots of listed plants.
- Listed plants will be physically shielded (e.g., covered with buckets or some other barrier that will not harm the plants) as needed to protect them from drift, unless they are dormant; plants will be uncovered immediately after spraying has been completed.

BMPs for ground broadcast spraying herbicide

- Broadcast sprays will only occur at a distance from listed plants where the hazard quotient identified from SERA risk assessment worksheets is below 1. Specific application buffers are as follows: 900 feet for clopyralid and imazapyr; 300 feet for triclopyr acid and BEE, and 50 feet for glyphosate (buffers are also shown in Table 19).
- If possible, spraying is to take place only during calm periods (no breeze).
- Spraying may take place IF there is a breeze of 3 mph or less AND the breeze is blowing away from the sensitive resource.
- Allow post-application rain free period according to herbicide label requirements
- Spray boom will be mounted such that nozzles are no more than four feet above the ground.
- Nozzles will be adjusted to minimize fine particle size such that spray does not drift off of project site.
- Nozzle pressure will be the adjusted to the lowest practical level (psi) while still providing for reasonable spray converge.
- Drift control agents will be used if necessary to prevent any spray from drifting off of the project site.

BMPs for Cut Surface application from edge of listed plant site to outer edge of project

- Applications will be made in a manner that prevents herbicide runoff onto the ground.
- Do not apply herbicide during periods of rain, snow, or melting snow.

<u>BMPs for Hack & Squirt / Injection application from edge of listed plant site to outer edge of project</u>

- Applications will be made in a manner that prevents herbicide runoff onto the ground.
- Do not apply during herbicide during periods of heavy rainfall.

<u>BMPs for spot application of dry granule [Pronone]</u>

- A 10-foot buffer will be maintained between the plant patch and the application area to prevent exposure by listed plants.
- If possible, application is to take place only during calm periods (no breeze).

Applications may take place <u>IF</u> there is a breeze of 10 mph or less <u>AND</u> the direction of the breeze is away from the sensitive resource.

3. ENVIRONMENTAL BASELINE

3.1. Status of Endangered Species and Critical Habitat

The ESA protects plants somewhat differently than wildlife. For listed fish and wildlife species, the act prohibits "take," including harm or harassment of listed species. For plants, the act prohibits removal or damage to plants on federal lands, or violation of any state plant protection or trespass laws. The act also prohibits several actions against both plants and wildlife, including unauthorized import or export and possession. In addition, the act directs federal agencies to ensure that any agency-funded action is not likely to jeopardize the continued existence or adversely modify the habitat of any endangered or threatened species.

Listed species addressed in this Biological Assessment are described below. Where designated and available, critical habitat information and maps are provided (see maps in Appendix C). Because the Oregon CREP is implemented on agricultural lands statewide, most federally-listed species in Oregon are included in this consultation. Exceptions are the marine species and certain species that have been eliminated from the consultation for the reasons discussed in Appendix F.

3.1.1. Anadromous Fish

3.1.1.1. Snake River Sockeye Salmon (*Oncorhynchus nerka*)

The Snake River (SR) sockeye salmon was listed as endangered in 1991 (56 FR 58519) and NMFS reaffirmed its endangered status on June 28, 2005 (70 FR 37160). Critical habitat was designated for SR sockeye on December 28, 1993 (58 FR 68543). The following summary information is from 56 FR 58519.

Adult Migration and Spawning SR sockeye salmon enter the Columbia River primarily during June and July. Arrival at Redfish Lake, Idaho, which now supports the only remaining run of SR sockeye salmon, peaks in August and spawning occurs primarily in October. Eggs hatch in the spring between 80 and 140 days after spawning. Fry remain in the gravel for three to five weeks, emerge in April through May, and move immediately into the lake where juveniles feed on plankton for one to three years before migrating to the ocean. Migrants leave Redfish Lake from late April through May, and smolts migrate almost 900 miles to the Pacific Ocean.

Designated critical habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, Alturas Lake Creek, Valley Creek, and Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks).

Juvenile Outmigration/Smolts Passage at Lower Granite Dam (the first dam on the Snake River downstream from the Salmon River) ranges from late April to July, with peak passage from May to late June. Once in the ocean, the smolts remain inshore or within the Columbia River influence during the early summer months. Later, they migrate through the northeast Pacific Ocean. SR sockeye salmon usually spend two to three years in the Pacific Ocean and return in their fourth or fifth year of life. Historically, the largest numbers of SR sockeye salmon returned to headwaters of the Payette River, where 75,000 were taken one year by a single fishing operation in Big Payette Lake. During the early 1880s, returns of SR sockeye salmon to the headwaters of the Grande Ronde River in Oregon (Walleye Lake) were estimated between 24,000 and 30,000 at a minimum. During the 1950s and 1960s, adult returns to Redfish Lake numbered more than 4,000 fish.

SR sockeye salmon returns to Redfish Lake since at least 1985, when the Idaho Department of Fish and Game began operating a temporary weir below the lake, have been extremely small (one to 29 adults counted per year). SR sockeye salmon have a very limited distribution relative to critical spawning and rearing habitat. Redfish Lake represents only one of the five Stanley Basin lakes historically occupied by SR sockeye salmon and is designated as critical habitat for the species.

3.1.1.2. Chinook Salmon (*Oncorhynchus tshawytscha*)

The following summary of general life history and ecology is taken from 63 FR 11481.

Chinook salmon are easily distinguished from other *Oncorhynchus* species by their large size. Adults weighing over 120 pounds have been caught in North American waters. Chinook salmon are very similar to coho salmon in appearance while at sea (blue-green back with silver flanks), except for their large size, small black spots on both lobes of the tail, and black pigment along the base of the teeth.

Chinook salmon are anadromous and semelparous. This means that as adults, they migrate from a marine environment into the freshwater streams and rivers of their birth (anadromous) where they spawn and die (semelparous). Adult female Chinook will prepare a spawning bed, called a redd, in a stream area with suitable gravel composition, water depth and velocity. Redds will vary widely in size and in location within the stream or river. The adult female Chinook may deposit eggs in four to five “nesting pockets” within a single redd. After laying eggs in a redd, adult Chinook will guard the redd from four to 25 days before dying.

Chinook salmon eggs will hatch, depending upon water temperatures, between 90 to 150 days after deposition. Stream flow, gravel quality, and silt load all significantly influence the survival of developing Chinook salmon eggs. Juvenile Chinook may spend from three months to two years in freshwater after emergence and before migrating to estuarine areas as smolts, and then into the ocean to feed and mature.

Among Chinook salmon two distinct races have evolved. One race, described as a “stream-type” Chinook, is found most commonly in headwater streams. Steam-type Chinook salmon have a longer freshwater residency, and perform extensive offshore migrations before returning to their natal streams in the spring or summer months. The second race is called the “ocean-type” Chinook, which is commonly found in coastal steams in North America. Ocean-type Chinook typically migrate to sea within the first three months of emergence, but they may spend up to a year in freshwater prior to emigration. They also spend their ocean life in coastal waters. Ocean-type Chinook salmon return to their natal streams or rivers as spring, winter, fall, summer, and late-fall runs, but summer and fall runs predominate. The difference between these life history types is also physical, with both genetic and morphological foundations.

Juvenile steam- and ocean-type Chinook salmon have adapted to different ecological niches. Ocean-type Chinook salmon tend to utilize estuaries and coastal areas more extensively for juvenile rearing. The brackish water areas in estuaries also moderate physiological stress during parr-smolt transition. The development of the ocean-type life history strategy may have been a response to the limited carrying capacity of smaller stream systems and glacially scoured, unproductive, watersheds, or a means of avoiding the impact of seasonal floods in the lower portion of many watersheds.

Stream-type juveniles are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. A stream-type life history may be adapted to those watersheds, or parts of watersheds, that are more consistently productive and less susceptible to dramatic changes in water flow, or which have environmental conditions that would severely limit the success of subyearling smolts. At the time of saltwater entry, stream-type (yearling) smolts are much larger, averaging 73-134 mm depending on the river system, than their ocean-type (subyearling) counterparts and are, therefore, able to move offshore relatively quickly.

Coast wide, Chinook salmon remain at sea for one to six years (more common, two to four years), with the exception of a small proportion of yearling males, called jack salmon, which mature in freshwater or return after two or three months in salt water. Ocean- and steam-type Chinook salmon are recovered differentially in coastal and mid-ocean fisheries, indicating divergent migratory routes. Ocean-type Chinook salmon tend to migrate along the coast, while stream-type Chinook salmon are found far from the coast in the central North Pacific. Differences in the ocean distribution of specific stocks may be indicative of resource partitioning and may be important to the success of the species as a whole.

There is a significant genetic influence to the freshwater component of the returning adult migratory process. A number of studies show that Chinook salmon return to their natal streams with a high degree of fidelity. Salmon may have evolved this trait as a method of ensuring an adequate incubation and rearing habitat. It also provides a mechanism for reproductive isolation and local adaptation. Conversely, returning to a stream other than that of one’s origin is important in colonizing new areas and responding to unfavorable or perturbed conditions at the natal steam.

Chinook salmon stocks exhibit considerable variability in size and age of maturation, and at least some portion of this variation is genetically determined. The relationship between size and length of migration may also reflect the earlier timing of river entry and the cessation of feeding for Chinook salmon stocks that migrate to the upper reaches of river systems. Body size, which is correlated with age, may be an important factor in migration and redd construction success. Under high density conditions on the spawning ground, natural selection may produce stocks with exceptionally large-sized returning adults.

Early researchers recorded the existence of different temporal “runs” or modes in the migration of Chinook salmon from the ocean to freshwater. Freshwater entry and spawning timing are believed to be related to local temperature and water flow regimes. Seasonal "runs" (i.e., spring, summer, fall, or winter) have been identified on the basis of when adult Chinook salmon enter freshwater to begin their spawning migration. However, distinct runs also differ in the degree of maturation at the time of river entry, the thermal regime and flow characteristics of their spawning site, and their actual time of spawning. Egg deposition must occur at a time to ensure that fry emerge during the following spring when the river or estuary productivity is sufficient for juvenile survival and growth.

Pathogen resistance is another locally adapted trait. Chinook salmon from the Columbia River drainage were less susceptible to *Ceratomyxa shasta*, an endemic pathogen, then stocks from coastal rivers where the disease is not know to occur. Alaskan and Columbia River stocks of Chinook salmon exhibit different levels of susceptibility to the infectious hematopoietic necrosis virus (IHNV). Variability in temperature tolerance between populations is likely due to selection for local conditions; however, there is little information on the genetic basis of this trait.

Physical and chemical habitat characteristics for Chinook salmon, in general are as follows:

- Temperatures for optimal egg incubation are 5.0-14.4 ^{o}C.
- Upper lethal limit is 25.1 ^{o}C, but may be lower depending on other water quality factors.
- Dissolved oxygen for successful egg development in redds is Æ 5.0 mg/l, and water temperatures of 4-14 ^{o}C.
- Freshwater juveniles avoid water with œ 4.5 mg/l dissolved oxygen at 20 ^{o}C.
- Migrating adults will pass through water with dissolved oxygen levels as low as 3.5-4.0 mg/l. Excessive silt loads (>4,000 mg/l) may halt Chinook salmon movements or migrations. Silt can also hinder fry emergence, and limit benthic invertebrate production. Low pH decreases egg and alevin (larval stage dependent on yolk sac as food) survival.

<u>3.1.1.3. SR Fall-Run Chinook Salmon</u> (*Oncorhynchus tshawytscha*)

SR fall-run Chinook salmon was listed as threatened in 1992 (59 FR 66786), and NMFS reaffirmed its threatened status on June 28, 2005 (70 FR 37160). An Emergency Rule (59 FR 54840) proposing to reclassify SR Chinook from threatened to endangered was published in November 1994, but expired on May 1995. Critical habitat for the SR fall Chinook salmon was designated on December 28, 1993 (58 FR 68543). The following summary is taken from information in these Federal Register notices.

The designated critical habitat (63 FR 11515) includes all river reaches assessable to Chinook salmon in the Columbia River from The Dalles Dam upstream to the confluence with the Snake River in Washington (inclusive). Critical habitat in the Snake River includes its tributaries in Idaho, Oregon, and Washington (exclusive of the upper Grande Ronde River and the Wallowa River in Oregon, the Clearwater River above its confluence with Lolo Creek in Idaho, and the Salmon River upstream of its confluence with French Creek in Idaho). Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to The Dalles Dam. Excluded are areas above specific dams identified in Table 17 of the Federal Register Notice (see 63 FR 11519) or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years).

ESU Status Almost all historical SR fall-run Chinook salmon spawning habitat in the SR Basin was blocked by the Hells Canyon Dam complex; other habitat blockages have also occurred in Columbia River tributaries. The ESU's range has also been affected by agricultural water withdrawals, grazing, and vegetation management. The continued straying by non-native hatchery fish into natural production areas is an additional source of risk. Assessing extinction risk to the newly-configured ESU is difficult because of the geographic discontinuity and the disparity in the status of the two remaining populations. The relatively recent extirpation of fall-run Chinook in the John Day, Umatilla, and Walla Walla Rivers is also a factor in assessing the risk to the overall ESU. Long-term trends in abundance for specific tributary systems are mixed. NMFS concluded that the ESU as a whole is likely to become an endangered species within the foreseeable future.

See the third paragraph under SR spring/summer Chinook salmon for life history comparisons between fall and spring/summer Chinook salmon. Adult SR fall-run Chinook salmon enter the Columbia River in July and migrate into the Snake River from August through October. Fall Chinook salmon natural spawning is primarily limited to the Snake River below Hells Canyon Dam, and the lower reaches of the Clearwater, Grand Ronde, Imnaha, Salmon and Tucannon Rivers. Fall Chinook salmon generally spawn from October through November and fry emerge from March through April.

Downstream migration generally begins within several weeks of emergence with juveniles rearing in backwaters and shallow water areas through mid-summer prior to smolting and migration. Peak migration in the Brownlee-Oxbow Dam reach of the Snake River occurs from April through the middle of May. Juveniles will spend one to four years in the Pacific Ocean before beginning their spawning migration. Chinook salmon fry tend to linger in the lower Columbia River and may spend a considerable portion of their first year in the estuary. For detailed information on the SR fall-run Chinook salmon see 56 FR 29542.

Elevated water temperatures are thought to preclude returning of fall Chinook salmon in the Snake River after early to mid-July. The preferred temperature range for Chinook salmon has been variously described as 12.2-13.9 ^{o}C, 10-15.6 ^{o}C, or 13-18 ^{o}C.. Summer temperatures in the Snake River substantially exceed the upper limits of this range.

No reliable historic estimates of abundance are available for Snake River fall Chinook salmon. Estimated returns of Snake River fall Chinook salmon declined from 72,000 annually between 1938 and 1949, to 29,000 from 1950 through. Estimated returns of naturally produced adults form 1985 through 1993 range from 114 to 742 fish.

3.1.1.4. SR Spring/Summer Run Chinook Salmon (*Oncorhynchus tshawytscha*)

The SR spring/summer run Chinook salmon was listed as threatened in 1994 (59 FR 66786), and NMFS reaffirmed its threatened status on June 28, 2005 (70 FR 37160). Critical habitat was designated on October 25, 1999 (64 FR 57399). The following summary information is from this Federal Register notice.

ESU status This information is taken from 56 FR 29544. Historically, it is estimated that 44 percent of the combined Columbia River spring/summer Chinook salmon returning adults entered the Salmon River. Since the 1960s, counts at SR dams have declined considerably. SR redd counts in index areas provide the best indicator of trends and status of the wild spring/summer Chinook population. The abundance of wild SR spring/summer Chinook has declined more at the mouth of the Columbia River than the redd trends indicate. Although pre-1991 data suggest several thousand wild spring/summer Chinook salmon return to the SR each year, these fish are thinly spread over a large and complex river system.

In general, the habitats utilized for spawning and early juvenile rearing are different among the three Chinook salmon forms (spring, summer, and fall). In both the Columbia and Snake Rivers, spring Chinook salmon tend to use small, higher elevation streams (headwaters), and fall Chinook salmon tend to use large, lower elevation streams or mainstem areas. Summer Chinook are more variable in their spawning habitats; in the Snake river, they inhabit small, high elevation tributaries typical of spring Chinook salmon habitat, whereas in the upper Columbia River they spawn in the larger lower elevation streams characteristic of fall Chinook salmon habitat. Differences are also evident in juvenile out-migration behavior. In both rivers, spring Chinook salmon migrate swiftly to sea as yearling smolts, and fall Chinook salmon move seaward slowly as subyearlings. Summer Chinook salmon in the Snake River resemble spring-run fish in migrating as yearlings, but migrate as subyearlings in the upper Columbia River. Early researchers categorized the two behavioral types as "ocean-type" Chinook for seaward migrating subyearlings and as "stream-type" Chinook for the yearling migrants.

Life history information clearly indicates a strong affinity between summer- and fall-run fish in the upper Columbia River, and between spring- and summer-run fish in the Snake River. Genetic data support the hypothesis that these affinities correspond to ancestral relationships. The relationship between SR spring and summer Chinook salmon is more complex and is not discussed here.

The present range of spawning and rearing habitat for naturally-spawned SR spring/summer Chinook salmon is primarily limited to the Salmon, Grande Ronde, Imnaha, and Tucannon sub-basins. Most SR spring/summer Chinook salmon enter individual sub-basins from May through September. Juvenile SR spring/summer Chinook salmon emerge from spawning gravels from February through June. Typically, after rearing in their nursery streams for about one year, smolts begin migrating seaward in April through May. After reaching the mouth of the Columbia River, spring/summer Chinook salmon probably inhabit near shore areas before beginning their northeast Pacific Ocean migration, which lasts two to three years. For detailed information on the life history and stock status of SR spring/summer Chinook salmon, see 56 FR 29542.

The number of wild adult SR spring/summer Chinook salmon in the late 1800s was estimated to be more than 1.5 million fish annually. By the 1950s, the population had declined to an estimated 125,000 adults. Escapement estimates indicate that the population continued to decline through the 1970s. Redd count data also show that the populations continued to decline through about 1980.

The SR spring/summer Chinook salmon ESU, the distinct population segment listed under the Act , consists of 39 local spawning populations (sub-populations) spread over a large geographic area. The number of fish returning to a given subpopulation would, therefore, be much less than the total run size.

Based on recent trends in redd counts in major tributaries of the Snake River, many sub-populations could be at critically low levels. Sub-populations in the Grande Ronde River, Middle Fork Salmon River, and Upper Salmon River basins are at particularly high risk. Both demographic and genetic risks would be of concern for such sub-populations, and in some cases, habitat may be so sparsely populated that adults have difficulty finding mates.

<u>3.1.1.5. Upper Columbia River Spring-Run Chinook Salmon</u> (*Oncorhynchus tshawytscha*)

The Upper Columbia River (UCR) spring-run Chinook salmon was listed as endangered in March 1999 (64 FR 14308) and NMFS reaffirmed its endangered status on June 28, 2005 (70 FR 37160). Critical habitat was designated on September 2, 2005 (70 FR 52360). The following life history information is taken from 63 FR 11489.

NMFS listed several Chinook salmon ESUs under the Act in March 1999 (64 FR 14308). The UCR spring-run Chinook ESU is listed endangered. This ESU includes stream-type Chinook salmon spawning above Rock Island Dam - that is, those in the Wenatchee, Entiat, and Methow Rivers. All Chinook salmon in the Okanogan River are apparently ocean-type and are considered part of the UCR summer- and fall-run ESU.

This ESU was first identified as the Mid-Columbia River summer/fall Chinook salmon ESU but a later determinations concluded this ESU's boundaries do not extend downstream from the Snake River. The ESU status of the Marion Drain population from the Yakima River is still unresolved.

ESU status Access to a substantial portion of historical habitat was blocked by Chief Joseph and Grand Coulee Dams. There are local habitat problems related to irrigation diversions and hydroelectric development, as well as degraded riparian and instream habitat from urbanization and livestock grazing. Mainstem Columbia River hydroelectric development has resulted in a major disruption of migration corridors and affected flow regimes and estuarine habitat. Some populations in this ESU must migrate through nine mainstem dams.

Artificial propagation efforts have had a significant impact on spring-run populations in this ESU, either through hatchery-based enhancement or the extensive trapping and transportation. Harvest rates are low for this ESU, with very low ocean and moderate instream harvest. Previous assessments of stocks within this ESU have identified several as being at risk or of concern. Due to lack of information on Chinook salmon stocks that are presumed to be extinct, the relationship of these stocks to existing ESUs is uncertain. Recent total abundance of this ESU is quite low, and escapements in 1994-1996 were the lowest in at least 60 years. At least six populations of spring Chinook salmon in this ESU have become extinct, and almost all remaining naturally-spawning populations have fewer than 100 spawners. In addition to extremely small population sizes, both recent and long-term trends in abundance are downward, some extremely so. NMFS concluded that Chinook salmon in this ESU are in danger of extinction.

Chinook salmon from this ESU primarily emigrate to the ocean as subyearlings but mature at an older age than ocean-type Chinook salmon in the Lower Columbia and Snake Rivers. Furthermore, a greater proportion of tag recoveries for this ESU occur in the Alaskan coastal fishery than is the case for SR fish. The status review for SR fall Chinook salmon also identified genetic and environmental differences between the Columbia and Snake rivers. Substantial life history and genetic differences distinguish fish in this ESU from stream-type spring Chinook salmon from the upper-Columbia River.

The ESU boundaries fall within part of the Columbia Basin Ecoregion. The areas is generally dry and relies on Cascade Range snowmelt for peak spring flows. Historically, this ESU likely extended farther upstream; spawning habitat was compressed down-river following construction of Grand Coulee Dam.

3.1.1.6. Lower Columbia River Chinook Salmon, All Runs (*Oncorhynchus tshawytscha*)
In March 1999, NMFS listed this ESU in the Lower Columbia River (LCR) as threatened under the Act (64 FR 14308) and reaffirmed its threatened status on June 28, 2005 (70 FR 37160). Critical habitat was designated on September 2, 2005 (70 FR 52360). The following life history information is taken from 63 FR 11488.

The LCR spring-run Chinook ESU is listed as threatened. This ESU includes all naturally spawned Chinook populations from the mouth of the Columbia River to the crest of the Cascade Range, excluding populations above Willamette Falls.

ESU status Apart form the relatively large and apparently healthy fall-run population in the Lewis River, production in this ESU appears to be predominantly hatchery-driven with few identifiable naturally spawned populations. All basins are affected (to varying degrees) by habitat degradation. Hatchery programs have had a negative effect on the native ESU. Efforts to enhance Chinook salmon fisheries abundance in the lower Columbia River began in the 1870s. Available evidence indicates a pervasive influence of hatchery fish on natural populations throughout this ESU, including both spring- and fall-run populations. The large number of hatchery fish in this ESU make it difficult to determine the proportion of naturally produced fish. The loss of fitness and diversity within the ESU is an important concern.

Harvest rates on fall-run stocks are moderately high, with an average total exploitation rate of 65 percent. Harvest rates are somewhat lower for spring-run stocks, with estimates for the Lewis River totaling 50 percent. Previous assessments of stocks within this ESU have identified several stocks as being at risk or of concern. There have been at least six documented extinctions of populations in the ESU, and it is possible that extirpation of other native population has occurred but has been masked by the presence of naturally spawning hatchery fish. NMFS concludes that Chinook salmon in this ESU are not presently in danger of extinction but are likely to become endangered in the foreseeable future.

3.1.1.7. Upper Willamette River Spring-Run Chinook Salmon (*Oncorhynchus tshawytscha*)

The Upper Willamette River spring-run Chinook salmon was listed as threatened in March 1999 (64 FR 14308) and NMFS reaffirmed its threatened status on June 28, 2005. Critical habitat was designated on September 2, 2005 (70 FR 52630). The following life history information is taken from 63 FR 11489.

This ESU includes naturally spawned spring-run Chinook salmon populations above Willamette Falls. Fall Chinook above Willamette Falls are introduced and although they are naturally spawning, they are not considered a population for purposes of defining this ESU.

ESU status While the abundance of Willamette River spring Chinook salmon has been relatively stable over the long term, and there is evidence of some natural production, it is apparent that at present natural production and harvest levels the natural population is not replacing itself. With natural production accounting for only one-third of the natural spawning escapement, it is questionable whether natural spawners would be capable of replacing themselves even in the absence of fisheries. The introduction of fall-run Chinook into the basin and laddering of Willamette Falls have increased the potential for genetic introgression between wild spring- and hatchery fall-run Chinook. Habitat blockage and degradation are significant problems in this ESU. Another concern for this ESU is that commercial and recreational harvests are high relative to the apparent productivity of natural populations. Recent escapement is less than 5,000 fish and been declining sharply. NMFS concludes that Chinook salmon in this ESU are not presently in danger of extinction but are likely to become endangered in the foreseeable future.

Historic, naturally spawned populations in this ESU have an unusual life history that shares features of both the stream and ocean types. Scale analysis of returning fish indicate a predominantly yearling smolt life-history and maturity at four years of age, but these data are primarily from hatchery fish and may not accurately reflect patterns for the natural fish. Young-of-year smolts have been found to contribute to the returning three year-old year class. The ocean distribution is consistent with an ocean-type life history, and tag recoveries occur in considerable numbers in the Alaskan and British Columbian coastal fisheries. Intra-basin transfers have contributed to the homogenization of Willamette River spring Chinook stocks; however, Willamette River spring Chinook remain one of the most genetically distinctive groups of Chinook salmon in the Columbia River Basin.

The geography and ecology of the Willamette Valley is considerably different from surrounding areas. Historically, the Willamette Falls offered a narrow temporal window for upriver migration, which may have promoted isolation from other Columbia River stocks.

3.1.1.8. Southern Oregon / Northern California Coast Coho Salmon (*Oncorhynchus kisutch*)

The Southern Oregon / Northern California Coast (SONC) coho ESU was listed as threatened in 1997, and NMFS reaffirmed its threatened status on June 28, 2005 (70 FR 37160). Critical habitat was designated on May 5, 1999 (64 FR 24049). The following life history summary is taken from 62 FR 24588, and 62 FR 6274.

ESU status In the 1940s, estimated abundance of coho salmon in this ESU ranged from 150,000 to 400,000 naturally spawning fish. Today, coho populations in this ESU are very depressed, currently numbering approximately 10,000 naturally produced adults. Although the Oregon portion of the SONC coho ESU has declined drastically, the Rogue River Basin increased substantially from 1974-1997. The bulk of current coho salmon production in this ESU consists of stocks from the Rogue River, Klamath River, Trinity River, and Eel River in Oregon.

In contrast to the life history patterns of other anadromous salmonids, coho salmon exhibit a relatively simple three-year life cycle.

In migration and spawning Most SONC coho salmon enter rivers between September and February and spawn from November to January (occasionally into early spring). In migration is influenced by river flow, especially for many small California stream systems that have sandbars at their mouths for much of the year except winter.

Incubation and rearing Coho salmon eggs incubate for 35 to 50 days between November and March, and start emerging from the gravel two to three weeks after hatching. Following emergence, fry move into shallow areas near the stream banks. As the fry grow larger, they disperse up- and downstream to establish and defend a territory. During the summer, fry prefer pools and riffles with adequate cover. Juveniles over-winter in large mainstem pools, backwater areas, and secondary pools with large woody debris, and undercut bank areas. Juveniles primarily eat aquatic and terrestrial insects. After rearing in freshwater for up to 15 months, the smolts enter the ocean between March and June.

Estuary and ocean migration Although coho salmon have been captured several thousand kilometers away from their natal stream, this species usually remains closer to its river of origin than Chinook salmon. Coho typically spend two growing seasons in the ocean before returning to spawn as three year-olds; precocious males ("jacks") may return after only six months at sea.

Population trends In Oregon south of Cape Blanco, all but one coho salmon stock is considered to be at "high risk of extinction." South of Cape Blanco, all Oregon coho salmon stocks are considered "depressed."

Threats to naturally-reproducing coho salmon throughout its range are numerous and varied. Habitat factors include: Channel morphology changes, substrate changes, loss of in stream roughness, loss of estuarine habitat, loss of wetlands, loss/degradation of riparian areas, declines in water quality (e.g., elevated water temperatures, reduced dissolved oxygen, altered biological communities, toxics, elevated pH, and altered stream fertility), altered stream flows, fish passage impediments, elimination of habitat, and direct take. The major activities responsible for the decline of coho salmon in Oregon are logging, road building, grazing and mining activities, urbanization, stream channelization, dams, wetland loss, beaver trapping, water withdrawals, and unscreened diversions for irrigation.

Agricultural practices have also contributed to the degradation of salmonid habitat on the west coast through irrigation diversions, overgrazing in riparian areas, and compaction of soils in upland areas by livestock. Urbanization has degraded coho salmon habitat through steam channelization, floodplain drainage, and riparian damage. Forestry has degraded coho habitat through removal and disturbance of natural vegetation, disturbance and compaction of soils, construction of roads, and installation of culverts. Timber harvest activities and erosion from logging roads can result in sediment delivered to streams through mass wasting and surface erosion that can elevate the level of fine sediments in spawning gravels and fill the substrate interstices inhabited by invertebrates.

Depletion of storage of natural flows have drastically altered natural hydrological cycles. Alteration of stream flows has increased juvenile salmonid mortality for a variety of reasons: migration delay resulting from insufficient flows or habitat blockages; loss of usable habitat due to de-watering and blockage; stranding of fish resulting from rapid flow fluctuations; entrainment of juveniles into unscreened or poorly screened diversions; and increased juvenile mortality resulting from increased water temperatures. In addition, reduced flows degrade or diminish fish habitats through increased deposition of fine sediments in spawning gravels, decreased recruitment of new spawning gravels, and encroachment of riparian and nonendemic vegetation into spawning and rearing areas.

Other factors contributing to the decline of SONC coho include overutilization for commercial recreational, scientific, or education purposes. Harvest management practiced by the tribes is conservative and has resulted in limited impact on the coho stock in the Klamath and Trinity Rivers; overfishing in non-tribal fisheries is believed to have been a significant factor in the decline of coho salmon. Marked hatchery coho are allowed to be harvested in the Rogue River. All other recreational coho salmon fisheries in the Oregon portion of this ESU are closed. Collection for scientific research and educational programs is believed to have had little or no impact on coho populations in the ESU.

Relative to other effects, disease and predation are not believed to be major factors contributing to the overall decline of coho salmon in this ESU. However, disease and predation may have substantial impacts in local areas.

<u>3.1.1.9. LCR Coho</u> (Oncorhynchus kisutch)

The Lower Columbia River (LCR) Coho salmon ESU is federally listed as threatened (70 FR 37160). This ESU includes the Columbia River and its tributaries from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers. Critical habitat has not been designated for this ESU. The following life history summary is from 70 FR 37160.

ESU status The status of the LCR coho ESU has experienced declines in abundance and productivity, reduced distribution, and threats to its genetic diversity. The ESU abundance exceeded 1 million fish in the early 1900s, while today it numbers between 2,000-5,000 naturally spawning fish. Over 90% of the historic populations in the ESU appear to be either extirpated or nearly so. Only two populations with any significant production remain, and these exhibit low abundance and declining trends.

There is, and historically has been, significant production of hatchery fish in this ESU. Hatchery production is suspected of causing changes in population structure and diversity, and loss of genetic diversity within the ESU. Nonetheless, the abundant hatchery populations in the ESU represent a substantial portion of the remaining genetic resources within the ESU.

In addition to effects from hatchery production, factors for decline of this ESU include significant sport and commercial harvests, with harvest rates between 80-90% in the 1950s-1980s. Harvest rates were reduced significantly in the 1990s, and in recent years are around 40%. Additionally, freshwater coho salmon habitat in the LCR, like most other West Coast river basins, has been altered significantly. Logging, agriculture, urbanization, modifications to the river and estuary associated with Columbia River navigation, dams for hydropower and flood control, and pollution have contributed to the ESU's decline. Unfavorable ocean/climate conditions, severe storms, and volcanic eruptions have also adversely affected the abundance and productivity of populations within the ESU.

Spawn timing Adults typically begin their freshwater spawning migration in the fall, spawn by mid winter, then die.

Spawning habitat and temperature Although each native stock appears to have a unique time and temperature for spawning that theoretically maximizes offspring survival, coho salmon generally spawn at water temperatures within the range of 10-12.8 ^{o}C. Predominant spawning streams are low gradient fourth- and fifth-order, with clean gravel of pea to orange size.

Hatching and emergence The favorable range for coho salmon egg incubation is 10-12.8 ^{o}C. Depending on water temperature, eggs incubate for 35 to 50 days and start emerging from the gravel two to three weeks after hatching.

Parr movement and smoltification Following emergence, fry move into shallow areas near the stream banks. Their territory seems to be related not only to slack water, but to objects which provide points of reference to which the fry can return. Juvenile rearing usually occurs in low gradient tributary streams, although they may move up to streams of 4 or 5 percent gradient. Juveniles have been found in streams as small as one to two meters wide. When the fry are approximately 4 cm in length, they migrate upstream considerable distances to reach lakes or other rearing areas. Rearing requires temperatures of 20 ^{o}C or less, preferably 11.7-14.4 ^{o}C. Coho salmon fry prefer backwater pools during spring. In the summer, juveniles are more abundant in pools than in glides or riffles. During winter, the fishes predominate in off-channel pools of any type. The ideal food channel for maximum coho smolt production is shallow, fairly swift mid-stream flows with numerous back-eddies, narrow width, copious overhanging mixed vegetation (for stream temperature control and insect habitat), and banks permitting hiding places. Rearing in freshwater may be up to 15 months followed by moving to the sea as smolts between February and June.

Estuary and ocean migration Little is known about residence time or habitat use in estuaries during seaward migration, although the assumption is that coho salmon spend only a short time in the estuary before entering the ocean. Growth is very rapid once the smolts reach the estuary. While living in the ocean, coho salmon remain closer to their river of origin than do Chinook salmon. After about 12 months at sea, coho salmon gradually migrate south and along the coast, but some appear to follow a counter-clockwise circuit in the Gulf of Alaska. Coho typically spend two growing seasons in the ocean before returning to their natal streams to spawn as three year-olds. Some precocious males ("jacks") return to spawn after only six months at sea.

Food The early diets of emerging fry include chironomid larvae and pupae. Juveniles are carnivorous opportunists, eating insects. These fish do not appear to pick stationary items off the substratum.

<u>3.1.1.10 Columbia River Chum Salmon</u> (*Oncorhynchus keta*)

The Columbia River chum salmon ESU is listed as threatened in 1999 (64 FR 14508), and NMFS reaffirmed its threatened status on June 28, 2005. Critical habitat was designated on September 2, 2005. The following life history information is taken from 63 FR 11773.

ESU status The Columbia River chum salmon ESU spawn in tributaries to the lower Columbia River in Washington and Oregon. Life history information specific to the this ESU is not available. The chum salmon or dog salmon is the third most abundant salmon species in the Pacific Northwest. Spawning for chum salmon adults may take place just at the head of tide waters similar to pink salmon (*O. gorbuscha*), however unlike pinks, chum also migrate upriver to spawn. Spawning occurs from October through December. Most adult females construct their redds near saltwater and are territorially aggressive; therefore, females may "miss out" on male spawners. Because of the location of most redds in lower rivers, an embryo mortality of 70 - 90 percent is possible due to siltation and decreased dissolved oxygen transfer. Chum salmon benefit from high quality habitat conditions in lower rivers and estuaries.

After emergence, fry do not rear in freshwater. Chum salmon fry migrate immediately, at night, to the estuary for rearing. Out-migration is March through June. Juveniles remain near the seashore during July and August. Juveniles spend from just half a year to four years at sea.

<u>3.1.1.11. Steelhead</u> (*Oncorhynchus mykiss* ssp.)

The following summary of steelhead life history and ecology is taken from 50 CFR 222, 227, and 63 FR 11797.

Steelhead exhibit one of the most complex life histories of any salmonid species. Steelhead may exhibit anadromy or freshwater residency. Resident forms are usually referred to as “rainbow” or “redband” trout, while anadromous life forms are termed “steelhead”.

Steelhead typically migrate to marine waters after spending two years in freshwater. They then reside in marine waters for two to three years prior to returning to their natal stream to spawn as 4- or 5- year-olds. Depending on water temperature, steelhead eggs may incubate in redds for one and one half to four months before hatching as alevins. Following yolk sac absorption, alevins emerge from the gravel as young juveniles (fry) and begin actively feeding. Juveniles rear in freshwater from one to four years, then migrate to the ocean as smolts.

Biologically, steelhead can be divided into two reproductive ecotypes, based on their state of sexual maturity at the time of river entry and the duration of their spawning migration. These two ecotypes are termed “stream maturing” and “ocean maturing”. Stream maturing steelhead return to freshwater in a sexually immature condition and require several months to mature and spawn. Ocean maturing steelhead enter freshwater with well-developed gonads and spawn shortly after river entry. These two reproductive ecotypes are more commonly referred to by their season of freshwater entry as either summer or winter steelhead.

Two major genetic groups or “subspecies” of steelhead occur on the west coast of the United States: a coastal group and an inland group, separated on the Fraser and Columbia River Basins by the Cascade crest. Historically, steelhead likely inhabited most coastal streams in Washington, Oregon, and California, as well as many inland streams in these states and Idaho. However, during this century, over 23 indigenous, naturally-reproducing stocks of steelhead are believed to have been extirpated, and many more are thought to be in decline in numerous coastal and inland streams.

Factors contributing to the decline of specific steelhead ESUs are discussed under each ESU. General information for west coast steelhead is summarized here. Forestry, agriculture, mining, and urbanization have degraded, simplified, and fragmented habitat. Water diversions for agriculture, flood control, domestic, and hydropower purposes have greatly reduced or eliminated historically accessible habitat. Washington and Oregon’s wetlands are estimated to have diminished by one-third. Loss of habitat complexity as seen in the decrease of abundance of large, deep pools due to sedimentation and loss of pool-forming structures has also adversely affected west coast steelhead.

Steelhead are not generally targeted in commercial fisheries but do support an important recreational fishery throughout their range. A particular problem occurs in the main stem of the Columbia River where listed steelhead from the Middle Columbia River ESU are subject to the same fisheries as unlisted, hatchery-produced steelhead, Chinook and coho salmon. Infectious disease and predation also take their toll on steelhead. Introductions of non-native species and habitat modifications have resulted in increased predator populations in numerous river systems. Federal and state land management practices have not been effective in stemming the decline in west coast steelhead.

3.1.1.12. SR Basin Steelhead (*Oncorhynchus mykiss* ssp.)

This inland steelhead ESU occupies the Snake River (SR) Basin of southeast Washington, northeast Oregon and Idaho. A final listing status of threatened was issued in August 1997 (62 FR 43937) for the spawning range upstream from the confluence with the Columbia River, and NMFS reaffirmed its threatened status on January 5, 2005 (71 FR 834). Critical habitat was designated on September 2, 2005 (70 FR 52630). The following information is taken from 50 CFR 222, 227, and 62 FR 43937.

The Snake River flows through terrain that is warmer and drier on an annual basis than the upper Columbia Basin or other drainages to the north. Geologically, the land forms are older and much more eroded than most other steelhead habitat. Collectively, the environmental factors of the

Snake River Basin result in a river that is warmer and more turbid, with higher pH and alkalinity, than is found elsewhere in the range of inland steelhead.

ESU status SR Basin steelhead all defined as "B-run" steelhead. Prior to Ice Harbor Dam completion in 1962, there were no counts of Snake River basin naturally spawned steelhead. From 1949 to 1971 counts averaged about 40,000 steelhead for the Clearwater River. At Ice Harbor Dam, counts averaged approximately 70,000 until 1970. The natural component for steelhead escapements above Lower Granite Dam was about 9400 (2400 B-run) from 1990-1994. SR Basin steelhead recently suffered severe declines in abundance relative to historical levels. Low run sizes over the last 10 years are most pronounced for naturally produced steelhead. The drop in parr densities characterizes many river basins in this region as being underseeded relative to the carrying capacity of streams. Declines in abundance have been particularly serious for B-run steelhead, increasing the risk that some of the life history diversity may be lost from steelhead in this ESU.

Interactions between hatchery and natural SR Basin steelhead are of concern because many of the hatcheries use composite stocks that have been domesticated over a long period of time. The primary indicator of risk to the ESU is declining abundance throughout the region.

SR Basin steelhead are summer steelhead, as are most inland steelhead, and comprise two groups, A-run and B-run, based on migration timing, ocean-age, and adult size. SR Basin steelhead enter freshwater from June to October and spawn in the following spring from March to May. A-run steelhead are thought to be predominately 1-ocean (one year at sea), while B-run steelhead are thought to be 2-ocean. SR Basin steelhead usually smolt at age 2- or 3-years.

The steelhead population from Dworshak National Fish Hatchery is the most divergent single population of inland steelhead based on genetic traits determined by protein electrophoresis; these fish are consistently referred to as B-run.

Similar factors to those affecting other salmonids are contributing to the decline of SRB steelhead. Widespread habitat blockage from hydrosystem management and potentially deleterious genetic effects from straying and introgression from hatchery fish. The reduction in habitat capacity resulting from large dams such as the Hells Canyon dam complex and Dworshak Dam is somewhat mitigated by several river basins with fairly good production of natural steelhead runs.

3.1.1.13. UCR Basin Steelhead (*Oncorhynchus mykiss* ssp.)

This inland steelhead ESU occupies the Columbia River Basin upstream from the Yakima River, Washington, to the U.S./Canada border. The geographic area occupied by the ESU forms part of the larger Columbia Basin Ecoregion. The UCR Basin steelhead ESU was listed as endangered in August 1997 (62 FR 43937) and NMFS downlisted it to threatened on January 5, 2006 (71 FR 834). Critical habitat was designated on September 2, 2005 (70 FR 52630). The following life history information is taken from 50 CFR 222, 227 and 62 FR 43937.

ESU status NMFS cites a pre-fishery run size estimate in excess of 5000 adults for tributaries above Rock Island Dam. Runs may have already been depressed by lower Columbia River fisheries at the time of the early estimates (1933-1959). Most of the escapement to naturally spawning habitat within the range of this ESU is to the Wenatchee, Methow and Okanogan Rivers. The Entiat River also has a small spawning run. Steelhead in the UCR ESU continue to exhibit low abundances, both in absolute numbers and in relation to numbers of hatchery fish throughout the region. Estimates of natural production of steelhead in the ESU are will below replacement (approximately 0.3:1 adult replacement ratios estimated in the Wenatchee and Entiat Rivers). The proportion of hatchery fish is high in these rivers (65-80 percent) with extensive mixing of hatchery and natural stocks.

Life history characteristics for UCR Basin steelhead are similar to those of other inland steelhead ESUs. However, some of the oldest smolt ages for steelhead, up to 7 years, are reported from this ESU; this may be associated with the cold stream temperatures. Based on limited data available from adult fish, smolt age in this ESU is dominated by 2-year-olds. Steelhead from the Wenatchee and Entiat Rivers return to freshwater after one year in salt water, whereas Methow River steelhead are primarily 2-ocean resident (i.e., two years in salt water).

In an effort to preserve fish runs affected by Grand Coulee Dam, which blocked fish passage in 1939, all anadromous fish migrating upstream were trapped at Rock Island Dam (river km 729) from 1939 through 1943 and either released to spawn in tributaries between Rock Island and Grand Coulee Dams or spawned in hatcheries and the offspring released in that area. Through this process, stocks of all anadromous salmonids, including steelhead, which historically were native to several separate sub-basins above Rock Island Dam, were randomly redistributed among tributaries in the Rock Island-Grand Coulee reach. Exactly how this has affected stock composition of steelhead is unknown.

Habitat degradation, juvenile and adult mortality in the hydrosystem, and unfavorable environmental conditions in both marine and freshwater habitats have contributed to the declines and represent risk factors for the future. Harvest in lower river fisheries and genetic homogenization from composite broodstock collection are other factors that may contribute significant risk to the UCR Basin ESU.

3.1.1.14. Middle Columbia River Steelhead (*Oncorhynchus mykiss* ssp.)

After a comprehensive status review of West Coast steelhead populations in Washington and Oregon, NMFS identified 15 ESUs. In March 1999, the Middle Columbia River (MCR) steelhead ESU was listed as threatened (64 FR 14517), and NMFS reaffirmed its threatened status on January 5, 2006 (71 FR 834). The middle Columbia area includes tributaries from above (and excluding) the Wind River in Washington and the Hood River in Oregon, upstream to, and including the Yakima River, in Washington. Steelhead of the SR Basin are excluded. Critical habitat was designated on September 2, 2005 (70 FR 52630). The following life history information is taken from 63 FR 11797.

ESU status Current population sizes are substantially lower than historic levels, especially in the rivers with the largest steelhead runs in the ESU: the John Day, Deschutes, and Yakima Rivers. At least two extinctions of native steelhead runs in the ESU have occurred (the Crooked and

Metolius Rivers, both in the Deschutes River Basin). In addition, NMFS remains concerned about the widespread long- and short-term downward trends in population abundance throughout the ESU.

Genetic differences between inland and coastal steelhead are well established, although some uncertainty remains about the exact geographic boundaries of the two forms in the Columbia River (63 FR 11801). All steelhead in the Columbia River Basin upstream from The Dalles Dam are summer-run, inland steelhead. Life history information for steelhead of this ESU indicates that most MCR steelhead smolt at two years and spend one to two years in salt water (i.e., 1-ocean and 2-ocean fish, respectively) prior to re-entering freshwater, where they may remain up to a year before spawning. Within this ESU, the Klickitat River is unusual in that it produces both summer and winter steelhead, and the summer steelhead are dominated by 2-ocean steelhead, whereas most other rivers in this region produce about equal number of both 1- and 2-ocean steelhead.

The recent and dramatic increase in the percentage of hatchery fish in natural escapement in the Deschutes River Basin is a significant risk to natural steelhead in this ESU. Coincident with this increase in the percentage of strays has been a decline in the abundance of native steelhead in the Deschutes River.

3.1.1.15. LCR Steelhead (*Oncorhynchus mykiss* ssp.)

This coastal steelhead ESU occupies tributaries to the Columbia River between the Cowlitz and Wind Rivers in Washington and the Willamette and Hood Rivers in Oregon. Excluded are steelhead in the upper Willamette River Basin above Willamette Falls, and steelhead from the Little and Big White Salmon Rivers in Washington. The LCR steelhead ESU was listed as threatened in 1998 (63 FR 13347), and NMFS reaffirmed its threatened status on January 5, 2006 (71 FR 834). Critical habitat was designated on September 2, 2005 (70 FR 52630). The following life history information is taken from 50 CFR 222, 227, 63 FR 13347 and 63 FR 32996.

The lower Columbia River has extensive intertidal mud and sand flats and differs substantially from estuaries to the north and south. Rivers draining into the Columbia River have their headwaters in increasingly drier areas, moving from west to east. Columbia River tributaries that drain the Cascade mountains have proportionally higher flows in late summer and early fall than rivers on the Oregon coast.

ESU status Steelhead populations are at low abundance relative to historical levels, placing this ESU at risk due to random fluctuations in genetic and demographic parameters that are characteristic of small populations. There have been almost universal, and in many cases dramatic, declines in steelhead abundance since the mid-1980s in both winter- and summer-runs. Genetic mixing with hatchery stocks have greatly diluted the integrity of native steelhead in the ESU. NMFS is unable to identify any natural populations of steelhead in the ESU that could be considered “healthy”.

Steelhead populations in this ESU are of the coastal genetic group, and a number of genetic studies have shown that they are part of a different ancestral lineage than inland steelhead from the Columbia River Basin. Genetic data also show steelhead in this ESU to be distinct from steelhead in the upper Willamette River and coastal streams in Oregon and Washington. Washington Department of Fish and Wildlife data show genetic affinity between the Kalama, Wind, and Washougal River steelhead. These data show differentiation between the LCR ESU and the Southwest Washington and Middle Columbia River Basin ESUs. The Lower Columbia ESU is composed of winter steelhead and summer steelhead.

Habitat loss, hatchery steelhead introgression, and harvest are major contributors to the decline the steelhead in this ESU. Details on factors contributing to the decline of west coast steelhead are discussed above.

3.1.1.16. Upper Willamette River Steelhead (*Oncorhynchus mykiss* ssp.)

In March 1999, the Upper Willamette River (UWR) steelhead ESU was listed as threatened (64 FR 14517) and NMFS reaffirmed its threatened status on January 5, 2006 (71 FR 834). Critical habitat was designated on September 2, 2005 (70 FR 52630). The following life history information is taken from 63 FR 11797.

This coastal ESU occupies the Willamette River and its tributaries, upstream from Willamette Falls. The Willamette River Basin is zoogeographically complex. In addition to its connection to the Columbia River, the Willamette River historically has had connections with coastal basins through stream capture and headwater transfer events.

Steelhead from the upper Willamette River are genetically distinct from those in the lower river. Reproductive isolation from lower river populations may have been facilitated by Willamette Falls, which is known to be a migration barrier to some anadromous salmonids. For example, winter steelhead and spring Chinook salmon occurred historically above the falls, but summer steelhead, fall Chinook salmon, and coho salmon did not.

ESU status Steelhead in the Upper Willamette ESU are distributed in a few, relatively small, natural populations. Over the past several decades, total abundance of natural late-migrating winter steelhead ascending the Willamette Falls fish ladder has fluctuated several times over a range of approximately 5,000-20,000 spawners. However, the last peak occurred in 1988, and this peak has been followed by a steep and continuing decline. Abundance in each of the last five years (to 1998) has been below 4,300 fish, and the run in 1995 was the lowest in 30 years. The low abundance, coupled with potential risks associated with interactions between naturally spawned steelhead and hatchery stocks is of great concern to NMFS.

The native steelhead of this basin are late-migrating winter steelhead, entering freshwater primarily in March and April, whereas most other populations of west coast winter steelhead enter freshwater beginning in November or December. As early as 1885, fish ladders were constructed at Willamette Falls to aid the passage of anadromous fish. As technology improved, the ladders were modified and rebuilt, most recently in 1971. These fishways facilitated successful introduction of Skamania stock summer steelhead and early-migrating Big Creek stock winter steelhead to the upper basin. Another effort to expand the steelhead production in the upper Willamette River was the stocking of native steelhead in tributaries not historically used by that species. Native steelhead primarily used tributaries on the east side of the basin, with cutthroat trout predominating in streams draining the west side of the basin.

Nonanadromous steelhead are known to occupy the UWR Basin; however, most of these nonanadromous populations occur above natural and man-made barriers. Historically, spawning by UWR steelhead was concentrated in the North and Middle Santiam River Basins. These areas are now largely blocked to fish passage by dams, and steelhead spawning is distributed throughout more of the UWR Basin than in the past. Due to introductions of non-native steelhead stocks and transplantation of native stocks within UWR steelhead, and their relationship to nonanadromous and possibly residualized steelhead within the basin.

3.1.2. Inland Fish

In this biological assessment, the term "Inland Fish" refers to those fish that are primarily freshwater species. These species are under the ESA jurisdiction of the U.S. Fish and Wildlife Service.

<u>3.1.2.1. Bull Trout</u> (*Salvelinus confluentus*)

Bull trout in the Columbia River and Klamath Basins were listed as threatened in 1998 (63 FR 31674); critical habitat was designated in 2006 (69 FR 59996).

Juvenile bull trout average 50-70 mm (2-3 in) in length at age 1, 100-120 mm (4-5 in) at age 2, and 150-170 mm (6-7 in) at age 3 (Pratt 1992). Juveniles have a slender body form and exhibit the small scalation typical of char. The back and upper sides are typically olive-green to brown with a white to dusky underside. The dorsal surface and sides are marked with faint pink spots. They lack the worm-like vermiculations and reddish fins commonly seen on brook trout (*Salvelinus fontinalis*). Spawning bull trout, especially males, turn bright red on the ventral surface with a dark olive-brown back and black markings on the head and jaw. The spots become a more vivid orange-red and the pectoral, pelvic, and anal fins are red-black with a white leading edge. The males develop a pronounced hook on the lower jaw. Bull trout have an obvious "notch" on the end of the nose above the tip of the lower jaw.

Bull trout populations are known to exhibit four distinct life history forms: resident, fluvial, adfluvial, and anadromous. Resident bull trout spend their entire life cycle in the same (or nearby) streams in which they were hatched. Fluvial and adfluvial populations spawn in tributary streams where the young rear from one to four years before migrating to either a lake (adfluvial) or a river (fluvial) where they grow to maturity (Fraley and Shepard 1989). Anadromous bull trout spawn in tributary streams, with major growth and maturation occurring in the ocean.

The historic range of the bull trout spanned seven states (Alaska, Montana, Idaho, Washington, Oregon, Nevada, and California) and two Canadian Provinces (British Columbia and Alberta) along the Rocky Mountain and Cascade Mountain ranges (Cavender 1978). In the United States, bull trout occur in rivers and tributaries throughout the Columbia Basin in Montana, Idaho, Washington, Oregon, and Nevada, as well as the Klamath Basin in Oregon, and several cross-boundary drainages in extreme southeast Alaska. In California, bull trout were historically found in only the McCloud River, which represented the southernmost extension of the species' range. Bull trout numbers steadily declined after completion of McCloud and Shasta Dams (Rode 1990). The last confirmed report of a bull trout in the McCloud River was in 1975, and the original population is now considered to be extirpated (Rode 1990).

Bull trout distribution has been reduced by an estimated 40 to 60 percent since pre-settlement times, due primarily to local extirpations, habitat degradation, and isolating factors. The remaining distribution of bull trout is highly fragmented. Resident bull trout presently exist as isolated remnant populations in the headwaters of rivers that once supported larger, more fecund migratory forms. These remnant populations have a low likelihood of persistence (Reiman and McIntyre 1993). Many populations and life history forms of bull trout have been extirpated entirely.

Highly migratory, fluvial populations have been eliminated from the largest, most productive river systems across the range. Stream habitat alterations restricting or eliminating bull trout include obstructions to migration, degradation of water quality, especially increasing temperatures and increased amounts of fine sediments, alteration of natural stream flow patterns, and structural modification of stream habitat (such as channelization or removal of cover).

In Oregon, bull trout were historically found in the Willamette River and major tributaries on the west side of the Oregon Cascades, the Columbia and Snake Rivers and major tributaries east of the Cascades, and in streams of the Klamath basin (Goetz 1989). Currently, most bull trout populations are confined to headwater areas of tributaries to the Columbia, Snake, and Klamath rivers (Ratliff and Howell 1992). Major tributary basins containing bull trout populations include the Willamette, Hood, Deschutes, John Day, and Umatilla (Columbia River tributaries), and the Owyhee/Malheur, Burnt/Powder, and Grande Ronde/Imnaha Basins (Snake River tributaries). Of these eight major basins, large fluvial migratory bull trout are potentially stable in only one, the Grande Ronde, and virtually eliminated from the remaining seven, including the majority of the mainstem Columbia River. The only known increasing population of bull trout is an adfluvial migrant population located in Lake Billy Chinook, that spawns and rears in the Metolius River and tributaries in the Deschutes Basin. In recognition of the precarious status of Oregon bull trout populations, harvest of bull trout is prohibited in all state waters with the exception of Lake Billy Chinook and Lake Sintustus in the Deschutes River Basin.

Columbia and Klamath River basin bull trout have been isolated from one another for over 10,000 years. Leary *et al.* (1993) demonstrated substantial genetic separation between bull trout in the Klamath and Columbia River basins; these two basin populations constitute "distinct population segments", and were listed as such under the ESA.

Bull trout spawn in the fall, primarily in September or October when water temperatures drop below 9%C (48%F). Typically, spawning occurs in gravel, in runs or tails of spring-fed pools. Adults hold in areas of deep pools and cover and migrate at night (Pratt 1992). After spawning, adfluvial adults return to the lower river and lake.

Bull trout eggs are known to require very cold incubation temperatures for normal embryonic development (McPhail and Murray 1979). In natural conditions, hatching usually takes 100 to 145 days and newly-hatched fry, known as alevins, require 65 to 90 days to absorb their yolk sacs (Pratt 1992). Consequently, fry do not emerge from the gravel and begin feeding for 200 or more days after eggs are deposited (Fraley and Shepard 1989), usually in about mid-April.

Fraley and Shepard (1989) reported that juvenile bull trout were rarely observed in streams with summer maximum temperatures exceeding 15%C (59%F). Fry, and perhaps juveniles, grow faster in cool water (Pratt 1992). Juvenile bull trout are closely associated with the substrate, frequently living on or within the streambed cobble (Pratt 1992). Along the stream bottom, juvenile bull trout use small pockets of slow water near high velocity, food-bearing water. Adult bull trout, like the young, are strongly associated with the bottom, preferring deep pools in cold water rivers, as well as lakes and reservoirs (Thomas 1992).

Juvenile adfluvial fish typically spend one to three years in natal streams before migrating in spring, summer, or fall to a large lake. After traveling downstream to a larger system from their natal streams, subadult bull trout (age 3 to 6) grow rapidly but do not reach sexual maturity for several years. Growth of resident fish is much slower, with smaller adult sizes and older age at maturity.

Juvenile bull trout feed primarily on aquatic insects (Pratt 1992). Subadult bull trout rapidly convert to eating fish and, as the evolution of the head and skull suggest, adults are opportunistic and largely nondiscriminating fish predators. Historically, native sculpins (*Cottus* spp.), suckers (*Catostomus* spp.), and mountain whitefish (*Prosopium williamsoni*) were probably the dominant prey across most of the bull trout range. Today, throughout most of the bull trout's remaining range, introduced species, particularly kokanee (*Oncorhynchus nerka*) and yellow perch (*Perca flavescens*), are often key food items (Pratt 1992).

Bull trout are habitat specialists, especially with regard to preferred conditions for reproduction. While a small fraction of available stream habitat within a drainage or subbasin may be used for spawning and rearing, a much more extensive area may be utilized as foraging habitat, or seasonally as migration corridors to other waters. Structural diversity is a prime component of good bull trout rearing streams (Pratt 1992). Several authors have observed highest juvenile densities in streams with diverse cobble substrate and low percentage of fine sediments (Shepard *et al.* 1984, Pratt 1992).

Persistence of migratory life history forms and maintenance or re-establishment of stream migration corridors is crucial to the viability of bull trout populations (Reiman and McIntyre 1993). Migratory bull trout facilitate the interchange of genetic material between populations, ensuring sufficient variability within populations. Migratory forms also provide a mechanism for reestablishing local populations that have been extirpated. Migratory forms are more fecund and larger than smaller non-native brook trout, potentially reducing the risks associated with hybridization (Reiman and McIntyre 1993). The greater fecundity of these larger fish enhances the ability of a population to persist in the presence of introduced fishes.

Critical habitat has been designated in Baker, Clatsop Columbia, Crook, Deschutes, Gilliam, Grant, Harney, Hood River, Jefferson, Klamath, Lake, Lane, Linn, Malheur, Morrow, Multnomah, Sherman, Umatilla, Union, Wallowa, Wasco, and Wheeler Counties of Oregon, as shown on the map(s) in Appendix C. Within the designated areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering, as follows.

- Water temperatures ranging from 36 to 59 °F (2 to 15 °C), with adequate thermal refugia available for temperatures at the upper end of this range. Specific temperatures within this range will vary depending on bull trout life history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence;
- Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures;
- Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine substrate less than 0.25 in (0.63 cm) in diameter and minimal substrate embeddedness are characteristic of these conditions;
- A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, a hydrograph that demonstrates the ability to support bull trout populations by minimizing daily and day-to-day fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variation;
- Springs, seeps, groundwater sources, and subsurface water connectivity to contribute to water quality and quantity;
- Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows;
- An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish;
- Few or no nonnative predatory, interbreeding, or competitive species present.
- Permanent water of sufficient quantity and quality such that normal reproduction, growth and survival are not inhibited.

3.1.2.2. Lahontan Cutthroat Trout (*Oncorhynchus clarki henshawi*)

The Lahontan cutthroat trout is listed as threatened without critical habitat (35 FR 16047). A recovery plan was published in 1995. The following information is from the species' fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsFish/Lahontan.htm.

Lahontan cutthroat trout historically occurred in most cold waters of the Lahontan Basin of Nevada and California, including the Humboldt, Truckee, Carson, Walker, and Summit Lake/Quinn River drainages. Large alkaline lakes, small mountain streams and lakes, small tributary streams, and major rivers were inhabited, resulting in the present highly variable subspecies. Only remnant populations remain in a few streams in the Truckee, Carson, and Walker basins out of an estimated 1,020 miles of historic habitat. Although mechanisms of stream colonization outside of the Lahontan basin by this subspecies are uncertain, transport by humans is suspected. Subsequently, resident stream populations were used to stock Oregon streams during the 1970's and 1980's.

The Lahontan cutthroat trout occurs in the following streams in southeastern Oregon: Willow Creek, Whitehorse Creek, Little Whitehorse Creek, Doolitle Creek, Fifteen Mile Creek (from the Coyote Lake Basin) and Indian, Sage, and Line Canyon Creeks, tributaries of McDermitt Creek in the Quinn River basin (NV).

Although coloration is variable, this species is generally heavily marked with large, rounded black spots, more or less evenly distributed over the sides, head, and abdomen. Spawning fish generally develop bright red coloration on the underside of the mandible and on the opercle. In spawning males, coloration is generally more intense than in females.

Lahontan cutthroat trout are obligate but opportunistic stream spawners. Typically, they spawn from April through July, depending on water temperature and flow characteristics. Autumn spawning runs have been reported from some populations. The fish may reproduce more than once, though post-spawning mortality is high (60-90%). Lake residents migrate into streams to spawn, typically in riffles on well washed gravels. The behavior of this subspecies is typical of stream spawning trout; adults court, pair, and deposit and fertilize eggs in a redd dug by the female.

Although the Lahontan cutthroat in Oregon were originally classified as Willow-Whitehorse cutthroat trout, genetic and taxonomic investigations led to its re-classification in 1991.

The Lahontan cutthroat trout is one subspecies of the wide-ranging cutthroat trout species (O. clarki) that includes at least 14 recognized forms in the western United States. Cutthroat trout have the most extensive range of any inland trout species of western North America, and occur in anadromous, non-anadromous, fluvial, and lacustrine populations. Many of the basins in which cutthroat trout occur contain remnants of much more extensive bodies of water which were present during the wetter period of the late Pleistocene epoch.

These fish are unusually tolerant of both high temperatures (>27 C) and large daily fluctuations (up to 20 C). They are also quite tolerant of high alkalinity (>3000 mg/l) and dissolved solids (>10000 mg/l). They are apparently intolerant of competition or predation by non-native salmonids, and rarely coexist with them.

The severe decline in range and numbers of Lahontan cutthroat is attributed to a number of factors including hybridization and competition with introduced trout species, loss of spawning habitat due to pollution from logging, mining, and urbanization, blockage of streams due to dams, channelization, de-watering due to irrigation and urban demands, and watershed degradation due to overgrazing of domestic livestock. Declining Lahontan cutthroat populations in the Whitehorse and Trout Creek Mountains are a result of decades of season-long intensive livestock grazing, recreational over-fishing, and more recently drought conditions from 1985 to 1994.

Oregon Department of Fish and Wildlife (ODFW) surveys indicated that Lahontan cutthroat trout populations were reduced from 1985 to 1989 by: 62% on Willow Creek; 69% on Whitehorse Creek; 93% on Little Whitehorse Creek; and 42% on Doolittle Creek. No Lahontan cutthroat trout were found in either the 1985 or 1989 ODFW surveys on Fifteen Mile creek. These declining numbers prompted ODFW to close area streams to fishing (by special order) in 1989. This closure remains in effect. Fish surveys of area streams were conducted again in October of 1994. Although methods vary among the conducted surveys (1985, 1989, and 1994), fish numbers have increased in general from approximately 8,000 fish in the mid-1980's to approximately 40,000 fish in 1994. However, in many areas, stream conditions remain less than favorable for the cutthroat.

3.1.2.3. Oregon Chub (*Oregonichthys crameri*)

The Oregon chub, a small minnow endemic to the Willamette River Basin in western Oregon, was listed as endangered without critical habitat in 1993 (58 FR 53804). The Service is expected to release a proposed critical habitat designation and rule by March 1, 2009. The Service published a recovery plan for the Oregon chub in 1998. The following information is from the Oregon chub endangered species fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsFish/Oregon%20Chub.htm.

Oregon chub are endemic to the Willamette River Valley of western Oregon. Although information is scarce, the Oregon chub probably occurred throughout the lower elevations of the Willamette River valley. Historical records indicate that Oregon chub were found as far downstream as Oregon City and as far upstream as Oakridge. Historical records also report Oregon chub were collected from the Clackamas River, Molalla River, South Santiam river, North Santiam River, Luckiamute River, Long Tom River, McKenzie River, Mary's River, Coast Fork Willamette River, Middle Fork Willamette River, and the Mainstem Willamette River from Oregon city to Eugene.

The current distribution of Oregon chub is limited to about 20 known naturally occurring populations and 4 recently reintroduced populations. The populations are found in the Santiam River, Middle Fork Willamette River, Coast Fork Willamette River, McKenzie River, and several tributaries to the Mainstem Willamette River downstream of the Coast Fork/Middle Fork confluence. Almost all of the populations are small and isolated. Without management, the Oregon chub could potentially disappear completely.

The Oregon chub is a small minnow with an olive colored back grading to silver on the sides and white on the belly. Adults are typically under 9 centimeters (3.5 inches) in length. Scales are relatively large with fewer than 40 occurring along the lateral line; scales near the back are outlined with dark pigment. Adults feed in the water column on the tiny larvae of aquatic invertebrates, such as mosquitos and other insects. Spawning occurs from the end of April through early August when water temperatures are between 16o and 28o C (60o and 82o F). Only males larger than 25 mm spawn, and males over 35 mm defend territories in or near vegetation. Females can lay several hundred eggs.

Oregon chub are found in slack water off-channel habitats such as beaver ponds, oxbows, side channels, backwater sloughs, low gradient tributaries, and flooded marshes. These habitats usually have little or no water flow, silty and organic substrate, and aquatic vegetation as cover for hiding and spawning. The average depth of Oregon chub habitats is typically less than 2 meters (6 feet) and the summer water temperature typically exceeds 16o C (61o F). Adult Oregon chub seek dense vegetation for cover and frequently travel in the mid-water column in beaver channels or along the margins of aquatic plant beds. Larval chub congregate in near shore areas in the upper layers of the water column in shallow areas. Juvenile Oregon chub venture farther from shore into deeper areas of the water column. In the winter months, Oregon chub can be found buried in the detritus or concealed in aquatic vegetation. Fish of similar size classes school and feed together. In the early spring, Oregon chub are most active in the warmer, shallow areas of the ponds.

Historically, the mainstem of the Willamette River was a braided channel with many side channels, meanders, oxbows, and overflow ponds that provided habitat for the chub. Periodic flooding of the river created new habitat and transported the chub into new areas to create new populations. The construction of flood control projects and dams, however, changed the Willamette River significantly, and prevented the formation of chub habitat and the natural dispersal of the species. Other factors responsible for the decline of the chub include: habitat alteration; the proliferation of non-native fish and amphibians; accidental chemical spills; runoff from herbicide or pesticide application on farms and timberlands or along roadways, railways, and power line rights-of-way; the application of rotenone to manage sport fisheries; desiccation of habitats; unauthorized water withdrawals; diversions, or fill and removal activities; sedimentation resulting from timber harvesting in the watershed; and possibly the demographic risks that result form a fragmented distribution of small, isolated populations. The introduction of non-native fish and amphibians continues to threaten existing populations of Oregon chub; many non-native species (such as bass, mosquitofish, and bullfrogs) occur in the same type of habitat as Oregon chub and eat small fish, including the chub.

The goal of the Oregon chub recovery plan is to reverse the decline of the Oregon chub by protecting existing wild populations, re-introducing chub into suitable habitats throughout its historic range, and increasing public awareness and involvement. The U.S. Forest Service, Army Corps of Engineers, and the Oregon Department of Fish and Wildlife have active programs to protect the Oregon chub. Careful and coordinated planning, management, and protection of Oregon chub habitat is necessary for the survival of this little minnow.

3.1.2.4. Warner Sucker (*Catostomus warnerensis*)

The Warner Sucker is federally listed as threatened with critical habitat (50 FR 39117). A recovery plan was completed in 1998. The information in this section is from the final rule.

The Warner Sucker is endemic to the streams and lakes of the Warner Basin in Southern Oregon. Habitats of Warner sucker include large natural lakes and associated marshes. Although primarily lacustrine, the species also spawns in headwaters of streams, tributary to lakes. It is presently known to occur in portions of Crump and Hart Lakes, the spillway canal north of Hart Lake, and portions of Snyder, Honey, Twentymile, and Twelvemile Creeks. It is part of a relict fauna isolated in remaining waters of a larger Pleistocene lake that previously covered much of the basin floor.

This species spawns in silt-free, gravel bottomed flowing sections of creeks. Larvae are found in shallow backwater pools or on stream margins where there is no current, often among or near aquatic plants. Young of the year use deep still pools, but also move into faster-flowing areas near the heads of pools.

Warner suckers mature at 3 to 4 years of age at approximately 5 to 6 inches. A bright orange lateral stripe is present on adults during spawning runs. Adult Warner Suckers occupy stretches of stream where the gradient is low enough to allow the formation of long pools. These pools tend to have undercut banks, large beds of aquatic plants, root wads or boulders, a vertical temperature differential of at least 2 degrees Celsius, a maximum depth of 1.5 meters, and overhanging vegetation.

The introduction of exotic fish species and the modification of stream flows into lakes of the Warner Valley by diversion structures have modified the sucker's habitat. Predation on juvenile suckers by large numbers of exotic fishes may be particularly significant. The water diversion structures prevent the stream-spawning sucker from reaching its spawning and rearing areas. Water pollution and siltation of gravel beds needed by the fish for spawning are also adversely affecting the lake and stream habitats.

Critical habitat for this species has been designated in Lake County, Oregon, as shown on the map in Appendix C. It includes the following streams and 50 feet on either side of the stream banks: 4 stream miles of Twelvemile Creek, 18 stream miles of Twentymile creek, 2 stream miles of the spillway canal north of Hart Lake, 3 stream miles of Snyder Creek, and 16 stream miles of Honey Creek. The 50-foot riparian zone on each side of the streams is included to protect the integrity of the stream ecosystem (FR 50, 39120). PCEs of all areas proposed as critical habitat include streams 15 feet to 80 feet wide with gravel-bottom shoal and riffle areas with intervening pools. Streams should have clean, unpolluted flowing water and a stable riparian zone. The streams should support a variety of aquatic insects, crustaceans, and other small invertebrates for food.

3.1.2.5. Shortnose Sucker (*Chasmistes brevirostris*)

The shortnose sucker is federally listed as endangered (53 FR 27130). Critical habitat has been proposed. A recovery plan was completed in 1993. The following information is from the species' fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsFish/Shortnose.htm.

Early records indicate that shortnose suckers were once widespread and abundant in the upper Klamath Basin of Oregon and California. This area historically contained over 350,000 acres of wetlands and floodplains. These wetlands protected sucker habitats by reducing erosion forces, removing organic and inorganic nutrients, and maintaining water quality. Agricultural development and associated water and land use changes in the basin have contributed to the significant loss of these wetlands. The resulting reduction and degradation of shortnose sucker lake and stream habitats has led to a significant decline in population size. Although overharvesting and pollution may have played a role in the species decline, it is believed that the construction of dams, the draining or dredging of lakes, and other alterations of natural stream flow have reduced the reproductive success of shortnose suckers by as much as 95% through the loss of suitable spawning habitat. At the time it was listed as endangered, it was noted that there had been no significant addition of young into the population in 18 years. Currently, the shortnose sucker occupies only a fraction of its former range and is restricted to a few areas in the Upper Klamath Basin, such as the Upper Klamath Lake, Tule Lake, and Clear Lake drainages. Poor water quality, reduced suitable habitat for all size and age classes, and the impacts of non-native fishes continue to threaten remaining shortnose sucker populations.

The shortnose sucker can live up to 33 years and is usually less than 50 cm (20 in) in length. The diet of this bottom-feeding species consists of detritus (decomposing organic matter), zooplankton (tiny floating aquatic animals), algae, and aquatic insects. Shortnose suckers reach sexual maturity around six or seven years and then participate in spawning migration. Adult suckers migrate from the quiet waters of lakes into fast moving streams from March through May in order to spawn; they may also spawn in springs from February to late April when water temperatures are a constant 15 C (60 F). Thousands of eggs (from 18,000 for smaller fish to 46,000 for larger fish) are typically laid near the stream bottom in areas where gravel or cobble is available. Once the larvae hatch, they begin migrating back to calmer waters.

The shortnose sucker dwells in the deeper water of lakes and spawns in springs or tributary streams upstream from its home lake. Some stream dwelling populations also exist. Areas with gravel or close-set stone ("cobble") bottoms are generally preferred for spawning habitat. In addition, spawning streams have a fairly shallow shoreline with an abundance of aquatic vegetation; these areas provide a safe haven for the young larvae during their journey back downstream to their home lakes or the deep, quiet waters of rivers. Shoreline vegetation in both lake and river habitats is important for the rearing of larval and juvenile suckers.

Although a number of factors have contributed to the decline of the shortnose sucker, habitat degradation is considered its primary cause. Streams, rivers, and lakes have been modified by channelization and dams. Grazing in the riparian zone has eliminated streambank vegetation, and has added nutrients and sediment to river systems. Eggs and larvae, for example, suffocate when the water is cloudy, or dry out or get eaten by other fish when they are not protected by aquatic vegetation. Loss of streambank vegetation due to overgrazing, logging activities, agricultural practices, and road construction has also led to increases in stream temperatures, high levels of nutrients (which encourages the buildup of excess algae and bacteria), and serious erosion and sedimentation problems in streams. Such water quality problems have reduced the availability of suitable shortnose sucker habitat and have resulted in major fish mortality. Entire age classes of young suckers are routinely lost due to poor water quality conditions. As a result, few young suckers survive to sexual maturity, and therefore, do not increase the population size. Other factors affecting the decline of the shortnose sucker include previous overharvesting, chemical pollution from pesticides, herbicides, and forestry practices, and predation and competition from native and non-native fishes such as largemouth bass, blue chub, yellow perch, fathead minnows, and rainbow trout.

Conservation efforts for the shortnose sucker focus on the re-establishment of a more naturally functioning ecosystem in the Klamath Basin. Fencing portions of streams to reduce cattle-caused erosion, replanting streambanks with native vegetation, improving forestry and agricultural practices, and assuring adequate water levels in reservoirs will contribute to the recovery of this species. Through coordination of the actions of land use agencies and private landowners, further degradation of sucker habitat can be avoided and steps can be taken to improve current conditions. By minimizing the impacts of future modifications to spawning habitat and restoring waters to a more natural state, recovery of shortnose sucker populations is possible in the Klamath Basin.

Critical habitat for Lost River and shortnose suckers has been proposed in Klamath County, Oregon. Approximately182,000 hectares (456,000 acres) of stream, river, lake and shoreline area is proposed as critical habitat for the shortnose sucker (U.S. Fish and Wildlife Service1994). The proposed PCEs for both species are:

- *Water:* This element is defined as a sufficient quantity of water of suitable quality (i.e., temperature, dissolved oxygen, flow rate, pH, nutrients, lack of contaminants, turbidity, etc.) to provide conditions required for the particular life stage for each species.
- *Physical Habitat:* This element is defined as including areas of the Upper Klamath Basin watershed that are inhabited or potentially habitable by suckers for use as refugia from stressful water quality conditions or predation, or for use as in spawning, nursery, feeding, or rearing areas, or as corridors between these areas.
- *Biological Environment:* The components of this element include food supply and a natural scheme of predation, parasitism, and competition in the biological environment. Food supply is a function of nutrient supply, productivity, and availability for each life stage of the species. Predation, although considered a normal component of this environment, may be out of balance due to introduced fish species or the elimination of refugial structures such as cover and shelter. Competition from nonnative fish species and parasitism may also be elevated due to stresses induced by degraded habitats.

3.1.2.6. Lost River Sucker (*Deltistes luxatus*)

The Lost River sucker is federally listed as endangered (53 FR 27130). Critical habitat has been proposed. A recovery plan was completed in 1993. The following information is from the species' fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsFish/LRsucker.htm.

Early records indicate that Lost River suckers were once widespread and abundant in the upper Klamath Basin of Oregon and California. This area historically contained over 350,000 acres of wetlands and floodplains. These wetlands protected sucker habitat by controlling erosion, recycling organic and inorganic nutrients, and maintaining water quality. Because suckers were historically very abundant, they were a major food source for Native Americans and local settlers in the late 1800's. Canneries were established along the Lost River to process suckers into oil, dried fish, and other products. However, agricultural development and associated water and land use changes in the basin have contributed to the significant loss of wetland habitat and a significant decline in sucker populations. Although overharvesting and pollution may have played a role in the species decline, it is believed that the combined effects of the construction of dams, the draining or dredging of lakes, and other alterations of natural stream flow have reduced the reproductive success of Lost River suckers by as much as 95% through the degradation of suitable breeding habitat. At the time the Lost River sucker was listed as endangered, it was noted that there had been no significant addition of young into the population in 18 years.

Currently, the Lost River sucker occupies only a fraction of its former range and is restricted to a few areas in the Upper Klamath Basin, such as the drainages of Upper Klamath Lake, Tule Lake, and Clear Lake. Poor water quality, reduced suitable habitat for all sizes and ages, and the impacts of non-native fishes continue to threaten remaining Lost River sucker populations.

Locally known as mullet, the Lost River sucker is a large, long-lived sucker that can reach 43 years of age. It has unique triangular-shaped gill structures which are used to strain a diet of detritus (decomposing organic matter), zooplankton (tiny floating aquatic animals), algae, and aquatic insects from the water. Lost River suckers typically begin to reproduce at nine years, when they first participate in spawning migration. Adult suckers migrate from the quiet waters of lakes into fast moving streams from March through May in order to spawn. They may also spawn in lakeshore springs from February to mid-April when the water temperature is a constant 15 C (60 F). Thousands of eggs (from 44,000 for smaller fish to 218,000 for larger suckers) are typically laid near the stream bottom in areas where gravel or cobble is available. Once the eggs hatch, the larval fish begin their migration back to calmer waters. They generally migrate at night and stay in shallow, shoreline areas and in aquatic vegetation during the day. Upon their return to the lake, larvae may be preyed upon by largemouth bass, yellow perch, or other non-native predatory fish, and larger juveniles may compete for food with non-native fishes such as fathead minnows, yellow perch, and others.

The Lost River sucker dwells in the deeper water of lakes and spawns in springs or tributary streams upstream of the home lake. Areas with gravel or close-set stone ("cobble") bottoms at springs or in moderate to fast-flowing springs are preferred for spawning. In addition, the spawning streams have a fairly shallow shoreline with abundant aquatic vegetation; these areas provide a safe haven for the young larvae during their journey back downstream to their home lakes or the deep, quiet waters of rivers.

Although a number of factors have contributed to the decline of the Lost River sucker, habitat degradation is considered the primary cause. Streams, rivers, and lakes have been modified by channelization and dams. Grazing in the riparian zone has eliminated streambank vegetation, and has added nutrients and sediment to river systems. Eggs and larvae, for example, suffocate when the water is cloudy, or dry out or get eaten by other fish when they are not protected by aquatic vegetation. Loss of streambank vegetation due to overgrazing, logging activities, agricultural practices, and road construction has also led to increases in stream temperatures, high levels of nutrients (which encourages the buildup of excess algae and bacteria), and serious erosion and sedimentation problems in streams. Such water quality problems have reduced the availability of suitable Lost River sucker habitat and have resulted in major fish mortality. Entire age classes of young suckers are routinely lost due to poor water quality conditions. As a result, few young suckers survive to sexual maturity, and therefore, do not increase the population size. Other factors affecting the decline of the Lost River sucker include previous overharvesting, chemical pollution from pesticides, herbicides, and forestry practices, and predation and competition from native and non-native fishes such as largemouth bass, blue chub, yellow perch, fathead minnows, and rainbow trout.

Conservation efforts for the Lost River sucker focus on the re-establishment of a more naturally functioning ecosystem in the Klamath Basin. Fencing portions of streams to reduce cattle-caused erosion, replanting streambanks with native vegetation, improving forestry and agricultural practices, and assuring adequate water levels in reservoirs will contribute to the recovery of this species. Through coordination of the actions of land use agencies and private landowners, further degradation of sucker habitat can be avoided and steps can be taken to improve current conditions. By minimizing the impacts of future modifications to spawning habitat and restoring waters to a more natural state, recovery of Lost River sucker populations is possible in the Klamath Basin.

Critical habitat for Lost River and shortnose suckers has been proposed in Klamath County, Oregon. Approximately 170,000 hectares (424,000 acres) of stream, river, lake and shoreline areas are proposed as critical habitat for the Lost River sucker (U.S. Fish and Wildlife Service1994). The PCEs discussed above for shortnose sucker habitat also apply to the Lost River sucker.

3.1.2.7. Modoc Sucker (*Catostomus microps*)

The Modoc sucker is listed as endangered, and has designated Critical Habitat in California (50 FR 24523, 24530). The following information is primarily from the final rule.

The historic range of the Modoc sucker included small streams tributary to the Pit River in Modoc and Lassen Counties, California. In 2001, the sucker was discovered in Oregon in Bauers and Thomas Creeks, tributaries to Goose Lake near Lakeview in Lake County.

Preferred habitat of the species consists of small streams characterized by large shallow pools with cover, soft sediments, and clear water. Food of the Modoc sucker consists of benthic invertebrates, algae, and detritus. During spring spawning runs, the species ascends creeks or tributaries that may be dry during summer months.

Modoc sucker populations declined significantly in the late 1970s and 1980s. The decline was largely attributed to habitat destruction and hybridization with the Sacramento sucker (*Catostomus occidentalis*). Hybridization has occurred due to the elimination of waterfalls and other natural instream barriers to fish movement by erosion, sedimentation, and channelization.

3.1.4. Mammals

3.1.4.1. Columbian White-Tailed Deer (*Odocoileus virginianus leucurus*)

The Columbian white-tailed deer is listed as endangered without critical habitat (55 FR 433). A recovery plan was completed in 1983. The following information is from the recovery plan (USFWS 1983).

This deer is medium-sized, with a coat that is tawny in the summer and bluish-gray in winter. Bucks weigh up to 182 kg (400 lb), whereas does are smaller, usually weighing less than 113 kg (250 lb). Female Columbian white-tailed deer typically have one or two fawns every season. Young deer have a reddish-tan coat with small white speckles.

The Columbian white-tailed deer is one of 38 subspecies of white-tailed deer in the Americas. Historically, the subspecies ranged from the southern end of Puget Sound in Washington to the Willamette Valley of Oregon and throughout the river valleys west of the Cascade Mountains. Following European settlement, conversion of land to agriculture pushed the deer into small vestiges of habitat where they are found today. Logging, vehicular fatalities, poaching, and flooding events also have contributed to the decline of this deer. Today, only two populations of the Columbian white-tailed deer exist, one near Roseburg, Oregon, and another on a few small islands and in isolated areas adjacent to the lower Columbia River, near Cathlamet, Washington.

Efforts to save the Columbian white-tailed deer from extinction began in 1972, when the Service established the 4,800-acre Julia Butler Hansen Refuge for the species near Cathlamet, Washington. Total numbers of the deer in the lower Columbia River population have increased in recent years, although the size of the population varies in response to flooding. In recent aerial surveys, biologists estimated a population of 60 deer on the Refuge mainland unit and 100 deer on 2,000-acre Tenasillahe Island in the Columbia River.

A separate population of Columbian white-tailed deer is found along the Umpqua River in Douglas County, Oregon, near Roseburg. In this population, deer are found in riparian woodlands adjacent to the North and South Umpqua Rivers, and in associated upland oak savannahs. This population has been de-listed (68 FR 43647). In Oregon, the species is currently listed in Clatsop, Columbia and Multnomah Counties.

3.1.5. Invertebrates

3.1.5.1. Vernal Pool Fairy Shrimp (*Branchinecta lynchi*)

The vernal pool fairy shrimp is listed as threatened with critical habitat (59 FR 48136). The following information is from the final listing rule.

Vernal pool fairy shrimp occur primarily in vernal pools, seasonal wetlands that fill with water during fall and winter rains and dry up in spring and summer. Typically the majority of pools in any vernal pool complex are not inhabited by the species at any one time. Different pools within or between complexes may provide habitat for the fairy shrimp in alternative years, as climatic conditions vary.

Vernal pool fairy shrimp typically hatch when the first rains of the year fill vernal pools. They mature in about 41 days under typical winter conditions. Adult fairy shrimp live only for a single season, while there is water in the pools. Towards the end of their brief lifetime, females produce thick-shelled "resting eggs" also known as cysts. During the summer, these cysts become embedded in the dried bottom mud, and during the winter, they are frozen for varying periods. These cysts hatch when the rains come again. In fact, it appears that prior freezing and/or drying seems to be necessary for the eggs to hatch.

At the time of its listing, the vernal pool fairy shrimp was known to occur only in California, extending from Tulare County in the south to Shasta County in the north. In 1998, the fairy shrimp were discovered in vernal pools in Jackson County, Oregon, in an area north of Medford known as the Agate Desert. Prior to the discovery, the most northerly known location for the species was south of Mount Shasta, California, some eighty miles south of the Agate Desert.

Vernal pool fairy shrimp have declined primarily because of destruction or degradation of vernal pools through development of urban, suburban, and agricultural projects. In addition to direct habitat loss, vernal pool fairy shrimp populations have declined from a variety of activities that degrade existing vernal pools by altering pool hydrology. Vernal pool hydrology can be altered by a variety of activities, including the construction of roads, trails, ditches, or canals that can block the flow of water into or drain water away from the vernal pool complex.

Critical habitat for the vernal pool fairy shrimp has been designated in Jackson County, Oregon, as shown on the map(s) in Appendix C. The PCEs of critical habitat for vernal pool fairy shrimp are the habitat components that provide:

- Vernal pools, swales, and other ephemeral wetlands and depressions of appropriate sizes and depths that typically become inundated during winter rains and hold water for sufficient lengths of time necessary for vernal pool fairy shrimp incubation, reproduction, dispersal, feeding, and sheltering, including but not limited to Northern Hardpan, Northern Claypan, Northern Volcanic Mud Flow, and Northern Basalt Flow vernal pools formed on a variety of geologic formations and soil types, but which are dry during the summer and do not necessarily fill with water every year; and
- The geographic, topographic, and edaphic features that support aggregations or systems of hydrologically interconnected pools, swales, and other ephemeral wetlands and depressions within a matrix of surrounding uplands that together form hydrologically and ecologically functional units called vernal pool complexes. These features contribute to the filling and drying of the vernal pool, and maintain suitable periods of pool inundation, water quality, and soil moisture for vernal pool crustacean hatching, growth and reproduction, and dispersal, but not necessarily every year.

3.1.5.2. Fender's blue butterfly (*Icaricia icaroides fenderi)*

The Fender's blue butterfly was listed as an endangered species in 2000 (65 FR 3875). Critical habitat was designated for the Fender's blue butterfly, Kincaid's lupine, and Willamette daisy in October 2006. The following information is from the Fender's blue butterfly endangered species fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsInverts/Fender%27s.htm.

This subspecies of the Boisduval's blue butterfly (*Icaricia icariodes*) was believed to be extinct from 1937 until it was rediscovered in 1989. The distribution of this butterfly is restricted to the Willamette Valley, Oregon. At the time of listing, it was known to occupy 32 sites in Yamhill, Polk, Benton, and Lane Counties. Since that time, it has been found on additional sites, including sites in Linn County. One population is found in wet, Deschampsia-type prairie, while all other remaining populations are found on drier, upland prairies characterized by Festuca species. Sites occupied by Fender's blue butterfly are located almost exclusively on the western side of the valley, within 33 kilometers (21 miles) of the Willamette River. The largest populations occur at the Willow Creek Main Preserve managed by The Nature Conservancy and Baskett Slouth NWR.

Fender's blue butterfly occurs in native prairie habitats. Most Willamette Valley prairies are seral (one stage in a sequential progression), requiring natural or human-induced disturbance for their maintenance. The vast majority of these prairies would eventually be forested if left undisturbed. Fender's blue butterfly is typically found in native upland prairies, dominated by red fescue (*Festuca rubra*) and/or Idaho fescue (*Festuca idahoensis*), where its primary larval food plant, Kincaid's lupine or its secondary larval food plants sickle-keeled lupine (*L. albicaulis*) and spur lupine (*L. arbustus*) also occur. Its primary larval food plant, Kincaid's lupine (listed as a threatened species), occurs on a few, small prairie remnants in the Willamette Valley. Native plants, including Tolmie's mariposa (*Calchortus tomiei*), Hooker's catchfly (*Silene hookeri*), broadpetal strawberry (*Fragaria virginiana*), rose checker-mallow (*Sidalcea virgata*) and common lomatium (*Lomatium spp.)* also occur on native upland prairies and serve as herbaceous indicators of prairie condition. These dry, fescue prairies make up the majority of habitat for Fender's blue butterfly. Although Fender's blue butterfly is occasionally found on steep, south-facing slopes and barren rocky cliffs, it does not appear to thrive in the xeric oatgrass communities often found there.

The life cycle of a Fender's blue butterfly begins in late spring or early summer when an adult female deposits an egg on the underside of a Kincaid's lupine leaflet. The egg soon hatches and the larva feeds on lupine leaflets. The larva may pass through one molt before dropping to the ground in mid-June or July where it goes into hibernation for the fall and winter. In the following March or April, the larva begins to feed on fresh lupine leaflets again. After three to four additional molts, it ecloses into a butterfly in May and begins the cycle again.

Critical habitat for Fender's blue butterfly has been designated in Benton, Lane, Polk, and Yamhill Counties of Oregon, as shown on the map(s) in Appendix C. The PCEs of critical habitat for Fender's blue butterfly are the habitat components that provide:

- Early seral upland prairie, wet prairie, or oak savanna habitat with a mosaic of low-growing grasses and forbs, an absence of dense canopy vegetation, and undisturbed subsoils;
- Larval host-plants Lupinus sulphureus ssp. kincaidii, L. arbustus, or L. albicaulis;
- Adult nectar sources, such as: Allium acuminatum (tapertip onion), Allium amplectens (narrowleaf onion), Calochortus tolmiei (Tolmie's mariposa lilly), Camassia quamash (small camas), Cryptantha intermedia (clearwater cryptantha), Eriophyllum lanatum (wooly sunflower), Geranium oreganum (Oregon geranium), Iris tenax (toughleaf iris), Linum angustifolium (pale flax), Linum perenne (blue flax), Sidalcea campestris (Meadow checkermallow), Sidalcea virgata (rose checker-mallow), Vicia cracca (bird vetch), V. sativa (common vetch), and V. hirsute (tiny vetch);
- Stepping-stone habitat consisting of undeveloped open areas with the physical characteristics appropriate for supporting the short-stature prairie oak savanna plant

community (well-drained soils), within approximately 1.2 miles (2 km) of natal lupine patches.

3.1.6. Plants

3.1.6.1. Nelson's Checkermallow (*Sidalcea nelsoniana*)

Nelson's checkermallow is federally listed as threatened without critical habitat (58 FR 8242). A recovery plan was published in 1998. The following information is from the recovery plan (USFWS 1998).

The species is a perennial herb in the mallow family (Malvaceae). The majority of sites for the species occur in the Willamette Valley of Oregon; the plant is also found at several sites in the Coast Range of Oregon and at two sites in the Puget Trough of southwestern Washington. Thus the range of the plant extends from southern Benton County, Oregon, north to Cowlitz County, Washington, and from central Linn County, Oregon, west to just west of the crest of the Coast Range.

Nelson's checkermallow bears tall lavender to deep pink flowers borne in clusters 50-150 cm (1.6-5 ft) tall at the end of short stalks. Inflorescences are usually somewhat spike-like, elongate and somewhat open. Plants have either perfect flowers (male and female) or pistillate flowers (female). The plant can reproduce vegetatively, by rhizomes, and by producing seeds, which drop near the parent plant. Flowering can occur as early as mid-May and extend into September in the Willamette Valley. Fruits have been observed as early as mid-June and as late as mid-October. Coast Range populations generally flower later and produce seed earlier, probably because of the shorter growing season.

Within the Willamette Valley, Nelson's checkermallow most frequently occurs in ash (*Fraxinus* spp.) swales and meadows with wet depressions, or along streams. The species also grows in wetlands within remnant prairie grasslands. Some sites occur along roadsides at stream crossings where exotics such as blackberry (*Rubus* spp.) and Queen Anne's lace (*Daucus carota)* are also present. Nelson's checkermallow primarily occurs in open areas with little or no shade and will not tolerate encroachment of woody species.

Prior to European colonization of the Willamette Valley, naturally occurring fires and fires set by Native Americans maintained suitable Nelson's checkermallow habitat. Current fire suppression practices allow succession by introduced and native species, which may gradually invade habitat for Nelson's checkermallow. Remnant prairie patches in the Willamette Valley have been modified by livestock grazing, fire suppression, or agricultural land conversion. Stream channel alterations, such as straightening, splash dam installation, and rip-rapping cause accelerated drainage and reduce the amount of water that is diverted naturally into adjacent meadow areas. As a result, areas that would support Nelson's checkermallow are lost. The species is now known to occur in 62 patches within five relict population centers in Oregon, and at two sites in Washington.

3.1.6.2. Bradshaw's Lomatium (*Lomatium bradshawii*)

Bradshaw’s lomatium is federally listed as endangered without critical habitat (53 FR 38451). The Service published a recovery plan for the species in 1993. The following information is from the species’ fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsPlants/Bradshaw%27sLomatium.htm.

Bradshaw’s lomatium is a member of the parsley family (Apiaceae), and grows from 20-50 cm (8-20 in) in height, with mature plants having only two to six leaves. Leaves are chiefly basal and are divided into very fine, almost threadlike, linear segments. The yellow flowers are small, measuring about 1 mm (0.05 in) long and 0.5 mm (0.025 in) across, and are grouped into asymmetrical umbels. Each umbel is composed of 5 to 14 umbellets, which are subtended by green bracts divided into sets of three. This bract arrangement differentiates *L. bradshawii* from other lomatiums. Bradshaw’s lomatium blooms during April and early May, with fruits appearing in late May and June. Fruits are oblong, about 1.2 cm (0.5 in) long, corky and thick-winged along the margin, and have thread-like ribs on the dorsal surface. This plant reproduces entirely from seed. Insects observed to pollinate this plant include a number of beetles, ants, and some small native bees.

The majority of Bradshaw’s lomatium populations occur on seasonally saturated or flooded prairies, adjacent to creeks and small rivers in the southern Willamette Valley. Soils at these sites are dense, heavy clays, with a slowly permeable clay layer located 15-30 cm (6-12 in) below the surface. This clay layer results in a perched water table during winter and spring, and so is critical to the wetland character of these grasslands, known as tufted hair-grass (*Deschampsia cespitosa*) prairies. Bradshaw’s lomatium occurs on alluvial soils.

Endemic to and once widespread in the wet, open areas of the Willamette Valley of western Oregon, Bradshaw’s lomatium is limited now to a few sites in Lane, Marion, and Benton Counties. The greatest concentrations of remaining sites and plants occur in and adjacent to the Eugene metropolitan area. Most of its habitat has been destroyed by land development for agriculture, industry, and housing. In addition, water diversions and flood control structures have changed historic flooding patterns, which may be critical to seedling establishment. Reductions in natural flooding cycles also permit invasion of trees and shrubs, and eventual conversion of wet prairies to woodlands.

3.1.6.3. Howell's Spectacular Thelypody (*Thelypodium howellii* ssp. *spectabilis*)

Howell's spectacular thelypody was proposed as threatened without critical habitat in January 1998 (63 FR 1948). A recovery plan was published in 2002. The following information on the species is from the proposed rule and Meinke (1982).

Howell's spectacular thelypody is a biennial plant (Family: Brassicaceae) that grows to approximately 60 cm (24 in) tall, with branches arising from near the base. Basal leaves are oblanceolate to spatulate and 2-10 cm (0.75-4 in) long. Cauline leaves (leaves borne on stem) are lanceolate to linear lanceolate, entire, and usually sagittate (arrowhead-shaped) at the base, 1-10 cm (0.4-4 in) long. Flowering typically takes place from June through July. Sepals are erect, scarious at the margin, and green, purple or lavender in color. The four petals per flower are mostly spatulate, occasionally oblanceolate, and lavender to purple in color. Its petal shape and paired free filaments distinguish *T. howellii* ssp. *spectabilis* from *T. howellii* ssp. *howellii*.

This plant occurs in moist, moderately well-drained, somewhat alkaline meadow habitats, typically growing with salt tolerant species such as greasewood (*Sarcobatus vermiculatus*), giant wild rye (*Elymus cinereus*), and goosefoot (*Chenopodium* spp.). *Thelypodium howellii* ssp. *spectabilis* appears to be dependent on periodic flooding because it rapidly colonizes areas adjacent to streams that have flooded. It occurs at 18 sites in the Baker-Powder River Valley located near the communities of North Powder, Haines, and Baker in Union and Baker Counties The plant has been extirpated from about one-third of known historic sites, including the type locality in Malheur county.

Threats to the taxon include 1) habitat loss due to urban and agricultural development; 2) habitat degradation due to livestock grazing and hydrological modification; 3) consumption by livestock; 4) use of herbicides or mowing during the growing season; and 5) competition with exotic species such as teasel (*Dipsacus sylvestris*), bull thistle (*Cirsium vulgare*), Canada thistle (*C. canadensis*), and yellow sweet clover (*Melilotus officinalis*).

3.1.6.4. Rough Popcornflower (*Plagiobothrys hirtus*)

An annual herb in the Borage family (Boraginaceae), the rough popcornflower was proposed as endangered without critical habitat in November 1997 (63 FR 61953). A recovery plan was completed in 2003. Information in this section is from the proposed rule, except where otherwise cited.

The rough popcornflower has stout stems, erect or reclining, that grow to 30-60 cm (12-24 in) long. The leaves are linear, the lower paired and the upper alternate, 10-25 cm (4-10 in) in length. The flowers are white with yellow centers, 5-petaled, radially symmetrical, up to 2 cm (0.75 in) across, and are arranged in curled racemes typical of the borage family. The nutlets (seeds) are ovate, 2 mm (0.1 in) long, with a prominent dorsal keel. It can be distinguished from other sympatric *Plagiobothrys* species by its distinctive, wide-spreading hairs, in contrast to the appressed hairs of the other species. The species is an annual, or creeping perennial with rooting stems, a unique trait for the genus.

The rough popcornflower has a narrow range historically, and currently occurs at only four known sites in Oregon’s Umpqua Valley, near Sutherlin, in Douglas County. The sites are all located within 8 km (5 miles) of one another and total under 4 hectares (10 acres) in area. Fewer than 3,000 plants are known to exist. The species occurs in moist, open areas on poorly drained silty clay soils in flat valley bottoms. Its habitat is maintained by the seasonal ponding of water.

The rough popcornflower is highly threatened by development, ditching, road building and maintenance, grazing, and competition with non-native weeds. One population occurs within the town of Sutherlin, on a vacant lot surrounded by residential areas. Another population occurs along the shoulder of Interstate 5, at the Sutherlin exit. The third population is transversed by a series of drainage ditches, with seasonal pool areas leveled with fill dirt, which has introduced non-native weeds to the site. The fourth site has a history of sheep grazing, and is presently grazed by cattle (Gamon and Kagan 1985).

3.1.6.5. Willamette Daisy (*Erigeron decumbens* var. *decumbens*)

The Willamette daisy was proposed as endangered without critical habitat in January 1998 (63 FR 3863). Critical habitat was designated for the Fender's blue butterfly, Kincaid's lupine, and Willamette daisy in October 2006. The following information is extracted from the proposed rule, unless otherwise attributed.

A member of the sunflower family (Asteraceae), this plant is a perennial herb, 15-62 cm (6-24 in) tall. Basal leaves are 5-18 cm (2-7 in) long and less than 1.2 cm (0.5 in) wide, becoming gradually shorter along the stem. The flowering stems, which are taller than the vegetative stems, produce 2 to 5 flower heads in June and July. The flowers are daisy-like, with yellow centers and 25 to 50 pinkish to blue rays, often fading to white with age.

The Willamette Daisy is endemic to Oregon's Willamette Valley. Historically, this plant was likely widespread throughout the Valley. Currently, 18 sites are known, distributed over an area of some 700,000 hectares (1.7 million acres), between Grand Ronde and Goshen, Oregon. The species occurs on alluvial soils. The plant is known to have been extirpated from an additional 19 historic locations (Clark *et al*. 1993).

Willamette daisy populations are known from both bottomland and upland prairie remnants. Prior to European settlement, these prairies were maintained by fire, which prevented the establishment of woody species. Prairie remnants are considered to be among the rarest habitats in western Oregon and are threatened by fragmentation, agriculture and urban growth. Most sites are small and privately owned. Only four sites are in protective ownership (Clark *et al*. 1993).

Critical habitat has been designated for the Willamette daisy in Benton, Lane, Linn, Marion, and Polk Counties of Oregon, as shown on the maps in Appendix C. The PCEs of critical habitat for *Erigeron decumbens var. decumbens* are the habitat components that provide early seral upland prairie, wet prairie, or oak savanna habitat with a mosaic of low-growing grasses and forbs, and spaces to establish seedlings or new vegetative growth; an absence of dense canopy vegetation; and undisturbed subsoils.

3.1.6.6. MacDonald's Rock-Cress (*Arabis macdonaldiana*)

MacDonald's rock-cress was federally listed as endangered without critical habitat in 1978 (43 FR 44810). A recovery plan was published for the California populations in 1990. The following information is from the species' fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsPlants/McRockCress.htm.

MacDonald's rock-cress is one of several closely related endemic species (species restricted to a well-defined geographic area) which have evolved in the Siskiyou Mountains region of southwest Oregon and northwest California. This species was not discovered in Oregon until

1980. It is an attractive plant, as are many of the endemic rock-cress species of the Siskiyou Mountains. Taxonomic studies are currently underway to investigate the relationship of the Oregon population to those in California.

MacDonald's rock-cress is s perennial species in the mustard family (Brassicaceae). This species has a branched caudex (short, vertical, often woody stem at or just beneath the ground surface) and several simple stems that measure 5-20 cm (2-8 in) in height. The lower leaves are in rosettes (a cluster of leaves in a circle), are spatulate (rounded above and narrowed to the base), measure 1-2 cm (0.4-0.8 in) long and 4-7 mm (0.2-0.3 in) wide, are toothed, and are essentially smooth. The petals are rose or purple in color and measure 9-11 mm (0.35-0.43 in) long. The fruits are siliques (elongate, dry, and open at maturity) that measure 3-4 cm (1.2-1.6 in) long. Flowering typically occurs from late April through June.

MacDonald's rock-cress occurs on serpentine soils (high in magnesium, iron, and certain toxic metals). This species is found below 1500 m (4920 ft) elevation in dry, open woods or brushy slopes, with sanicles (Sanicula spp.), violets (Viola spp.), and onions (Alium spp.).

Mining activities and collection of specimens has contributed to the decline of this species.

This species is restricted to Curry County in Oregon on U.S. Forest Service and private land and in adjacent Del Norte County, California. It has also been reported from Mendocino County, California.

3.1.6.7. Applegate's Milk-Vetch (*Astragalus applegatei*)

Applegate's milkvetch was federally listed as endangered without critical habitat in 1993 (58 FR 40547). A recovery plan was published in 1998. The following information is from the Applegate's milk-vetch endangered species fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsPlants/Applegate.htm.

Applegate's milkvetch is a slender perennial in the pea family (Fabaceae). It occurs in flat-lying, seasonally moist, strongly alkaline soils dominated by greasewood (*Sarcobatus vermiculatus*) with sparse, native bunch grasses and patches of bare soil.

Urban development, agriculture, weeds, fire suppression, flood control and land reclamation have contributed to the decline of this species.

This species is historically known from only four sites, near the city of Klamath Falls in Klamath County, Oregon, approximately 1250 m (4,100 ft) above sea level. The largest population is located near Ewauna Lake in Klamath Falls; a significant portion of the site this population occurs on is owned by The Nature Conservancy. Applegate's milkvetch typically flowers from June to early August.

3.1.6.8. Golden paintbrush (*Castilleja levisecta*)

Golden paintbrush is federally listed as a threatened species without critical habitat (62 FR 31740). A recovery plan was published in 2000. The following information is from the final listing rule.

Golden paintbrush occurs in the Puget Trough Physiographic Province of Washington and lower Vancouver Island at elevations from sea level to about 100 meters. It also occurred historically in the Willamette Valley in Oregon, but has not been observed in Oregon for more than 50 years.

This plant occurs on generally flat grasslands, including some that are characterized by mounded topography, and on steep coastal bluffs that are grass-dominated. Low deciduous shrubs are commonly present as small to large thickets.

The mainland population in Washington occurs in a gravelly, glacial outwash prairie. Other populations occur on clayey soils derived from either glacial drift or glacio-lacustrine sediments. All of the extant populations are on soils derived from glacial origins. Historic populations also occurred on near-bedrock soils (Lighthouse Point) as well as clayey alluvial soils (in the southern end of its historic range).

Threats to golden paintbrush include habitat modification as succession causes prairies and grasslands to become shrub and forest lands; development of property for commercial, residential, and agricultural use; low potential for expansion of paintbrush populations and their refugia because existing habitat is constricted; and recreational picking and herbivory.

<u>3.1.6.9. Gentner's fritillary</u> (*Fritillaria gentneri*)

Gentner's fritillary was listed as an endangered species in 1999 (64 FR 69195). A recovery plan was completed in 2003. The following information is from the final listing rule.

Gentner's fritillary typically grows in or on the edge of open woodlands at elevations from 60 to 450 meters (180 to 1,360 feet) with Oregon white oak (*Quercus garryana*) and Pacific madrone (*Arbutus menziesii*) as the most common overstory plants. Western yellow pine (*Pinus ponderosa*) and Douglas fir (*Pseudotsuga menziesii*) are also frequently present. Associated understory species include white-leaved manzanita (*Arcostaphylos viscida*), poison oak (*Rhus diversiloba*), ashy rock cress (*Arabis subpinnatifida),* Rogue River milkvetch (*Astragalus accidens* var. *hendersoni*), fringed brome (*Bromus ciliatus*), Henderson's shootingstar (*Dodecathon hendersoni*), California fescue (*Festuca californica*), mission bells (*Fritillaria affinis*), scarlet fritillary (*Fritillaria recurva*), fineleaf biscuit-root (*Lomatium utriculatum*), Sandberg's bluegrass (*Poa sandbergii*), and American vetch (*Vicia americana*).

Gentner's fritillary can also grow in open chaparral/grassland habitat, which is often found within or adjacent to the mixed hardwood forest type, but always where some wind or sun protection is provided by other shrubs. It does not grow on very dry sites. Flowering typically occurs from April to June.

<u>3.1.6.10. Water howellia</u> (*Howellia aquatilis*)

Water howellia was listed as a threatened species in 1994 (59 FR 35860). The following information is from the water howellia endangered species fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsPlants/WaterHowellia.htm.

Water howellia is known to occur sporadically in Washington, Idaho, Montana, and California. There are no known extant occurrences in Oregon. However, the species has historically been collected (voucher specimens in herbariums) from at least four different places in the state. It was first collected in 1879 from Sauvie Island, Multnomah County. It was collected from Sauvie Island again in 1886, but not since then. It was also collected from Lake Oswego in Clackamas County in 1892. It was collected from two places in the Salem area, most recently in 1977. Numerous attempts to relocate these sites have been unsuccessful. The historic Oregon sites were all located within the Columbia River floodplain or the broad valley of the Willamette River.

In Oregon, sites where water howellia were historically found are now within developed urban areas. Channelization and construction of dams along the Columbia, Willamette, and other rivers has led to loss of suitable wetland habitats. The historical California population may have been eliminated by cattle grazing and trampling. Idaho bottomland habitats have been altered by roads, development, and conversion to agriculture and pasture lands. Timber harvest, wetland succession, and encroachment by non-native plants such as reed canarygrass (Phalaris arundinaceae) have also contributed to the decline of this species.

Information on herbarium labels or Oregon collections describe the habitat of water howellia as “ponds in woods,” “ponds in shaded woods,” and “stagnant ponds in the timber.” Information from other locales indicate this species is restricted to small, vernal, freshwater wetlands, glacial pothole ponds, or former river oxbows that have an annual cycle of filling with water over the fall, winter and early spring, followed by drying during the summer months. These habitats are generally small (less than one hectare (2.5 acres)) and shallow (less than one meter (three feet)) deep. Bottom surfaces are reported as firm, consolidated clay, and organic sediments. Most locations were surrounded by deciduous trees and howellia was found in shallow water or around the edges of deep ponds. Associated species include duckweed (*Lemna spp.),* water starwort (*Callitriche spp.),* water buttercup (*Ranunculus aquaticus*), yellow water-lily (*Nuphar polysepalum*), bladderwort (*Utricularia vulgaris*), and pondweeds (*Potamogeton spp.).* Flowering typically occurs from May to August.

3.1.6.11. Western lily (*Lilium occidentale*)

Western lily was listed as an endangered species in 1994 (59 FR 42171). A recovery plan was published in 1998. The following information is from the Western lily endangered species fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsPlants/WesternLily.htm.

Western lily has been reported from sites in a narrow band along the Pacific Coast no more than four miles inland from Coos County, Oregon, south to Humboldt County, California. In Oregon, the plant occurs on State of Oregon, Bureau of Land Management, and private lands. Agriculture (pasture and cranberry bogs) and infrastructure projects (roads, campgrounds, and utilities), and succession have contributed to the decline of this species.

Western lily typically occurs on the edges of bogs near the ocean. These bogs are composed of poorly drained, highly organic soils (Blacklock) of Sphagnum origin. Associated plant species include sundews (Drosera spp.), Pacific rhododendron (Rhododendron macrophyllum), evergreen huckleberry (Vaccinium ovatum), Labrador tea (Ledum groenlandicum), and red alder (Alnus rubra). Flowering typically occurs from mid-June to early August.

3.1.6.12. Large-flowered meadowfoam (*Limnanthes floccosa* ssp. *grandiflora*)

Large-flowered meadowfoam was listed as an endangered species in 2002 (67 FR 68004). The following information is from the large-flowered meadowfoam endangered species fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsPlants/LFWMeadowfoam.htm.

The large-flowered meadowfoam is known to occur in the Agate Desert region of Jackson County, Oregon on land owned by Jackson County, Oregon Department of Fish and Wildlife, the City of Medford, and private individuals. Industrial, commercial, and residential development, road and powerline construction and maintenance, livestock grazing, agricultural conversion, weed competition, mowing, and roadside spraying have all contributed to the decline of this species.

Large-flowered meadowfoam occurs at the edge of vernal pools at elevations of 375 to 400 meters (1,230 to 1,310 feet), generally near the wetter, inner edges as opposed to the drier outer fringes which harbor the sympatric ssp. floccosa. Associated species include small-flowered lupine (Lupinus micranthus), poverty clover (Trifolium depauperatum), and least mouse-tail (Myosurus minimum). Flowering typically occurs from April to May.

3.1.6.13. Cook's lomatium (*Lomatium cookii*)

Cook's lomatium was listed as an endangered species in 2002 (65 FR 30941). The following information is from the Cook's lomatium endangered species fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsPlants/Cook%27sLomatium.htm.

Cook's lomatium is known from the Agate Desert near Medford, Jackson County, Oregon and French Flat in the Illinois Valley in Josephine County, Oregon on land owned by the Nature Conservancy (Agate Desert Preserve), Jackson County, Oregon Department of Fish and Wildlife, City of Medford, Oregon Department of Transportation, Bureau of Land Management (French Flat), and private landowners. Industrial, commercial, and residential development, road and powerline construction and maintenance, livestock grazing, agricultural conversion, weed competition, mowing, and roadside spraying have all contributed to the decline of this species. In Josephine County, Cook's lomatium is also threatened by gold mining, logging, fire suppression, and uncontrolled off-road-vehicle use.

Cook's lomatium occurs only where soil types have a hard pan or clay pan layer close to the soil surface, creating seasonally wet soils and vernal pools. The Agate Desert is characterized by shallow, Agate-Winlow soils, a relative lack of trees, sparse prairie vegetation, and agate on the soil surface.

Associated species in the Agate Desert include meadowfoam (*Limananthes floccosa ssp. Grandiflora* – also proposed for listing- and *L. F. ssp. floccosa*), *Plagiobothrys bracteatus* (no common name), and *Navarretia spp*. Associated species at French Flat include California oatgrass (*Danthonia californica*), *Plagiobothrys bracteatus*, shaggy horkelia (*Horkelia congesta*), short-stemmed star tulip (*Calochortus uniflorus*), and sedge-leaf buckbrush (*Ceanothus cueatus*). Flowering typically occurs from mid-March to mid-May.

<u>3.1.6.14. Kincaid's lupine</u> (*Lupinus sulphureus var. kincaidii*)

Kincaid's lupine was listed as a threatened species in 2000 (65 FR 3875). Critical habitat was designated for the Fender's blue butterfly, Kincaid's lupine, and Willamette daisy in October 2006. The following information is from the Kincaid's lupine fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsPlants/Kincaid%27sLupine.htm.

Kincaid's lupine occupies sites throughout the Willamette Valley, a few sites in the Umpqua River Basin, and one site in southern Washington. The northern limit of Kincaid' s lupine is Lewis County, Washington, and it ranges south to Douglas County, Oregon.

Native prairie has been virtually eliminated from the Willamette Valley as a result of conversion to agriculture, urbanization, and other development. Most Willamette Valley grasslands are seral (one stage in a sequential progression), requiring natural or human-induced disturbance for their maintenance. Grasslands by nature are a transient community which require disturbance to prevent transition to forest. The vast majority of Willamette Valley grasslands would be forested if left undisturbed. Native Americans probably maintained Willamette Valley prairies by manipulating fire regines prior to European settlement. With extensive changes in the fire regime, disturbance forces that maintained native prairies were substantially altered allowing tree and shrub species to invade and shade out the low-growing Kincaid's lupine. In addition, non-native species such as Himalayan blackberry (Rubus discolor) aggressively overtake spaces and crowd out native species.

Kincaid's lupine is found mainly in the Willamette Valley, Oregon, where it occupies native grassland habitats. Kincaid's lupine is typically found in native upland prairie with the dominant species being red fescue and/or Idaho fescue. Tolmie's mariposa, Hooker's catchfly, broadpetal strawberry, rose checker-mallow, and common lomatium serve as herbaceous indicator species. These dry, fescue prairies make up the majority of habitat for Kincaid's lupine. Although Kincaid's lupine is occasionally found on steep, south-facing slopes and barren rocky cliffs, it does not appear capable of occupying the most xeric oatgrass communities on these south-facing slopes. The plant's distribution implies a close association with native upland prairie sites that are characterized by heavier soils and mesic to slightly xeric soil moisture levels. At the southern limit of its range, this species occurs on well-developed soils adjacent to serpentine outcrops (high in magnesium, iron and certain toxic metals), where it is often found under scattered oaks. Flowering occurs from May to June.

Critical habitat has been desginated for Kincaid's lupine in Benton, Lane, Polk, and Yamhill Counties of Oregon, as shown in Appendix C. The PCEs of critical habitat for the Lupinus sulphureus ssp. kincaidii are the habitat components that provide:

- Early seral upland prairie, or oak savanna habitat with a mosaic of low growing grasses and forbs, and spaces to establish seedlings or new vegetative growth; an absence of dense canopy vegetation; and undisturbed subsoils.
- The presence of insect outcrossing pollinators, such as Bombus mixtus and B. californicus, with unrestricted movement between existing lupine patches.

<u>3.1.6.15. MacFarlane's four o'clock</u> (*Mirabilis macfarlanei*)

MacFarlane's four o'clock was federally listed as an endangered species in 1979 (44 FR 61912) and downlisted to threatened status in 1996 (61 FR 10693). A revised recovery plan was published in 2000. The following information is from the revised recovery plan (USFWS 2000).

MacFarlane's four o'clock is endemic to portions of the Snake, Salmon, and Imnaha River canyons in Wallowa County in northeast Oregon, and adjacent Idaho County in Idaho. It is currently found in eleven populations in Idaho and Oregon. It is endemic to low to mid-elevation canyon grassland habitats in west-central Idaho and northeastern Oregon. Plants are found on gravelly to loamy and sandy soils between approximately 300 and 900 meters (1,000 to 3,000 feet) elevation. Grazing by domestic livestock and the invasion of exotic species are the greatest threats to this species. Other threats include human trampling, off-road vehicle use, construction and maintenance of roads and trails, and herbicide spraying.

The amount of occupied habitat located in Idaho and Oregon since the species' listing represents a three-fold increase due to new discoveries. Currently, almost 1,000 plants are known on about 66 hectare (163 acres) in eighteen locations. The species occurs along 9.6 kilometers (six miles) of Hells Canyon of the Snake River in Idaho County, Idaho, and Wallowa County, Oregon; along 29 kilometers (eighteen miles) of the Salmon River in Idaho County, Idaho; and along 4.8 kilometers (three miles) of the Imnaha River in Wallowa County, Oregon.

MacFarlane's four o'clock is found on talus slopes in canyon land corridors where the climate is regionally warm and dry with precipitation occurring mostly in a winter-to-spring period. The species generally occurs as scattered plants on open, steep (fifty percent) slopes of sandy soils, generally having west to southeast aspects. Flowering typically occurs from early May to early June.

<u>3.1.6.16. Spalding's catch-fly</u> (*Silene spaldingii*)

Spalding's catch-fly was listed as a threatened species in 2001 (66 FR 51598). The following information is from the Spaldin's catch-fly fact sheet at http://www.fws.gov/oregonfwo/EndSpp/FactsPlants/SpaldingCatchfly.htm.

It is mainly a species of the Palouse Prairie and adjacent areas in Washington, Oregon, Idaho, and Montana. It is known in Oregon from private land in Wallowa County and on land owned by The Nature Conservancy, Forest Service, Bureau of Land Management, and U.S. Air Force in

Idaho, Washington, and Montana. Agricultural and urban development, livestock and native ungulate grazing and trampling, herbicide treatment, and competition from non-native plants have all contributed to the decline of this species.

This species grows on mesic grassland prairies at low to mid elevations. Associated species include Idaho fescue, blue bunch wheatgrass (Agropyron spicatum), Nootka rose (Rosa nutkana), purple avens (Geum triflorum), sticky geranium (Geranium viscosissum), balsamroot (Balsamorhiza sagittata) and scattered Ponderosa pine. Flowering typically occurs from June to September.

4. ANALYSIS OF POTENTIAL EFFECTS

This chapter evaluates potential effects to threatened and endangered species and critical habitat from CREP projects, both positive and negative. Effects are discussed in the categories of biological, mechanical, and chemical. Within these categories, effects on groups of species are discussed. Overall discussions about the effects on individual listed species or groups of listed species are provided in section 5. Actions and the potential effects to species and their habitats are also displayed in several tables in Appendix B, with cross references to FOTG practices that are applicable to the various actions.

FSA believes that over the long term, CREP projects will be highly beneficial to most threatened and endangered species. Some short-term negative impacts are possible, but short and long-term benefits are also expected.

The short-term positive environmental impacts of CREP include reduced sedimentation from tillage and livestock activity, reduced introduction of agricultural chemicals into streams from adjacent croplands, and increased bank stability. If grazing or cropping pressure are eliminated from the riparian area or wetland, recovery strategies depend on the climate and soil, the time frame and severity of the damage to the riparian area, and the presence of invasive species. A riparian area may recover quickly through natural regeneration or require active restoration to aid with recovery. In some parts of Oregon, invasive weeds may rapidly colonize a riparian area if it is left alone to recover. As native vegetation established through CREP grows and matures, stream shading will increase and stream temperatures will decrease, and habitat for terrestrial wildlife along riparian areas will increase. Buffers will help reintroduce large woody debris to stream channels and restore channel structure, benefiting fish and other aquatic life.

FSA is not able to precisely document where project sites will be located over the next five years or describe CREP project site-specific conditions or species effects, whether adversely or beneficially. However, the effects the covered CREP activities will have on listed species have been analyzed programmatically considering the nature and scope of the various activities, project habitat types and geographical areas, and listed species needs and threats. Ultimately, all of the covered restoration activities should provide long-term benefits by improving existing conditions for many of these species. The duration of these benefits will depend on the specific activity and any other actions that may occur in the future to extend the current benefits at a project site.

Based on the average enrollment during the first 9 years of CREP we anticipate 704 more projects covering 18,000 additional acres throughout Oregon during the next five years. The actual number will depend on landowner interest and the availability of technical staff to work with landowners to enroll in the program and complete practices. The estimated amount of habitat that may be affected from the completion of restoration activities will vary widely depending on landowner interest and local site conditions. An individual project may contain one to multiple sites. Activities will normally occur on a single site until the work is completed, unless similar actions will be completed on adjacent sites. The duration of a restoration activity at a site may last for less than one day to several weeks. However, this will depend on the extent and complexity of the activity. The overriding assumption regarding activity duration is that there will be more potential habitat disturbances for activities requiring a longer duration to complete. These longer activities will usually require a greater length of time to restore a habitat back to a stable condition.

FSA will initiate individual consultations with the Services on CREP projects that include activities not evaluated in this chapter, such as earthmoving involving heavy equipment for wetland restorations. Also, FSA will initiate a consultation if an activity is modified in a way that may cause an effect to a listed species not considered in this biological assessment, new information or project monitoring results reveal that an activity may affect a listed species in a way not previously considered, a project arises that may affect a species that has been dropped from this consultation, or a new species is listed or critical habitat designated that may be affected by project activities.

4.1. Biological Effects

4.1.1. Disturbance and Displacement

Short-term disturbance to and displacement of threatened and endangered fish and wildlife may occur from CREP activities because of construction noise, human presence, or activities in the area that may disturb or displace animals that may be foraging, resting, nesting, denning or moving through the area. To avoid or minimize these potential effects to fish and wildlife, applicable BMPs in sections 2.4 and 2.5 will be followed. It is expected that any adverse affects to listed species due to disturbance or displacement will be minimal in terms of both intensity and duration.

4.1.2. Physical Disturbance to Species

Direct physical harm to fish, mammals, invertebrates, and plants is not expected from most CREP projects. However, while fish and wildlife are expected to temporarily vacate construction areas where they could be physically harmed in many cases, ground disturbances and the use of equipment and vehicles could directly affect fish redds, fish in isolated habitats such as springs or ponds, or sites that support invertebrates or plants that are not able to move away from construction disturbances.

Soil disturbing activities and the use of equipment will not occur in areas with listed plants and Fender’s blue butterfly, with the exception of mowing. There are likely to be short-term adverse effects from mowing. However, the long-term effects have been shown to be almost exclusively beneficial. Extensive research has been conducted in the last decade on the effects of various mowing regimes on rare species; these studies have shown that mowing is an important tool for restoring native prairies and increasing populations of associated sensitive praire species (U.S. Fish and Wildlife Service 2008a).

Potential physical impacts to fish should be minimized on projects where water is diverted and pumped for livestock watering facilities or irrigation of revegetated areas due to the use of fish screens that meet NOAA Fisheries screening criteria. The installation of pumps for water diversions over 0.5 cfs is not covered under this programmatic consultation in areas where listed suckers or Oregon chub may occur due to the potential for these species to become entrained or impinged on fish screens, and the need for further effects analyses and project design considerations on larger diversions. However, most if not all CREP activities involving water diversions (i.e., irrigation and watering facilities) will involve less than 0.5 cfs and will be covered.

Herbicide applications also have the potential to cause adverse physical effects to listed species, as discussed in section 4.3. However, the BMPs discussed in sections 2.4 and 2.5 have been developed to avoid and minimize these potential effects.

4.2. Mechanical Effects

4.2.1. Terrestrial Habitats

Mechanical activities in terrestrial habitats are generally associated with the removal of invasive and nonnative vegetation by disking, tilling or grubbing. Planting, mowing, creating vernal pools, breaking tile, and installation of livestock fencing, crossings and watering facilities may also involve mechanical equipment and activities that result in ground disturbance. Most of the project sites will be in areas that have been degraded due to past and present agricultural activity. These practices have reduced or eliminated habitat suitability for many species that depend on them.

Terrestrial habitats will be directly affected by any of the restoration activities proposing to restore or enhance riparian, upland, wetland, and estuarine areas. These activities will help to restore the composition and structural diversity of native plant communities and hydrological functions.

Habitat modifications will be restricted to immediate project vicinities. Soil disturbance and compaction or removal of existing woody and herbaceous vegetation may occur on project sites requiring the use of heavy equipment. Important habitat features and native vegetation will be maintained, to the extent possible, during construction activities, although some may be impacted. Affected areas will be restricted and the effects are expected to be short-term, or avoided altogether, because of the implementation of BMPs. Dispersal and travel corridors for wildlife species will be improved as project sites are stabilized and native vegetation recovers over time.

4.2.2. Aquatic Habitats

Mechanical activities such as site preparation for some CREP projects may cause temporary adverse affects to aquatic habitat. It is possible, although not likely due to the BMPs that will be followed, that some sediment could enter streams, slightly affecting fish spawning areas and juveniles or adults through siltation or turbidity.

Construction-related sediments may enter a water source through soil disturbance and use of heavy equipment, particularly during in-water work activities. These sediments may appear as localized increases in turbidity due to fine sediments. Sediment increases may occur during the implementation of an activity. Sediment could also be carried by surface runoff when erosion control structures are removed. The time duration for the turbidity increase is dependent on several factors, including:

- Type of erosion control structures installed at the project site
- Ability to remove sediments from behind work isolation structures before removal
- Amount of area that was originally disturbed and the local topography of the area
- Distance between the structure or activity and the water source, including the amount and type of filter materials in the buffer area
- Time duration between the completion of the activity and onset of high flows or heavy rains

Also, there is the potential for short-term shade reduction from removal of riparian weeds, which could slightly affect stream temperatures or dissolved oxygen levels. This may cause short-term stress to fish adults, juveniles and eggs. There is also a small potential for these activities to affect aquatic and terrestrial insect populations, which would possibly reduce food availability for juveniles and adults.

The short-term positive environmental impacts of CREP include reduced sedimentation by reducing tillage and livestock activity in sensitive areas, reduced introduction of agricultural chemicals into streams from adjacent croplands, and increased bank stability.

The long-term effects of CREP projects to aquatic habitats are highly beneficial. Exclusion of livestock from streams should reduce bank erosion and sediment delivery and reduce the potential for fish spawning site destruction or egg trampling. Reestablishment of riparian vegetation should increase shade, lowering stream temperatures and allowing for higher dissolved oxygen levels. Riparian vegetation will also provide bank stability, and in some areas, encourage large woody debris inputs to streams, both of which will enhance aquatic habitat.

To minimize short-term impacts to aquatic habitats and maximize long-term benefits, the following BMPs will be followed.

- Whenever possible, livestock will be excluded from streams and riparian areas altogether.
- If livestock crossings are needed, livestock fords will only be constructed on the smallest streams, generally 10 feet or less in width at mean high water level. Fords will not be placed on the mid- to downstream end of gravel point bars. Fords will generally be 30 feet or less in width. Fords will be appropriately rocked to stabilize soils/slopes and prevent erosion. Fords will be placed on bedrock or stable substrates whenever possible.
- Off-channel livestock watering facilities will not be located in areas where compaction and/or damage could occur to sensitive soils, slopes, or vegetation due to congregating livestock.
- Sedimentation and erosion controls will be implemented on all project sites where the implementation of restoration activities has the potential to deposit sediment into a stream or waterbody. Structures/techniques must be placed and/or anchored appropriately to prevent adverse impacts to down slope habitats. Control structures/techniques may include, but are not limited to, silt fences, straw bale structures, seeding by hand and hydro-seeding, jutte mats, and coconut logs. Grading and shaping will generally restore natural topography and hydrology.

4.3. Chemical Effects

Chemical effects are possible to both terrestrial and aquatic species. Possible adverse effects to terrestrial species include impacts from direct spray or drift from herbicide applications, or direct impacts from equipment leaks or fuel spills. Possible adverse effects to aquatic species include runoff of eroded sediment and adsorbed chemicals to streams. The BMPs in sections 2.4 and 2.5 greatly reduce the risks of potential adverse effects associated with chemicals.

Long-term water quality effects from CREP are expected to be highly positive. The quality of water sources should improve over time because of the reduction or elimination of chronic sediment sources, control of point and nonpoint source pollutants, increased dissolved oxygen, and temperature abatement.

4.3.1. Herbicide Applications

This section provides an overview of the, potential effects to listed species from herbicides used on CREP projects and describes Best Management Practices to minimize effects.

On many CREP projects, landowners or contractors apply manufactured or synthetic herbicides to plants or soil. Herbicides may be applied (a) before planting trees, shrubs and other vegetation to reduce competing vegetation; (b) after planting to reduce competing vegetation and get the plantings to a "free-to-grow" condition; and (c) throughout the life of the CREP contract to control noxious weeds and invasive plants.

The decision of whether to use herbicides to control competing vegetation with CREP plantings over other control methods is based on integrated weed management principles. Decisions are made based on whether other methods or combination of methods are known to be effective on the species in similar habitat. In most cases, if an herbicide is selected, it is used in combination with other methods. For example, initial treatment on an invasive species may be done by an herbicide, but then manual or mechanical methods are implemented as maintenance treatments over the long term.

Herbicides interfere with plant metabolic processes, stopping growth and usually killing the plant. They may control all types of vegetation (non-selective herbicides), or they selectively control either some broadleaf plants or grasses while not affecting others (selective). Some herbicides may control only actively growing vegetation at the time of application, or they may provide invasive plant control through root uptake from the soil (short-term to over a few years). Those differences in selectivity are the basis for developing herbicide recommendations in CREP planting plans while minimizing adverse effects and facilitating success of the CREP plantings. The choice of herbicide is based on the target competing species, how it reproduces, its seed viability, the size of its population, site conditions, known effectiveness under similar site conditions and the ability to mitigate effects on non-target species.

Physical forms of herbicides vary. Some may be oil- or water-soluble molecules dissolved in liquids, or attached to granules for dry application to soil surface. Each herbicide is sold as one or more commercial products, called formulations. The product label for herbicide formulation provides legally binding direction on its use, including safe handling practices, application rates, and practices to protect human health and the environment. Label application restrictions can also limit the number of herbicides available to control any site-specific invasive plant infestations.

Herbicides may be applied with a variety of equipment and techniques. The techniques vary in effectiveness, environmental effects, and costs. Herbicides may be spot sprayed with backpack sprayers, applied in granular form around seedlings planted through CREP, or sprayed via ground vehicles with hose sprayers or booms using an array of spray nozzles.

Some application equipment is most often used for selective treatment and/or to minimize non-target effects. Backpack sprayers are most frequently used to spray the foliage, stem, and/or surrounding soil of target invasive plants. Other equipment includes herbicide-soaked wicks or paintbrushes for wiping target vegetation, and lances, hatches or syringes for injection of herbicide onto stems of target plants. Granular herbicides may be applied using hand-held seeders, or other specialized dispensing devices.

Herbicides may move from their location of application through leaching (dissolved in water as it moves through soil), dissolution in surface runoff, volatilization (moving through air as a dissolved gas), spray drift, and erosion (adsorbed by molecular electrical charges to soil particles that are moved by wind or water). In soil and water, herbicides may persist or be decomposed by sunlight, microorganisms, hydrolysis, or other factors.

Generally, active ingredients have been tested on only a limited number of species and mostly under laboratory conditions. While laboratory experiments can be used to determine acute toxicity and effects to reproduction, cancer rates, birth defect rates, and other effects that must be considered, laboratory experiments do not account for wildlife in their natural environments. This leads to uncertainty in the risk assessment analysis. Environmental stressors can increase the adverse effects of contaminants, but the degree to which these effects may occur for various herbicides is largely unknown. Adverse effects to wildlife health such as lethargy, weight loss, nausea, and fluid loss due to diarrhea or vomiting, can affect their ability to compete for food, locate and/or capture food, avoid or fight off predators, or reproduce.

4.3.1.1. Effects of Herbicide Applications to Terrestrial Wildlife

The information in this section is from an analysis of herbicide effects to wildlife prepared by the U.S. Forest Service, Region 6, which used FS/SERA risk assessments and published literature as the primary sources of information. The analysis evaluates potential effects of both acute and chronic herbicide exposures. To examine potential effects of herbicide applications to Oregon's listed mammal species potentially affected by CREP projects, the Columbian white-tailed deer, the analyses for a 70 kg mammal are included below. Assumptions used in the analyses are that a deer-sized animal (70 kg mammal) consumes contaminated grass (grass has higher herbicide residues), daily food consumption is 14/16 kg/day (equal to 20 percent of body weight), and one day's diet is 100 percent contaminated.

As discussed below in sections 4.3.1.1.1 through 4.3.1.1.14 for specific herbicides, aminopyralid, chlorsulfuron, imazapic, imazapyr and metsulfuron methyl do not appear to pose any plausible risk to terrestrial wildlife or bees at either the typical or highest application rates. When an herbicide does pose plausible risk, it is consistently insectivorous and grass-eating animals that are most likely to receive doses above the toxicity index. Direct spray of mammals is a concern only for 2,4-D and NPE surfactants at the typical application rate, and additionally, dicamba at the highest application rate. Consumption of contaminated water, even as the result of an accidental spill, results in doses well below the toxicity index for all herbicides. For the herbicides considered in this analysis, birds are less sensitive than mammals to acute exposures. Chronic toxicity data on birds is often limited.

Dicamba, triclopyr, and 2,4-D have the highest potential to adversely affect wildlife. Dicamba has a relatively low acute toxicity to adult animals, in terms of direct lethal doses, but adverse effects on reproduction and nervous systems can occur at much lower doses. Dicamba shows a consistent pattern of increased toxicity to larger sized animals, across several species and animal types (i.e., birds and mammals). Dicamba exposures exceed the toxicity indices for five scenarios at the typical application rate, and nine scenarios at the highest application rate.

Triclopyr TEA and BEE are somewhat more toxic to birds than triclopyr acid. The toxicities of these compounds to mammals show no remarkable differences. Triclopyr can be acutely lethal only at very high doses. However, indications of adverse effects to the kidney can occur at very low doses, at least in dogs. These adverse effects are indicated by increases in blood urea nitrogen and creatinine in dogs, but no histopathological changes to the kidneys were found. Triclopyr exposures exceed the toxicity indices for eight scenarios at the typical application rate, and 12 scenarios at the highest application rate.

Hexazinone has low acute toxicity to birds and mammals. Granular exposures do not appear to pose any plausible risk to terrestrial wildlife or bees at the typical application rate. However, exposures from the liquid form exceed the toxicity indices for one scenario at the typical application rate.

2,4-D also has a relatively low acute toxicity to mammals in terms of direct lethal doses, but signs of adverse effects to the nervous system or internal organs may occur at very low doses. 2,4-D shows a consistent pattern of increased toxicity to larger sized animals. Birds appear somewhat less sensitive than mammals to acute toxic effects. The toxicity indices for 2,4-D in the risk assessment (SERA, 1998) are inconsistent with the most sensitive effects reported for mammals (SERA, 1998, p. 3-52). Relying on the most sensitive effects, reported, 2,4-D use may produce exposures that can have adverse effects to terrestrial wildlife in 15 scenarios at the typical application rate, and 16 scenarios at the highest application rate.

Glyphosate, applied at the typical information rate, has little potential to adversely affect birds or mammals. An exception might be insectivorous birds that experience chronic exposures. There are no data available on the persistence or degradation of glyphosate residue on insects, so the acute dose is compared to the chronic toxicity index. This is an extremely protective approach and may greatly overestimate risk. However, it is worth noting so that appropriate protective measures may be taken when using glyphosate in the habitat of insectivorous birds. At the highest application rate, glyphosate has the potential to adversely affect large grass-eating mammals, and insectivorous birds and mammals in acute and chronic exposures. Additionally, grass-eating birds may be adversely affected in a chronic exposure. In total, glyphosate exposures exceed the toxicity indices for one scenario at the typical application rate, and eight exposures at the highest application rate.

Clopyralid, applied at the typical application rate, has little potential to adversely affect birds or mammals, except for insectivorous birds and mammals. There are no data available on the persistence or degradation of clopyralid residue on insects, so the acute dose is compared to the chronic toxicity index. This is an extremely protective approach and may greatly overestimate risk. However, it is worth noting so that appropriate protective measures may be taken when using clopyralid in the habitat of insectivorous birds and mammals. At the highest application rate, clopyralid may adversely affect grass-eating mammals, insectivorous birds and mammals and predatory birds eating small mammal prey for chronic exposures. The same qualification for chronic exposure to insectivorous animals applies to predatory birds, in that the acute dose is compared to the chronic toxicity index. No acute exposures exceed the toxicity indices. In total, clopyralid exposures exceed the toxicity indices for one exposure at the typical application rate, and four at the highest application rate.

In standard experimental toxicity studies in rates, mice, rabbits, and dogs, aminopyralid has low acute and chronic oral toxicity. Results of acute exposure studies in birds indicate that avian species appear no more sensitive than experimental mammals to aminopyralid in terms of acute lethality. In terms of non-lethal effects, however, birds may be somewhat more sensitive than mammals to aminopyralid after exposures.

The actual likelihood of exposing specific bird or mammal species depends on the application method, size of treatment area, habitat treated and season of application. In lieu of analyzing potential exposures at the site-specific level through individual consultations, severe exposure scenarios were analyzed in order to address this issue and potential effects programmatically. Actual exposures from CREP activities are expected to be much lower than those described in this section.

4.3.1.1.1. Aminopyralid

Large Herbivorous Mammal

The acute NOAEL (no observed adverse effect level) for mammals in laboratory toxicity tests is 104 mg/kg. For exposure scenarios that use the typical application rate of .08 lb/acre, if a 70 kg mammal consumed contaminated vegetation onsite shortly after application, assuming the highest residue rates and 100 percents of the diet contaminated, it would receive an acute dose of 3.79 mg/kg (SERA 2007 Aminopyralid, Worksheet F10). This dose is .04 of the acute NOAEL, so there is no basis for asserting or predicting that adverse effects to mammals are plausible (SERA 2007 Aminopyralid, p. 101).

The chronic NOAEL for mammals in laboratory toxicity tests is 50 mg/kg/day. Chronic exposure from the consumption of contaminated vegetation for 90 days at the treatment site, assuming the highest residue rates, results in a dose of .968 mg/kg (SERA, 2007 Aminopyralid, Worksheet F11a). This dose is .02 of the chronic NOAEL, so there is no basis for asserting or predicting that adverse effects to mammals are plausible (SERA, 2007 Aminopyralid, p. 101).

Estimated doses using the highest application rate (.11 lb/acre) are much less than the acute and chronic NOAELs for mammals, so there is no basis for asserting or predicting that adverse effects are plausible using typical or worst-case exposure scenarios (SERA, 2007-Aminopyralid, p. 101).

4.3.1.1.2. Chlorsulfuron

Large Herbivorous Mammal

The acute NOAEL for mammals in laboratory toxicity tests is 75 mg/kg. For exposure scenarios that use the typical application rate of .056 lb/acre, if a 70 kg mammal consumed contaminated vegetation onsite shortly after application, assuming the highest residue rates and 100 percents of the diet contaminated, it would receive an acute dose of 2.72 mg/kg (SERA 2003 Chlorsulfuron, Worksheet F10). This does is .036 of the acute NOAEL, so there is no basis for asserting or predicting that adverse effects to large herbivorous mammals are plausible (SERA 2003-Chlorsulfuron, p. 4-27).

The chronic NOAEL for mammals in laboratory toxicity tests is 5 mg/kg/day. Chronic exposure from the consumption of contaminated vegetation for 90 days at the treatment site, assuming the highest residue rates, results in a dose of 1.14 mg/kg (SERA, 2003-Chlorsulfuron, Worksheet F11a). This dose is .228 of the chronic NOAEL, so there is no basis for asserting or predicting that adverse effects to large herbivorous mammals are plausible (SERA, 2003-Chlorsulfuron, P. 4-27).

Estimated doses using the highest application rate (.25 lb/acre) are less than the acute NOAEL and equal to the chronic NOAEL for mammals. No exposure exceeds the NOAEL, so no adverse effects are plausible from acute or chronic dietary exposures. The assumptions in the chronic exposure scenario are very unlikely to occur in field conditions, so the weight of evidence suggests that no adverse effects are plausible using typical or worst-case exposure assumptions (SERA, 2003-Chlorsulfuron, p. 4-28).

4.3.1.1.3. Clopyralid

Large Herbivorous Mammal

The acute NOAEL for mammals in laboratory toxicity tests is 75 mg/kg. For exposure scenarios that use the typical application rate of .35 lb/acre, if a 70 kg mammal consumed contaminated vegetation on site shortly after application, assuming the highest residue rates and 100 percents of the diet contaminated, it would receive an acute dose of 17 mg/kg (SERA, 2003-Clopyralid, Worksheet F10). This dose is .2 times the acute NOAEL, so there is no basis for asserting or predicting that adverse effects to large herbivorous mammals are plausible (SERA, 2003-Clopyralid, p. 4-23).

The chronic NOAEL for mammals in laboratory toxicity tests is 15 mg/kg/day. Chronic exposure from the consumption of contaminated vegetation for 90 days at the treatment site, assuming the highest residue rates, results in a dose of 8.95 mg/kg/day (SERA, 2003-Clopyralid, Worksheet F11a). This dose is .6 of the chronic NOAEL, so there is no basis for asserting or predicting that adverse effects to large herbivorous mammals are plausible (SERA, 2003-Clopyralid, p. 4-23).

Estimated doses using the highest application rate (.50 lb/acre) are less than the acute and chronic NOAELs for mammals, although only marginally so for the chronic NOAEL. Since both doses are still below the NOAEL, there is no basis for asserting or predicting that adverse effects are plausible using typical or worst-case exposure assumptions (SERA, 2003-Clopyralid, p. 4-23).

4.3.1.1.4. Dicamba

Large Herbivorous Mammal

The acute NOAEL for large mammals in laboratory toxicity test is 3 mg/kg. For exposure scenarios that use the typical application rate of .3 lb/acre, if a 70 kg mammal consumed contaminated vegetation onsite shortly after application, it would receive an acute dose of 14.6 mg/kg (SERA, 2003-Dicamba, Worksheet F10). This dose is greater than the acute NOAEL and also exceeds the acute Lowest Observed Adverse Effect Level (LOAEL) for large mammals (10 mg/kg). Since the toxicity index is based on reproductive effects, the interpretation of risk is made with respect to the toxicity studies on which the NOAEL is based (SERA, 2003-Dicamba, p. 4-33). Therefore, adverse effects to the reproductive ability of large grass-eating mammals are plausible at the typical application rate (SERA, 2003-Dicamba, p. 4-31).

The chronic NOAEL for both large and small mammals in laboratory toxicity tests is 3 mg/kg/day, based on the same studies used to determine the acute NOAEL for large mammals. Chronic exposure from the consumption of contaminated vegetation for 90 days at the treatment site, assuming the highest residue rates, results in a dose of 2.10 mg/kg/day (SERA 2003 Dicamba, Worksheet F11a). This dose if .7 of the chronic NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2003-Dicamba, p. 4-32).

Estimated doses using the highest application rate (2.0 lb/acre) are greater than the acute NOAEL and greater than the chronic NOAEL for mammals. The acute dose (97.3 mg/kg) is intermediate between the NOAEL for neurotoxicity (30 mg/kg) and the LOAEL for neurotoxicity, so adverse effects to nervous systems are not expected, but are plausible (SERA 2003 Dicamba, p. 4-33). However, the acute dose is a factor of 10 above the LOAEL for reproductive effects, so adverse effects to reproduction would not only be plausible, they are expected at the highest application rate (SERA, 2003-Dicamba, p. 4-33). The chronic dose (14.0 mg/kg/day) is greater than the chronic LOAEL (10 mg/kg/day) for reproductive effects. Adverse effects to reproduction are also plausible for chronic exposure.

4.3.1.1.5. Glyphosate

Large herbivorous mammal

The acute NOAEL for mammals in laboratory toxicity tests is 175 mg/kg. For exposure scenarios that use the typical application rate of 2 lb/acre, if a 70 kg mammal consumed contaminated vegetation after application, assuming the highest residue rates and 100 percent of the diet contaminated, it would receive an acute dose of 97.1 mg/kg (SERA, 2003-Glyphosate, Worksheet F10). This dose is .6 of the acute NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2003-Glyphosate, p. 4-43).

The chronic NOAEL for mammals in laboratory toxicity tests is 175 mg/kg/day. Chronic exposure from the consumption of contaminated vegetation for 90 days at the treatment site, assuming the highest residue rates, results in a dose of 53.2 mg/kg/day (SERA, 2003-Glyphosate, worksheet F11a). This dose is .3 of the chronic NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2003-Glyphosate, P. 4-43).

Estimated doses using the highest application rate (7 lb/acre) result in doses greater than the acute and equal to the chronic NOAEL for mammals. The acute dose is equal to a NOAEL that resulted in some mortality to pregnant rabbits. Thus, while the acute dose to herbivorous mammals at the highest application rate is well below the Lethal Dose, 50% kill rate (LD 50) (2000 mg/kg), mortality in some animals would be plausible (SERA, 2003-Glyphosate, p. 4-44).

4.3.1.1.6. Hexazinone

Large Herbivorous Mammal

The acute NOAEL for mammals in laboratory toxicity tests is 100 mg/kg. For exposure scenarios that use the typical application rate of 2 lb/acre, if a 70-kg mammal consumed contaminated vegetation on site shortly after an application, assuming the highest residue rates and 100 percents of the diet contaminated, it would receive an acute dose of 97.1 mg/kg using the liquid form and 3.88 mg/kg using the granular form (SERA, 2003-Hexazinone-liquid formulations, Worksheet F10 and SERA, 2003-Hexazinone-granular formulations, Worksheet F10). These doses are .97 and .0388 of the acute NOAEL, respectively, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2003-Hexazinone, p. 4-26)

The chronic NOAEL for mammals in laboratory toxicity tests is 5 mg/kg/day. Chronic exposure from the consumption of contaminated vegetation for 90 days at the treatment site, assuming the highest residue rates, results in a dose of 41 mg/kg/day using the liquid form and 1.63 mg/kg/day using the granular form (SERA, 2003-Hexazinone, Worksheet F11a). The dose received from a liquid application of hexazinone is 8 times higher than the chronic NOAEL, so adverse effects to large grass-eating mammals are possible from chronic exposure to a liquid application (SERA, 2003-Hexazinone, p. 4-27). The dose received from a granular application is .33 of the chronic

NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible from a granular application (SERA, 2003-Hexazinone, p. 4-27).

Estimated doses using the highest application rate (4 lb/acre) are higher than the acute and chronic NOAEL for mammals using the liquid form, so adverse effects to large grass-eating mammals are possible from liquid applications (SERA, 2003-Hexazinone, pp. 4-26-4-27). Estimated doses using the highest application rate of the granular form are less than the acute and chronic NOAEL for mammals, so there is no basis for asserting or predicting that adverse effects are plausible using typical or worst-case exposure assumptions for the granular form.

4.3.1.1.7. Imazapic

Large Herbivorous Mammal

The acute NOAEL for mammals in laboratory toxicity tests is 350 mg/kg. For exposure scenarios that use the typical application rate of 0.1 lb/acre, if a 70 kg mammal consumed contaminated vegetation on site shortly after application, assuming the highest residue rates and 100 percents of the diet contaminated, it would receive an acute dose of 4.86 mg/kg (SERA, 2003-Imazapic, Worksheet F10). This dose is 0.01 of the acute NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA 2003 Imazapic, p. 4-21).

The chronic NOAEL for mammals in laboratory toxicity tests is 45 mg/kg/day. Chronic exposure from the consumption of contaminated vegetation for 90 days at the treatment site, assuming the highest residue rates, results in a dose of 0.929 mg/kg/day (SERA, 2003- Imazapic, Worksheet F11a). This dose is 0.02 of the chronic NOAEL, so there is no/ basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2003-Imazapic, p. 4-21).

Estimated doses using the highest application rate (0.1875 lb/acre) are less than the acute and chronic NOAELs for mammals, so there is no basis for asserting or predicting that adverse effects are plausible using typical or worst-case exposure assumptions (SERA, 20030- Imazapic, p. 4-21).

4.3.1.1.8. Imazapyr

Large herbivorous mammal

The acute NOAEL for mammals in laboratory toxicity tests is 250 mg/kg. For exposure scenarios that use the typical application rate of .45 lb/acre, if a 70-kg mammal consumed contaminated vegetation on site shortly after application, assuming the highest residue rates and 100 percents of the diet contaminated, it would receive an acute dose of 21.9 mg/kg (SERA, 2003-Imazapyr, Worksheet F10). This dose is .09 of the acute NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2003-Imazapyr, p. 4-25)

The chronic NOAEL for mammals in laboratory toxicity tests is 250 mg/kg/day. Chronic exposure from the consumption of contaminated vegetation for 90 days at the treatment site, assuming the highest residue rates, results in a dose of 10.6 mg/kg/day (SERA, 2003-Imazapyr, Worksheet F11a). This dose is .04 of the chronic NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2003-Imazapyr, p. 4-25).

Estimated doses using the highest application rate (1.25 lb/acre) are less than the acute and chronic NOAEL for mammals, so there is no basis for asserting or predicting that adverse effects are plausible using typical or worst-case exposure assumptions (SERA, 2003-Imazapyr, p. 4-25).

4.3.1.1.9. Methsulfuron methyl

Large Herbivorous Mammal

The acute NOAEL for mammals in laboratory toxicity tests is 25 mg/kg. For exposure scenarios that use the typical application rate of .03 lb/acre, if a 70-kg mammal consumed contaminated vegetation onsite shortly after application, assuming the highest residue rates and 100 percents of the diet contaminated, it would receive an acute dose of 1.46 mg/kg (SERA, 2003-Metsulfuron methyl, Worksheet F10). This dose is .06 of the acute NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2003-Metsulfuron methyl, p. 4-26). The chronic NOAEL for mammals in laboratory toxicity tests is 25 mg/kg/day. Chronic exposure from the consumption of contaminated vegetation for 90 days at the treatment site, assuming the highest residue rates, results in a dose of .613 mg/kg/day (SERA, 2003-Metsulfuron methyl, Worksheet F11a). This dose if .02 of the chronic NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2003-Metsulfuron methyl, p. 4-27).

Estimated doses using the highest application rate (.15 lb/acre) are less than the acute and chronic NOAEL for mammals, so there is no basis for asserting or predicting that adverse effects are plausible using typical or worst-case exposure assumptions (SERA 2003 Metsulfuron methyl, p. 4-27).

4.3.1.1.10. Picloram

Large herbivorous mammal

The acute NOAEL for mammals in laboratory toxicity tests is 34 mg/kg. For exposure scenarios that use the typical application rate of .35 lb/acre, if a 70 kg mammal consumed contaminated vegetation onsite shortly after application, assuming the highest residue rates and 100 percents of the diet contaminated, it would receive an acute dose of 17.0 mg/kg (SERA, 2003-Picloram, p. 4-29). The chronic NOAEL for mammals in laboratory toxicity tests is 7 mg/kg/day. Chronic exposure from the consumption of contaminated vegetation is 90 days at the treatment site, assuming the highest residue rates, results in a dose of 2.18 mg/kg/day (SERA 2003 Picloram, Worksheet F11a). This dose is .3 of the chronic NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2003-Picloram, p. 4-29).

Estimated doses using the highest application rate (1 lb/acre) are greater than the acute NOAEL and about equal to the chronic NOAEL for mammals. The acute dose (48.6 mg/kg) is less than the acute LOAEL for decreased weight gain in rabbits (USEPA/OPP, 1998). No adverse effects are plausible from chronic exposures, but adverse effects to large herbivorous mammals may be plausible from acute dietary exposures.

4.3.1.1.11. Sethoxydim

<u>Large herbivorous mammal</u>

The acute NOAEL for mammals in laboratory toxicity tests is 160 mg/kg. For exposure scenarios that use the typical application rate of 0.30 lb/acre, if a 70 kg mammal consumed contaminated vegetation on site shortly after application, assuming the highest residue rates and 100 percent of the diet contaminated, it would receive an acute dose of 14.6 mg/kg (Project file, Sethoxdim Worksheet F10). This dose is 0.09 of the acute NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2001-Sethoxydim, p. 4-19).

The chronic NOAEL for mammals in laboratory toxicity tests is 9 mg/kg/day. Chronic exposure from the consumption of contaminated vegetation for 90 days at the treatment site, assuming the highest residue rates, results in a dose of 0.701 mg/kg/day (Project file, Sethoxdim Worksheet F11a). This dose is 0.08 of the chronic NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2001-Sethoxydim, p. 4-19).

Estimated doses using the highest application rate (0.375 lb/acre) are less the acute and chronic NOAELs for mammals, so there is no basis for asserting or predicting that adverse effects are plausible using typical or worst-case exposure assumptions (SERA 2001 Sethoxydim, p. 4-19).

4.3.1.1.12. Sulfometuron methyl

<u>Large herbivorous mammal</u>

The acute NOAEL for mammals in laboratory toxicity tests is 87 mg/kg. For exposure scenarios that use the typical application rate of .045 lb/acre, if a 70 kg mammal consumed contaminated vegetation onsite shortly after application, assuming the highest residue rates and 100 percents of the diet contaminated, it would receive an acute dose of 2.19 mg/kg (SERA, 2003-Sulfometuron methyl, Worksheet F10). This dose is .03 of the acute NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2003-Sulfometuron methyl, p. 4-30).

The chronic NOAEL for mammals in laboratory toxicity tests is 2 mg/kg/day. Chronic exposure from the consumption of contaminated vegetation for 90 days at the treatment site, assuming the highest residue rates, results in a dose of .35 mg/kg/day (SERA, 2003-Sulfometuron methyl, Worksheet F11a). This dose is .2 of the chronic NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible (SERA, 2003-Sulfometuron methyl, p. 4-30).

Estimated doses using the highest application rate (.38 lb/acre) are less than the acute NOAEL, but greater than the chronic NOAEL for mammals. The chronic dose (2.95 mg/kg) is less than the chronic LOAEL (20 mg/kg/day) for effects to blood and bile ducts. No adverse effects are plausible from acute exposures, but adverse effects to large herbivorous mammals appear plausible from chronic dietary exposures, based on dose exceeding the chronic NOAEL. However, the assumptions in the chronic exposure scenario are very unlikely to occur in field conditions, so the weight of evidence suggests that no adverse effects are plausible using typical or worst-case exposure assumptions (SERA 2003 Sulfometuron methyl, p. 4-31).

4.3.1.1.13. Triclopyr [BEE] and Triclopyr [Amine]

Toxicity indices are the same for triclopyr acid and triclopyr BEE for mammals, but they differ for birds. The EPA has used two different values for a reference dose on the effects of triclopyr to mammals. The FS/SERA risk assessment (2003 Triclopyr) relies on a chronic toxicity index (NOEL of 5 mg/kg/day) from a rat reproduction study. In this analysis, we will use a lower value from a 1-year feeding study of dogs (chronic NOEL of .5 mg/kg/day; Quast et al 1976, cited in SERA, 2003-Triclopyr). Dogs were not considered by EPA to be a good model for human health effects, because they do not excrete weak acids as well as other animals (see Timchalk and Nolan 1997; Timchalk et al 1997). Canids are, however, relevant for concerns about effects to wildlife. It may be argued that the use of the .5 mg/kg/day value for the toxicity index in this analysis is overly cautious, because it represents competition for excretion rather than a toxic effect (Timchalk et al 1997), and because it is being applied to other animals besides canids. However, it meets the criteria for providing a data-based worst-case analysis for potential effects to wildlife and is therefore consistent with the criteria for choice of other indices used in this analysis.

<u>Large herbivorous mammal</u>

The acute NOAEL for mammals in laboratory toxicity tests is 100 mg/kg. For exposure scenarios that use the typical application rate of 1 lb/acre, if a 70 kg mammal consumed contaminated vegetation onsite shortly after application, assuming the highest residue rates and 100 percents of the diet contaminated, it would receive an acute dose of 48.6 mg/kg (SERA, 2003-Triclopyr, Worksheet F10). This dose is .5 of the acute NOAEL, so there is no basis for asserting or predicting that adverse effects to large grass-eating mammals are plausible.

The chronic NOAEL for mammals in laboratory toxicity tests is .5 mg/kg/day. Chronic exposure from the consumption of contaminated vegetation for 90 days at the treatment site, assuming the highest residue rates, results in a dose of 32.0 mg/kg/day (SERA, 2003-Triclopyr, Worksheet F11a). This dose is greater than the chronic NOAEL and 13 times greater than the LOAEL of 2.5 mg/kg for effects to kidneys. Adverse effects to grass-eating mammals are plausible and of substantial concern with the use of triclopyr (SERA, 2003-Triclopyr, p. 4-28).

Estimated doses using the highest application rate (10 lb/acre) are greater than the acute and chronic NOAEL for mammals. The acute dose is 486 mg/kg; which also exceeds the acute LOAEL for malformed fetuses. The chronic dose is 320 mg/kg, which exceeds the chronic LOAEL for effects to kidneys. Adverse effects to reproduction and internal organs of grass-eating mammals are plausible with acute and chronic exposures at the highest application rate. The potential for adverse effects are of substantial concern with the use of triclopyr (SERA, 2003-Triclopyr, p. 4-28).

4.3.1.1.14. 2,4-D

Large herbivorous mammal

The acute "non-lethal" dose for mammals in laboratory toxicity tests is 10 mg/kg. For exposure scenarios that use the typical application rate of 1 lb/acre, if a 70 kg mammal consumed contaminated vegetation onsite shortly after application, assuming the highest residue rates and 100 percents of the diet contaminated, it would receive an acute dose of 48.6 mg/kg (Project file, 2,4-D Worksheet F10). This dose is greater than the acute "non-lethal" dose. This dose is within the range of doses in which mild signs of systemic toxicity are plausible and sub-clinical signs of neurologic toxicity, increased thyroid weight, decreased testicular weight, decreased body weight gain, damage to several organs are expected (SERA, 1998, p. 3-52).

The chronic NOAEL for mammals in laboratory toxicity tests is 1 mg/kg/day. Chronic exposure from the consumption of contaminated vegetation for 90 days at the treatment site, assuming the highest residue rates, results in a dose of 10.8 mg/kg/day (Project file, 2,4-D Worksheet F11a). This dose is greater than the chronic NOAEL and the chronic LOAEL (5 mg/kg/day) for effects to kidney, blood, and liver. This dose is within the range of doses in which mild signs of systemic toxicity are plausible, and subclinical signs of neurologic toxicity, increased thyroid weight, decreased testicular weight, decreased body weight gain, damage to several organs are expected (SERA, 1998, p. 3-52)/

Estimated doses using the highest application rate (2 lbs/acre) are 97.1 mg/kg for acute doses and 21.5 mg/kg/day for chronic doses. The acute dose is much greater than the acute "non-lethal" dose and chronic LOAEL (5 mg/kg) for mammals (Project file, 2,4-D High Rate Worksheet WL Ex1). The acute dose is within the range of doses in which mild signs of systemic toxicity are plausible; sub-clinical signs of neurologic toxicity, increased thyroid weight, decreased testicular weight, decreased body weight gain, damage to several organs are expected; and mortality may occur (SERA, 1998, p. 3-52). The chronic dose is four times greater than the chronic LOAEL for effects to kidney, blood, and liver. Unlike the case with the chronic exposure scenario involving non-selective herbicides, the acute and chronic exposure scenario could occur in the field. 2,4-D is selective for broadleaved weeds, so if 2,4-D were broadcast sprayed in foraging habitat in attempt to control broadleaved weeds, the forage grasses with herbicide residue would remain available to large grass-eating mammals.

4.3.1.1.1. Summary of herbicide effects on mammals

Based on the predicted acute and chronic exposures, potential adverse effects to Columbian white-tailed deer are possible from some of the herbicides included in this BA. Table 6 summarizes the herbicides included in the BA and whether absorbed doses were predicted in SERA Assessments to exceed acute or chronic NOAELs for mammals. Herbicide use will be limited to chemicals and application rates that do not exceed the NOAELs, as discussed in the BMPs for Columbian white-tailed deer in section 2.5.3.

Table 6. Summary of herbicides and predicted NOAELs for mammals

Herbicide	Acute Exceedences	Chronic Exceedences
Aminopyralid	Dose was below acute NOAEL at typical and highest rates	Dose was below chronic NOAEL at typical and highest rates
Chlorsulfuron	Dose was below acute NOAEL at typical and highest rates	Dose was below chronic NOAEL at typical and highest rates
Clopyralid	Dose was below acute NOAEL at typical and highest rates	Dose was below chronic NOAEL at typical, but only marginally below at highest rates
Dicamba	Dose exceeded acute NOAEL at typical and highest application rates	Dose exceeded chronic NOAEL at highest rate, dose was below NOAEL at typical rate
Glyphosate	Dose exceeded NOAEL at highest application rate, dose was below acute NOAEL at typical rate	Dose exceeded NOAEL at highest application rate, dose was below NOAEL at typical rate
Hexazinone - granular	Dose was below acute NOAEL at typical and highest rates	Dose was below chronic NOAEL at typical and highest rates
Hexazinone - liquid	Dose exceeded NOAEL at highest application rate, dose was below NOAEL at typical application rate	Dose exceeded NOAEL at typical and highest application rates
Imazapic	Dose was below acute NOAEL at typical and highest rates	Dose was below chronic NOAEL at typical and highest rates
Imazapyr	Dose was below acute NOAEL at typical and highest rates	Dose was below chronic NOAEL at typical and highest rates
Metsulfuron methyl	Dose was below acute NOAEL at typical and highest rates	Dose was below chronic NOAEL at typical and highest rates
Picloram	Dose exceeded NOAEL at highest application rate, dose was below NOAEL at typical application rate	Dose was below chronic NOAEL at typical and highest rates
Sethoxydim	Dose was below acute NOAEL at typical and highest rates	Dose was below chronic NOAEL at typical and highest rates
Sulfometuron methyl	Dose was below acute NOAEL at typical and highest rates	Dose exceeded NOAEL at highest application rate, dose was below NOAEL at typical application rate
Triclopyr	Dose exceeded NOAEL at highest application rate, dose was below NOAEL at typical application rate	Dose exceeded NOAEL at typical and highest application rates
2,4-D	Dose exceeded NOAEL at typical and highest application rates	Dose exceeded NOAEL at typical and highest application rates

4.3.1.2. Effects of Herbicide Applications to Listed Fish

This section evaluates potential effects of herbicide applications to listed fish. Both anadromous and inland fish species are included in the evaluation. Some of the PCEs for designated critical habitats are also evaluated in this section, although they are discussed more specifically for each species in section 5.

The following three general herbicide exposure scenarios were identified that have the potential to adversely affect listed fish.

- Runoff from riparian application along streams, lakes and ponds
- Runoff from treated ditches and dry intermittent streams
- Application within perennial streams

Each exposure scenario was analyzed to determine the level of acute exposure risk. The risk of chronic exposure from the herbicides included in the activity description was analyzed, and that analysis is summarized below.

Dicamba was not included in the chronic effects analysis because no information is available on the chronic toxicity of dicamba to aquatic animals and the available acute toxicity data do not permit reasonable estimates of toxicity values for chronic toxicity (SERA, 2003-Dicamba). Given the short half life of dicamba salt in soil, its high solubility and low sorption coefficient, it is likely that dicamba would either move offsite or degrade in the soil quickly enough to prevent chronic effects to aquatic life.

The chronic effects analysis concluded that an insufficient amount of the proposed herbicides would be applied in the 10 acre/small stream scenario to result in exposure of fish and aquatic invertebrates to chronic effects threshold concentrations for the standard durations (90 days for fish, 21 days for aquatic invertebrates). The analysis also concluded that chronic effects to algae (21 days) from herbicides in this activity description other than hexazinone and sulfometuron are not possible, and that chronic effects to algae from sulfometuron are unlikely. Chronic effects to aquatic macrophytes (21 days) from clopyralid, glyphosate, 2,4-D amine and ester, and sethoxydim were determined not to be possible, not likely to occur for imazapyr, metsulfuron, and sulfometuron, and likely to occur for hexazinone and for chlorsulfuron under some conditions. The chronic exposure analysis determined that adverse effects to aquatic macrophytes are likely for chlorsulfuron when 10 or more streamside acres are treated at application rates greater than about 0.08 pounds a.i.[3]/acre (0.056 pounds a.i./acre is the typical rate, and 0.25 pounds a.i./acre is the maximum rate).

[3] a.i. = active ingredient

Table 7. Summary of application zones and techniques

Herbicide	Perennial/flowing channels; lakes and ponds			Dry intermittent and ephemeral channels, and ditches		
	Spot spray	Hand/select	Broadcast Spray	Spot spray	Hand/select	Broadcast spray
Aminopyralid	EOW[1]	EOW	15 feet from HWM[2]	Allowed through channel/ditch	Allowed through channel/ditch	Allowed through channel/ditch
Chlorsulfuron	HWM	HWM	25 feet from HWM	HWM	HWM	25 feet from HWM
Clopyralid	HWM	HWM	15 feet from HWM	HWM	HWM	HWM
Dicamba	15 feet from HWM	15 feet from HWM	15 feet from HWM	Allowed through channel/ditch	Allowed through channel/ditch	Allowed through channel/ditch
Glyphosate (aquatic)	EOW and emergent	EOW and emergent	15 feet from HWM	Allowed through channel/ditch	Allowed through channel/ditch	Allowed through channel/ditch
Hexazinone	15 feet from HWM	15 feet from HWM	25 feet from HWM	Allowed through channel/ditch	Allowed through channel/ditch	Allowed through channel/ditch
Imazapic	HWM	HWM	15 feet from HWM	Allowed through channel/ditch	Allowed through channel/ditch	Allowed through channel/ditch
Imazapyr	EOW and emergent[3]	EOW and emergent	25 feet from HWM	Allowed through channel/ditch	Allowed through channel/ditch	Allowed through channel/ditch
Metsulfuron methyl	HWM	HWM	25 feet from HWM	HWM	HWM	25 feet from HWM
Picloram	15 feet from HWM	15 feet from HWM	15 feet from HWM	Allowed through channel/ditch	Allowed through channel/ditch	Allowed through channel/ditch
Sethoxydim	HWM	HWM	15 feet from HWM	HWM	HWM	15 feet from HWM
Sulfometuron methyl	HWM	HWM	25 feet from HWM	HWM	HWM	25 feet from HWM
Triclopyr BEE	25 feet from HWM	25 feet from HWM	Not allowed	25 feet from HWM	25 feet from HWM	Not allowed
Triclopyr amine	EOW	EOW and emergent	25 feet from HWM	Allowed through channel/ditch	Allowed through channel/ditch	25 feet from HWM
2,4-D amine	HWM	HWM	15 feet from HWM	HWM	HWM	15 feet from HWM
2,4-D ester	HWM	HWM	15 feet from HWM	HWM	HWM	15 feet from HWM

[1] Edge of water
[2] High water mark
[3] Aquatic formulations only for emergent application

The project application zones and techniques proposed to minimize herbicide exposure and water quality effects are displayed in Table 7. Design criteria include both equipment restrictions and application zones. Design criteria are likely to minimize exposure from leaching and surface runoff from riparian, ditch, and ephemeral/intermittent channel applications by reducing herbicide/soil contact in areas nearest to flowing streams and reducing drift. Design criteria are likely to minimize exposure from applications to emergent plants by resulting in more precise application and reducing drift.

The risk of adverse effects to listed fish and their habitat was evaluated in terms of hazard quotient (HQ) values. Hazard quotients are calculated by dividing the expected environmental concentration by the effects threshold concentration. If this value is >1, then adverse effects are considered likely to occur. Hazard quotient values were calculated for fish, aquatic invertebrates, algae, and aquatic macrophytes.

Adverse effect threshold values for each species group were defined as either 1/20th of the LC_{50} value for listed salmonids, 1/10th of the LC_{50} value for non-listed aquatic species, or the lowest acute or chronic "no observable effect concentration" (NOEC), whichever was lower, found in available literature. Generally, effect threshold values for listed salmonids were lower than values for other fish species groups, so values for salmonids were also used to evaluate potential effects to other listed fish. In the case of sulfometuron methyl, threshold values for fathead minnow were lower than salmonid values, so threshold values for minnow were used to evaluate effects to listed fish.

Runoff from Riparian Application

This section addresses exposure risk in both small streams and the margins of larger streams from herbicide application in riparian areas. The analysis is based on the small stream scenario used in the risk assessments performed by Syracuse Environmental Research Associates (SERA) for the USFS[4], and provides a high-risk exposure scenario. The exposure scenario is for a 10-acre herbicide application adjacent to a small stream (base flow of 1.8 cfs).

Since several relevant parameters of the margins of larger streams are analogous to the small stream scenario modeled, the small stream analysis results are extended to stream margin habitat. Stream margins often provide shallow, low flow habitat, have a slow mixing rate with mainstem waters, and may also be the site at which subsurface runoff is introduced.

Early stage juvenile salmonids, particularly recently emerged fry, often utilize low flow areas along stream margins (Groot and Margolis 1991; Quinn 2005). As juveniles grow, they migrate away from margins, occupying habitats of progressively higher velocity (Lister and Genoe 1970; Everest and Chapman 1972). Weber and Fausch (2004) found that wild Chinook salmon reared near the river margin until reaching about 60 mm in length. Stream margins are utilized by salmonids for a variety of reasons, including nocturnal resting (Roussel and Bardonnet 1999; Polacek and James 2003), summer and winter thermal refuge (U.S. EPA 1999), predator avoidance (Roussel and Bardonnet 1999), and flow refuge (Roussel and Bardonnet 1999).

[4] Syracuse Environmental Research Associates risk assessments are available at: http://www.fs.fed.us/foresthealth/pesticide/risk.shtml

This section also evaluates exposure to inland fish using the small pond scenario used in the risk assessments performed by Syracuse Environmental Research Associates (SERA) for the USFS[5], and provides a high risk exposure scenario. The exposure scenario is for a 10 acre herbicide application adjacent to a small pond.

Exposure resulting from riparian applications occurs when rainfall mobilizes herbicides and associated compounds by dissolution and percolation through soils or into surface runoff, and ultimately into stream channels. Soil erosion can also deliver herbicides from riparian applications.

Table 8 summarizes the results of the small stream exposure analysis (Appendix E, small stream analysis spreadsheet). Water contamination rate (WCR) values used in this analysis are the modeled values reported in the SERA risk assessments. The small stream exposure analysis used WCR values for annual rainfall rates of 15, 50, and 150 inches per year, typical and maximum herbicide application rates, and effects threshold concentrations to calculate HQ values.

Table 9 summarizes the results of the small pond exposure analysis (Appendix E, small pond analysis spreadsheet*)*. Water contamination rate (WCR) values used in this analysis are the modeled values reported in the SERA risk assessments. The small pond exposure analysis used WCR values for annual rainfall rates of 15, 50, and 150 inches per year, typical and maximum herbicide application rates, and effects threshold concentrations to calculate HQ values.

The WCR values for annual rainfall rates of 15, 50, and 150 inches were selected to represent climates in eastern Oregon and Washington, the western cascades and western Oregon and Washington valleys, and coastal mountain ranges, respectively. The lowest and highest peak WCR values predicted (by soil type) for each rainfall level, and typical and maximum herbicide application rates, were used to calculate the likely range of HQ values. Modeled peak WCR values increased with higher application and rainfall rates. The primary influence of soil type was lower peak WCR values in loam, most likely due to slower leaching.

[5] Syracuse Environmental Research Associates risk assessments are available at: http://www.fs.fed.us/foresthealth/pesticide/risk.shtml

Table 8. Summary of hazard quotient (HQ) values exceeding 1 for small streams.

Species Group	Annual Rainfall (inches)	Aminopyralid	Chlorsulfuron	Clopyralid	Dicamba	Glyphosate	Hexazinone	Impazapic	Imazapyr	Metsulfuron	Picloram	Sethoxydim	Sulfometuron	Triclopyr	2,4-D
Fish	15	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	50	---	---	---	---	---	---	---	---	---	A	A[1]	---	B	---
	150	---	---	---	---	B[2]	---	---	---	---	C	D[4]	---	D	---
Aquatic Invertebrates	15	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	50	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	150	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Algae	15	---	---	---	---	---	C	---	---	---	---	---	---	---	C
	50	---	A	---	---	---	C	---	---	---	---	---	---	B	C
	150	---	C[3]	---	---	B	D	---	A	---	---	---	---	B	D
Aquatic Macrophytes	15	---	C	---	---	---	C	---	---	---	---	---	---	---	C
	50	---	D	---	---	---	D	---	---	A	---	---	---	B	C
	150	---	D	---	---	---	D	---	A	A	A	---	A	B	D

[1]A = HQ >1 at high water contamination rate (WCR) at maximum application rate only
[2]B = HQ >1 at high and low WCR at maximum application rate
[3]C = HQ >1 at high WCR at typical and maximum application rates
[4]D = HQ >1 at high and low WCR at typical and maximum application rates

Table 9. Summary of hazard quotient values exceeding 1 for small ponds.

Species Group	Annual Rainfall (inches)	Aminopyralid	Chlorsulfuron	Clopyralid	Dicamba	Glyphosate	Hexazinone	Imazapic	Imazapyr	Metsulfuron	Picloram	Sethoxydim	Sulfometuron	Triclopyr	2,4-D
Fish	15	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	50	---	---	---	---	---	---	---	---	---	A	---	---	B	---
	150	---	---	---	---	---	---	---	---	---	C	---	---	C	---
Aquatic Invertebrates	15	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	50	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	150	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Algae	15	---	---	---	---	---	C	---	---	---	---	---	---	B	C
	50	---	A	---	---	---	C	---	---	---	---	---	---	A	C
	150	---	A	---	---	---	D	---	---	---	---	---	---	A	D
Aquatic Macrophytes	15	---	A	---	---	---	C	---	---	---	---	---	---	B	C
	50	---	D	---	---	---	D	---	---	---	---	---	A	A	C
	150	---	D	---	---	---	D	---	---	A	A	---	A	A	D

[1]A = HQ >1 at high water contamination rate (WCR) at maximum application rate only
[2]B = HQ >1 at high and low WCR at maximum application rate
[3]C = HQ >1 at high WCR at typical and maximum application rates
[4]D = HQ >1 at high and low WCR at typical and maximum application rates

The letter codes in Tables 5 and 6 identify HQ exceedences (HQ values > 1), and represent increasing exposure risk for a given species group, with HQ exceedence of “A” the lowest level of exposure risk and “D” the highest. At exposure risk “A”, HQ values exceed 1 (the adverse effects threshold) only at the maximum herbicide application rate on the soil type with the highest herbicide yield. At exposure risk “B”, HQ values exceed 1 on all soil types at the maximum application rate. At exposure risk “C”, HQ values exceed 1 on the soil type with the highest herbicide yield at both the typical and maximum herbicide application rates. At exposure risk “D”, the HQ values exceed 1 on all soil types at both the typical and maximum application rates.

The HQ exceedences and their implications for effects to listed fish are discussed below by herbicide. The effects conclusions stated for each herbicide are based on the assumption that application occurs over a 10 acre plot adjacent to stream channels or ponds containing listed fish and/or their habitat.

4.3.1.2.1. Aminopyralid

Application of aminopyralid under the modeled scenario did not result in any HQ exceedences for any of the species groups in either the stream or pond analysis. Adverse effects to listed fish or their critical habitat are not likely to result from aminopyralid application adjacent to stream channels or small ponds.

4.3.1.2.2. Chlorsulfuron

Stream analysis

As displayed in Table 8, no chlorsulfuron HQ exceedences occurred for fish or aquatic invertebrates. HQ exceedences did occur for algae at rainfall rates of 50 and 150 inches per year and for aquatic macrophytes at rainfall rates of 15, 50, and 150 inches per year.

The HQ values predicted for algae at 50 inches per year (from Appendix E, small stream spreadsheet) ranged from 0.002 – 2.8, and the HQ exceedence occurred at the maximum application rate on clay soils. The HQ values predicted for algae at 150 inches per year ranged from 0.02 – 5.0, and HQ exceedences occurred at both the typical (HQ of 1.1) and maximum (HQ of 5.0) application rates on clay soils. Application of chlorsulfuron adjacent to stream channels at the typical and maximum application rates, in rainfall regimes of 50 – 150 inches per year, is likely to adversely affect critical habitat by adversely affecting algal production when occurring on soils with poor infiltration.

The HQ values predicted for aquatic macrophytes at 15 inches per year ranged from 0 – 64, and HQ exceedences occurred at both the typical and maximum application rates on clay soils. The HQ values for aquatic macrophytes at 50 inches per year ranged from 0.5 – 585, and ranged from 4.8 – 1064 at 150 inches per year. The HQ exceedences at 50 and 150 inches per year occurred at both typical and maximum application rates, with lower HQ values occurring on loam soils, and the highest values on clay soils. Given the wide range of HQ values observed among soil types at a given rainfall rate, soil type is clearly a major driver of exposure risk for chlorsulfuron, with low permeability soils markedly increasing exposure levels. Application of chlorsulfuron adjacent to stream channels at the typical and maximum application rates, in rainfall regimes of 15 – 150 inches per year, is likely to adversely affect critical habitat by adversely affecting aquatic macrophytes. Application on soils with low infiltration rates will have a substantially higher risk of resulting in adverse effects.

Pond analysis

As displayed in Table 9, no chlorsulfuron HQ exceedences occurred for fish or aquatic invertebrates. HQ exceedences did occur for algae at rainfall rates of 50 and 150 inches per year and for aquatic macrophytes at rainfall rates of 15, 50, and 150 inches per year.

The HQ exceedences for algae were at the maximum application rate only at the high water contamination rate. The HQ value for the maximum application rate at the high water contamination rate at the 50-inch rainfall level was 1.9; and the value for the maximum application rate at the high water contamination rate at the 150-inch rainfall level was 4. All of the exceedences occurred on clay soils.

The HQ exceedence at the 15-inch rainfall level for aquatic macrophytes was at the maximum application rate only at the high water contamination rate. At the 50-inch rainfall level, the exceedence at the low water contamination rate (HQ=2.7) occurred on loam soil and only at the maximum application rate. The exceedences at the high water contamination rate occurred at both typical and maximum application rates (HQ=91 and 404) on clay soils. At the 150-inch rainfall level, HQ values at the low water contamination rate were 4.8 and 21 for the typical and maximum application rates on loam soils, and 191 and 851 at the high water contamination rate for the typical and maximum application rates on clay soils.

4.3.1.2.3. Clopyralid

Application of clopyralid under the modeled scenario did not result in any HQ exceedences for any of the species groups in either the stream or pond analysis. Adverse effects to listed fish or their critical habitat are not likely to result from clopyralid application adjacent to stream channels or small ponds.

4.3.1.2.4. Dicamba

Application of dicamba under the modeled scenario did not result in any HQ exceedences for any of the species groups in either the stream or pond analysis. Adverse effects to listed fish or their critical habitat are not likely to result from dicamba application adjacent to stream channels or small ponds.

4.3.1.2.5. Glyphosate

Stream analysis

Glyphosate HQ exceedences occurred for fish and algae at a rainfall rate of 150 inches per year, and no HQ exceedences occurred for aquatic invertebrates or aquatic macrophytes. The HQ exceedences occurred at the maximum application rates only. The HQ values for fish at 150 inches per year ranged from 1.5 – 3.6, and occurred within a narrow range on all soil types. The HQ values for algae at 150 inches per year ranged from 0.8 – 2.0 in sand. Application of glyphosate adjacent to stream channels at application rates approaching the maximum, in rainfall regimes approaching 150 inches per year, on all soil types is likely to adversely affect listed fish. When glyphosate is applied adjacent to stream channels at rates approaching the maximum on sandy soils, in rainfall regimes approaching 150 inches per year, adverse effects to critical habitat are likely to occur by adversely affecting algal production.

Pond analysis

Application of glyphosate under the modeled scenario did not result in any HQ exceedences for any of the species groups. Adverse effects to listed fish or their critical habitat are not likely to result from glyphosate application adjacent to small ponds.

4.3.1.2.6. Hexazinone

Stream analysis

Application of hexazinone did not result in any HQ exceedences for fish or aquatic invertebrates. Exceedences occurred for algae and aquatic plants at both typical and high application rates across all rainfall zones.

The HQ values for algae at the low water contamination rate occurred at the low water contamination rate for both typical and maximum application rates of 50 and 150 inches per year with both typical and maximum application rates on loam soils. HQ values ranged from 3 – 23. At the high water contamination rate, HQ exceedences occurred for both typical and maximum application rates across all rainfall zones on clay soils. HQ values ranged from 15 – 420.

HQ values for aquatic macrophytes occurred at the low water contamination rate for both typical and maximum application rates at rainfall rates of 50 and 150 inches per year on loam soils. HQ values ranged from 3 – 23. At the high water contamination rate, HQ exceedences occurred at both typical and maximum application rates for all rainfall levels on clay soils. HQ values ranged from 15 – 420.

Pond analysis

Application of hexazinone did not result in any HQ exceedences for fish or aquatic invertebrates. Exceedences occurred for algae and aquatic plants at both typical and high application rates across all rainfall zones.

The HQ values for algae at the low water contamination rate occurred on loam soil only with a rainfall level of 150 inches per year with both typical and maximum application rates. HQ values ranged from 6.5-13. At the high water contamination rate, HQ exceedences occurred for both typical and maximum application rates across all rainfall zones on clay soils. HQ values ranged from 20 – 300.

HQ values for aquatic macrophytes occurred at the low water contamination rate for both typical and maximum application rates at rainfall rates of 50 and 150 inches per year on loam soils. HQ values ranged from 3.35 to 13. At the high water contamination rate, HQ exceedences occurred at both typical and maximum application rates for all rainfall levels on clay soils. HQ values ranged from 20-300.

4.3.1.2.7. Imazapic

Application of imazapic under the modeled scenario did not result in any HQ exceedences for any of the species groups in either the stream or pond analysis. Adverse effects to listed fish or their critical habitat are not likely to result from imazapic application adjacent to stream channels or small ponds.

4.3.1.2.8. Imazapyr

Stream analysis

No HQ exceedences occurred for imazapyr for fish or aquatic invertebrates. HQ exceedences occurred for algae and aquatic macrophytes at a rainfall rate of 150 inches per year.

The HQ values for algae at 150 inches per year ranged from 0 – 1.3. The HQ exceedence at 150 inches per year occurred only at the maximum application rate on clay soils. The HQ values for aquatic macrophytes at 150 inches per year ranged from 0 – 2.0. The HQ exceedence at 150 inches per year occurred only at the maximum application rate on clay soils. Given the range of HQ values observed for imazapyr at a rainfall rate of 150 inches per year, soil type is an important factor in determining exposure risk, with low permeability soils markedly increasing exposure levels. Application of imazapyr adjacent to stream channels at application rates approaching the maximum on soils with low permeability, in rainfall regimes approaching 150 inches per year, is likely to adversely affect critical habitat by adversely affecting algal production and aquatic macrophytes.

Pond analysis

Application of imazapyr under the modeled scenario did not result in any HQ exceedences for any of the species groups. Adverse effects to listed fish or their critical habitat are not likely to result from imazapyr application adjacent to small ponds.

4.3.1.2.9. Metsulfuron

Stream analysis

No HQ exceedences occurred for metsulfuron for fish, aquatic invertebrates, or algae. The HQ exceedences for aquatic macrophytes occurred at the maximum application rate on clay soils at rainfall rates of 50 and 150 inches per year. The HQ values ranged from 0.009 – 1.0 at 50 inches, and from 0.02 – 1.9 at 150 inches per year.

Given the range of HQ values observed for metsulfuron at each rainfall level, soil type is an important factor in determining exposure risk, with low permeability soils markedly increasing exposure levels. In areas with rainfall rates between 50 – 150 inches per year, application of metsulfuron adjacent to stream channels on soils with low permeability at application rates approaching the maximum is likely to adversely affect critical habitat by adversely affecting aquatic macrophytes.

Pond analysis

No HQ exceedences occurred for metsulfuron for fish, aquatic invertebrates, or algae. The HQ exceedence for aquatic macrophytes occurred at the maximum application rate on clay soils at the rainfall rate of 150 inches per year. The HQ value was 1.5.

4.3.1.2.10. Picloram

Stream analysis

In the stream analysis, application of picloram under the modeled scenario resulted in HQ exceedences for listed fish at the 50-inch rainfall rate at the highest application rate at the high WCR (HQ=2.5), and at the 150-inch rainfall rate at the high WCR for both typical and highest application rates (HQ=1.7, 4.8). One HQ exceedence occurred for aquatic macrophytes at the 150-inch rainfall level at the highest application rate at the high WCR (HQ=1.7).

Pond analysis

In the pond analysis, application of picloram under the modeled scenario resulted in HQ exceedences for listed fish at the 50 and 150-inch rainfall rates under the high WCR. The HQ exceedence at 50 inches per year occurred only at the maximum application rate, and the exceedence at 150 inches per year occurred at both the typical and maximum application rates. HQ values ranged from 1.2 to 3.5.

4.3.1.2.11. Sethoxydim

Stream analysis

No HQ exceedences occurred for sethoxydim for aquatic invertebrates, algae, or aquatic macrophytes. The HQ exceedences for fish occurred at rainfall rates of 50 and 150 inches per year, and ranged from 0.3 – 1.0, and from 1.1 – 3.0, respectively. The HQ exceedence at 50 inches per year occurred only at the maximum application rate on loam soils. The HQ exceedences at 150 inches per year occurred at the typical application rate on sand, and at the maximum application rate on loam soil.

The HQ values for sethoxydim were calculated using the toxicity data for the Poast formulation, and incorporates the toxicity of naphtha solvent. The toxicity of sethoxydim alone for fish and aquatic invertebrates is generally much less than that of the formulated product (about 30 times less toxic for invertebrates, and about 100 times less toxic for fish). Since the naphtha solvent tends to volatilize or adsorb to sediments, using Poast formulation data to predict indirect aquatic effects from runoff leaching is likely to overestimate adverse effects (Durkin 2001). Project design criteria (e.g., BMPs that reduce the risk of erosion) are likely to substantially reduce the risk of naphtha solvent presence in percolation runoff reaching streams by allowing volatilization and soil sorption. When design criteria to reduce naphtha solvent exposure are employed, application of sethoxydim adjacent to stream channels is not likely to adversely affect listed salmonids or critical habitat.

Pond analysis

Application of sethoxydim under the modeled scenario did not result in any HQ exceedences for any of the species groups. Adverse effects to listed fish or their critical habitat are not likely to result from sethoxydim application adjacent to small ponds.

4.3.1.2.12. Sulfometuron

Stream analysis

No HQ exceedences occurred for sulfometuron for fish, aquatic invertebrates, or algae. The HQ exceedence for aquatic macrophytes occurred at rainfall rates of 50 and 150 inches per year on clay soils. The HQ values ranged from 0.0001 – 1.4 at 50 inches and 0.007 – 3.8 at 150 inches per year.

Considering the range of HQ values observed for sulfometuron at each rainfall level, soil type is an important factor in determining exposure risk, with low permeability soils markedly increasing exposure levels. In areas with rainfall rates ranging from 50 – 150 inches per year, application of metsulfuron adjacent to stream channels on soils with low permeability at application rates approaching the maximum is likely to adversely affect critical habitat by adversely affecting aquatic macrophytes.

Pond analysis

No HQ exceedences occurred for sulfometuron for fish, aquatic invertebrates, or algae. The HQ exceedence for aquatic macrophytes occurred at the 50 and 150 inch rainfall rates at the maximum application rates on clay soils, and HQ values ranged from 1.1 to 2.9.

4.3.1.2.13. Triclopyr

Stream analysis

Triclopyr HQ exceedences occurred for fish at the low WCR for high application rates on all soils at rainfall rates of 50 and 150 inches per year, at the high WCR at the typical application rate on clay at 150 inches per year, and at the maximum application rate on all soils at 150 inches per year. No exceedences occurred for invertebrates. Exceedences occurred for algae and aquatic macrophytes at the maximum application rate on all soils at 50 inches per year (HQ values of 1.3 – 3.1), and at the maximum application rate on all soils at 150 inches per year (HQ values of 2.6 – 7.6).

Pond analysis

Triclopyr exceedences occurred for fish at the low WCR on sandy soil (HQ=1.6), and at the high WCR on clay soil (HQ=2.5), at the high application rate in the 50-inch rainfall zone. A HQ exceedence also occurred for fish at the 150-inch rainfall zone at the high WCR at the maximum application rate (HQ=2).

No HQ exceedences occurred for invertebrates. For algae and aquatic macrophytes, HQ values exceeded 1 at the maximum application rate in the 15-inch rainfall zone at both the low and high WCRs on clay and loam soil, respectively. HQ exceedences also occurred at the high WCRs in the 50 and 150 inch rainfall zones at the maximum application rate on clay soils. HQ values ranged from 1 to 1.5.

4.3.1.2.14. 2,4-D

Stream analysis

No HQ exceedences occurred for 2,4-D for fish or aquatic invertebrates. HQ exceedences for algae and aquatic plants occurred for the high WCR on clay soils at all rainfall levels, and at low and high application rates for the low WCR on loam at the 150 inch rainfall level.

Pond analysis

No HQ exceedences occurred for 2,4-D for fish or aquatic invertebrates. HQ exceedences for algae and aquatic macrophytes occurred for the high WCR on clay soils at both typical and maximum rates for the 15 and 50 inch rainfall zones. In the 150 inch rainfall zone, HQ exceedences for algae and aquatic macrophytes occurred for both the low and high WCRs on loam and clay soils, respectively, at typical and maximum application rates. HQ exceedences for algae and aquatic macrophytes ranged from 1.1 to 208.

4.3.1.3. Effects of herbicide applications on streams

4.3.1.3.1. Runoff from Treated Ditches and Dry Intermittent Streams

The proposed action allows 8 herbicides to be applied up to the maximum label rate in ditches and intermittent channels. The proposal also allows additional herbicides to be used from the high water mark upland, or with a small setback from the high water mark (see Table 7). Only those herbicides that would be applied within ditches or intermittent channels are discussed in this section. It is assumed that the small stream analyses in section 4.3.1.2 covers the proposed herbicide use at and beyond the high water mark of ditches and intermittent channels.

Herbicides applied in and adjacent to ditches and intermittent stream channels can be delivered to perennial channels by leaching, dissolving directly into ditch or stream channel flow, and erosion. The relative contributions among these delivery pathways are likely to vary considerably among sites. The primary determinants of exposure risk from ditch/intermittent channel treatments are herbicide properties, application rate, extent of application, application timing, precipitation amount and timing, proximity to habitat for listed fish, and site conditions such as soils, ditch slope, etc.

Monitoring of storm runoff has documented that the highest concentrations of pollutants are likely to occur during the first storm following treatment (Caltrans 2005; USGS 2001). In addition, the highest pollutant concentrations generally occur during the early part of storm runoff, relative to concentrations later in the runoff event (Caltrans 2005). The discharge of ditch/intermittent channel runoff in the early stages of the storm hydrograph is generally low, but is exposed to the greatest amount of pollutants available for dissolution. The ratio of low discharge to highest amount of available pollutant results in early runoff solute concentrations that are high relative to those occurring later in the runoff event. Runoff later in the hydrograph occurs at a higher discharge, and dissolved pollutant concentrations are typically lower, even though mass movement of pollutants can be greater. Therefore, exposure of listed fish and their critical habitat elements to the highest concentrations of herbicides resulting from application to ditches and intermittent channels is likely to occur early in storm runoff. The most relevant exposure locations are at or near confluences with perennial streams.

In contrast to the well established understanding of the “first flush” effect on storm runoff pollutant concentrations described in the preceding paragraph, little monitoring data is available regarding specific concentrations of herbicides likely to occur in runoff from treated ditches. A USGS (2001) monitoring report provides data for concentrations of sulfometuron and glyphosate in runoff from treated roadside plots into ditches in western Oregon. The USGS (2001) report provides data for runoff yield from herbicide application to road shoulders, but does not address the question of herbicide runoff yield from application within ditches. Application within ditches and intermittent stream channels may result in high herbicide concentrations in ditch runoff, and efficient delivery habitat for listed fish. Norris et al (1991) stated that application to intermittent streams was likely to have caused increases in herbicides observed in perennial streams following storms. Given the high runoff potential from application within ditches and intermittent channels and the lack of quantitative monitoring data, the USGS (2001) road shoulder data is used in this analysis as an estimate of herbicide runoff yield from application within ditches and intermittent channels. In the USGS (2001) report, sulfometuron was applied at a rate of 0.23 pounds/acre, and resulted in runoff concentrations of 0.119 – 0.253 mg/l (corresponding to about 3 – 7 percent of amount applied) from simulated rainfall 24 hours following application. Glyphosate was applied at a rate of about 2 pounds/acre, and resulted in runoff concentrations of 0.323 – 0.736 mg/l (corresponding to about 1 – 2% of amount applied) from simulated rainfall 24 hours following application. The samples were collected in the initial 15 liters of runoff from simulated rainfall at a rate of 0.3 inches per hour, and lasting 0.5 – 1.4

hours. These concentrations are the best estimates available for what would occur in 24 hour post application runoff from ditch/intermittent stream applications from "first flush" events for these herbicides (per amount applied, per unit area).

The runoff concentrations likely for the herbicides proposed for application within ditches and intermittent channels can be estimated from the USGS (2001) data. Ramwell et al. (2002) and Huang et al. (2004) found that herbicides with high solubility and low K_{oc} produced the highest peak concentrations and highest total yield of herbicides in roadside runoff. Krutz et al. (2005) stated that herbicide concentrations observed at vegetative filter strip outflows correlate positively with increasing solubility. If solubility and K_{oc} values are the primary determinants of herbicide yield in ditch runoff, with high solubility and low K_{oc} increasing runoff risk, then it is reasonable to assume that herbicides with solubility values greater than, and K_{oc} values less than or equal to, sulfometuron are likely to be present in runoff at concentrations at least equal to that for sulfometuron. The shortest soil half-life of any of the herbicides proposed for ditch and intermittent channel application is 14 days for dicamba, and the others are considerably longer, so it is reasonable to ignore half-life for estimating 24-hour post-application runoff concentrations.

Table 7 summarizes herbicide soil mobility factors (solubility, and K_{oc} ratios) and application rates for sulfometuron and the 8 herbicides proposed for application within ditches and intermittent channels. With the exception of glyphosate, the herbicides proposed for application all have K_{oc} values similar to or less than sulfometuron, and much higher solubility. Since the USGS (2001) report contains runoff concentration data for glyphosate, it was not necessary to estimate glyphosate runoff concentrations from the sulfometuron data. In addition, glyphosate is an anomaly in that solubility and K_{oc} values are both high, indicating high soil sorption in spite of high solubility.

Sulfometuron solubility is low (70 mg/l) relative to the 7 herbicides for which roadside monitoring data are not available (see Table 10), but a substantial portion of the amount applied appears in the initial runoff. Due to the relatively low application rate of 0.23 pounds/acre, the initial runoff only needs to reach 0.6% saturation to remove 10% of sulfometuron applied. Under circumstances where the ratio of water volume to a low solubility organic chemical is very large, dissolution is seldom limited by solubility (Lyman 1995). Thus, at low herbicide application rates, solubility of these herbicides likely to be less important than K_{oc} as a determinant of runoff risk. It is therefore reasonable to assume that the runoff efficiency of those 7 herbicides is likely to occur at a rate at least equal to that of sulfometuron following a rainstorm occurring 24 hours post-application. This assumption is also consistent with groundwater movement ratings from Vogue et al. (1994). In addition, foliar wash-off fractions of these 7 herbicides are similar to or higher than for sulfometuron (see Table 10) indicating that an amount greater than or equal to sulfometuron will be available for dissolution.

Table 10. Summary of herbicide fate and transport properties

Herbicide	Solubility[1,2] (mg/l)	K_{oc}[2]	Soil Half-life[2,3] (days)	Wash-off Fraction [4]
Aminopyralid	205,000	9	343	0.95
Dicamba	400,000	2	14	0.65
Hexazinone	33,000	54	90	0.9

Herbicide	Solubility[1,2] (mg/l)	K_{oc} [2]	Soil Half-life[2,3] (days)	Wash-off Fraction [4]
Imazapic	36000	112	113	0.8
Imazapyr	500,000	100	90	0.8
Picloram	200,000	16	90	0.6
Triclopyr amine	2,100,000	20	46	0.95
Glyphosate	900,000	24,000	47	0.6
Sulfometuron	70	78	140	0.65

[1] Solubility values are for salts, if salts are typically the ingredient in commercial formulations
[2] From Vogue et al. (1994), located: http://npic.orst.edu/ppdmove.htm
[3] From SERA risk assessments, located: http://www.fs.fed.us/foresthealth/pesticide/risk.shtml
[4] From Knisel (2000) and SERA risk assessments

The average sulfometuron 24-hour post-application runoff concentration reported by USGS (2001) was used to extrapolate likely concentrations of the 7 herbicides for which comparable monitoring data was unavailable, predict exposure risk to listed salmonids and their habitat, and calculate HQ values. The equation for extrapolation of the USGS (2001) sulfometuron data to these herbicides was derived by treating application rate as the independent variable (x), runoff concentration as the dependent variable (y), and solving for the slope of the line intersecting y = 0, x = 0 (no herbicide was considered to be in runoff if none was applied). The resulting function represents herbicide roadside runoff yield (in mg/l) per pound of herbicide applied. The average sulfometuron runoff concentration of the 24-hour simulated rainfall plots was 0.2 mg/l, and the application rate was 0.23 lbs/acre. Thus, where m = slope and b = y intercept:

$$y = mx + b$$
$$y = (\text{runoff concentration}/\text{application rate}) * x + 0$$
$$y = (0.2 \text{ mg/l})/0.23 \text{ lbs/acre}) * x + 0$$
$$\text{mg/l in runoff} = 0.87 \text{ mg/l per lb/acre} * \text{application rate in lbs/acre}$$

The results of the extrapolation and resulting HQ values from projected runoff concentrations at typical and maximum application rates are summarized in Table 11. As discussed above, runoff concentrations in Table 11 for glyphosate were estimated from USGS (2001) glyphosate monitoring data.

Table 11. Projected runoff concentrations and resulting HQ values

Herbicide	Typ. Application Rate (pounds/acre)	Expected Typ. Runoff Conc. (mg/l)	Max. Application Rate (lbs/acre)	Expected Max. Runoff Conc. (mg/l)	Species Group	Effects Threshold Concentration (mg/l)	Typ. Rate HQ	Max. Rate HQ
Aminopyralid	0.08	0.07	0.11	0.09	Fish	1.36	0.05	0.07
					Aq. Inverts	100	0.00	0.00
					Algae	30	0.00	0.00
					Aq. Plants	88	0.00	0.00
Dicamba	0.3	0.26	2.00	1.74	Fish	1.4	0.2	1.2
					Aq. Inverts	0.38	0.7	4.6
					Algae	0.0049	53	354
					Aq. Plants	0.25	1.0	7.0
Glyphosate	2	0.48	8	1.92	Fish	0.5	1.0	3.8
					Aq. Inverts	78	0.006	0.025
					Algae	0.89	0.5	2.2
					Aq. Plants	3	0.2	0.6
Hexazinone	2	1.74	4	3.48	Fish	12	0.1	0.3
					Aq. Inverts	29	0.1	0.1
					Algae	0.004	435	870
					Aq. Plants	0.004	435	870
Imazapic	0.13	0.11	0.1875	0.16	Fish	100	0.0	0.0
					Aq. Inverts	96	0.0	0.0
					Algae	2.25	0.1	0.1
					Aq. Plants	0.00258	44	63
Imazapyr	0.45	0.39	1.5	1.30	Fish	5	0.1	0.3
					Aq. Inverts	100	0.004	0.01
					Algae	0.02	20	65
					Aq. Plants	0.013	30	100
Picloram	0.35	0.30	1	0.87	Fish	0.04000	8	22
					Aq. Inverts	2.68000	0	0
					Algae	0.23000	1	4
					Aq. Plants	0.10000	3	9
Triclopyr	1	0.87	10	8.70	Fish	0.21	4.1	41
					Aq. Inverts	13.9	0.1	0.6
					Algae	0.42	2.1	21
					Aq. Plants	0.42	2.1	21

Exposure of listed fish to herbicide concentrations reflected in the HQ values in Table 11 is likely to require herbicide application to a segment of a ditch/intermittent channel directly adjacent to the confluence with a perennial stream with occupied or critical habitat present, or treatment of a few hundred feet of ditch/intermittent channel separated from the perennial channel by less than a proportionate untreated segment. Herbicide treatments approaching the maximum rates for ditch/intermittent channel segments under these conditions are likely to occur within the project area. However, due to the generally patchy distribution of invasive plant infestations in ditches and intermittent channels, and use of conservative herbicide application methods when reasonable, the treatment of large, contiguous areas in ditches and intermittent channels near the maximum application rate is likely to be infrequent. Treatments of large, contiguous ditch and intermittent channel sites at the typical rate are likely to occur more often, particularly when vegetation conversion is required on large sites.

Based on the analysis results presented in Table 11, the herbicides likely to adversely affect listed fish and their habitat from 24-hour post-application storm at ditch/intermittent channel confluences with perennial streams are as follows:

- Dicamba is likely to adversely affect listed fish only at higher application rates, and glyphosate, picloram, and triclopyr are likely to adversely affect listed fish in the full range of application rates analyzed.

- Dicamba is likely to adversely affect aquatic invertebrates at higher application rates.

- Glyphosate is likely to adversely affect algae at only higher application rates, and dicamba, hexazinone, imazapyr, picloram, and triclopyr are likely to adversely affect algae in the full range of application rates analyzed.

- Dicamba, hexazinone, imazapic, imazapyr, picloram, and triclopyr are likely to adversely affect aquatic macrophytes in the full range of application rates analyzed.

Actual exposure concentrations and durations at or near confluences with perennial streams will depend on a variety of factors, including the extent of the herbicide application within the ditch/intermittent stream, application rate, extent of adjacent riparian applications, soil conditions, and rainfall timing, intensity, and amount.

In addition, the projected runoff concentrations and HQ values displayed in Table 11 should be interpreted with an understanding of the precision and accuracy of the USGS (2001) data upon which they are based. Although the USGS (2001) results were based on relatively ambitious quality assurance, the author states “it is important to recognize that all of the data presented are semi-quantitative in nature and that interpretations should take this into account. These data can be relied on only for order-of-magnitude representations of concentrations, and possibly for trends.” Thus, the runoff concentrations and HQ values in Table 11 should be considered as estimates that may vary by an order of magnitude lower or higher. However, when the methodology used to estimate runoff concentrations in Table 11 is applied to clopyralid, the results are reasonably consistent (within an order of magnitude) with roadside ditch runoff data for clopyralid reported by Huang *et al.* (2004) and collected under similar conditions.

4.3.1.3.2. Application within Perennial Streams

Aminopyralid, glyphosate, imazapyr, and triclopyr amine can be applied between the high water mark level and water's edge of perennial streams, and glyphosate, imazapyr, and triclopyr amine can be applied to emergent plants within the flowing portion of streams. Exposure from application within stream channels can occur from overspray, foliar rinse by rainfall, erosion, leaching, and site inundation. Juvenile and fry life stages are likely to be at the highest risk of exposure, and the highest risk sites for exposure are stream margins and areas immediately surrounding treated emergent plants.

Exposure of juveniles in stream margins can result from overspray, upstream storms resulting in inundation of treatment sites, rainfall at the treatment sites delivering herbicide to stream margins via percolation or surface runoff, or a combination of these factors.

Juveniles utilizing stream margin habitat are likely to be present in the low flow refuge near the water's edge as the stream level rises. As inundation of recently treated areas occurs, glyphosate overspray or wash-off present on the substrate surrounding treated plants, or on the treated plants, may enter solution.

Adverse effects to algae and aquatic macrophytes are not analyzed for stream margin exposures resulting from application to dry portions of perennial channels, since any storm-driven adverse effects are assumed to be less than what will have already occurred during treatment of the area.

Aminopyralid

Table 9 displays the potential peak exposure levels and consequent HQ values likely to occur in stream margins for 3 application rates if the available glyphosate applied per unit area to dry portions of perennial channels is dissolved into 4 inches or 12 inches of water. The amount of glyphosate available for dissolution (96.25 percent of the amount applied) is based on assumptions of a foliar wash-off fraction of 0.95 (Durkin 2007), and a 25% overspray rate. As displayed in Table 12, no HQ values exceed 1 for salmonids or aquatic invertebrates, and adverse effects are not likely to occur.

Table 12. Peak aminopyralid concentrations in stream margins from in-channel applications

Application Rate (pounds/acre)	Depth (inches)	[1, 2] Aminopyralid Concentration (mg/l)	Hazard Quotient for Salmonids	Hazard Quotient for Aquatic Invertebrates
0.78	4	0.061	0.04	0.00
0.11	4	0.086	0.06	0.00
0.78	12	0.020	0.01	0.00
0.11	12	0.029	0.02	0.00

[1] Assumes 25% overspray to substrate and foliar wash-off fraction of 0.95, resulting in about 96.25% of applied aminopyralid reaching water.
[2] Assumes no leaching contamination from application occurring above high water mark level.

Glyphosate

Table 10 displays the potential peak exposure levels and consequent HQ values likely to occur in stream margins for 3 application rates if the available glyphosate applied per unit area to dry portions of perennial channels is dissolved into 4 inches or 12 inches of water. The amount of glyphosate available for dissolution (62.5 percent of the amount applied) is based on assumptions of a foliar wash-off fraction of 0.5 (Durkin 2003), and a 25% overspray rate. The data displayed in Table 13 shows that glyphosate application to dry areas of perennial channels at rates greater than or equal to about one pound per acre can result in HQ values exceeding 1 in stream margins following a rainfall event.

Table 13. Peak glyphosate concentrations in stream margins from in-channel applications

Application Rate (pounds/acre)	Depth (inches)	[1, 2] Glyphosate Concentration (mg/l)	Hazard Quotient for Salmonids	Hazard Quotient for Aquatic Invertebrates
0.5	4	0.35	0.7	0.00
2	4	1.4	2.8	0.02
8	4	5.5	11	0.06
0.5	12	0.11	0.2	0.00
2	12	0.45	0.9	0.01
8	12	1.8	3.6	0.02

[1] Assumes 25% overspray to substrate and foliar wash-off fraction of 0.5, resulting in about 62.5% of applied glyphosate reaching water.
[2] Assumes no leaching contamination from application occurring above high water mark level.

Numerous factors will influence the actual concentration in stream margins near an application site, such as application rate, rainfall proximity and intensity, time since application, substrate permeability, and water turbulence and flow rate. Glyphosate applications to dry areas of perennial channels located near backwater refuges, gravel bars, and other areas containing shallow rearing habitat are the most likely to result in the highest exposure levels. Glyphosate is strongly sorbed by most soils (Yu and Zhou 2005), so exposure levels of glyphosate are likely to be attenuated when channel surface substrate contains a substantial soil component. Concurrent applications to adjacent riparian areas (above high water mark) are likely to result in additional exposure.

Label instructions for the Aquamaster aquatic glyphosate formulation recommend to “always use the higher rate of this product per acre within the recommended range when weed growth is heavy or dense or weeds are growing in an undisturbed (noncultivated) area”. For dense infestations, the product label allows an application rate up to 8 pounds/acre. Therefore, it is assumed that application at or near the label maximum is likely to be necessary in some situations for invasive plant control on gravel bars and other instream sites.

Exposure of listed fish from treatment of emergent plants with glyphosate is likely to occur via three pathways – overspray, foliar wash-off, and leakage from stem injections. Since delivery via each pathway is driven by different factors (overspray, rainfall, and plant death and breakage), exposures from the three pathways are very unlikely to overlap in time.

Assuming the same overspray rate used for stream margin exposure calculations, 25 percent, maximum glyphosate concentrations from emergent plant overspray at 4 inch water depth would range from 0.14 mg/l at an application rate of 0.5 lbs/acre to 2.2 mg/l at a rate of 8 pounds/acre. The corresponding range of salmonid HQ values is 0.28 – 4.4. For the same application rate values, the maximum exposure concentrations in 12 inch water depth would range from 0.05 – 0.74 mg/l, with salmonid HQ values ranging from 0.1 – 1.5.

Glyphosate exposure via rain wash-off from treatment of emergent plants, assuming a foliar wash-off fraction of 0.5 and application rates ranging from 0.5 to 8 pounds/acre, would result in maximum exposure concentrations ranging from 0.21 – 3.3 mg/l at 4 inch depth, with salmonid HQ values ranging from 0.42 – 6.6. For the same application range, maximum exposure concentrations at 12 inch depth range from 0.07 – 1.1 mg/l, with salmonid HQ values ranging from 0.14 – 2.2.

Exposure concentrations resulting from breakage of knotweed stems injected with glyphosate are difficult to predict, due to high uncertainty regarding the amount and rate of glyphosate release. Only a few milliliters of glyphosate are injected per stem, and, assuming that breakage release would likely occur infrequently and to only one or a few stems at a time, instream concentrations exceeding the salmonid effects threshold are unlikely to occur.

Imazapyr

The stream margin exposure analysis for imazapyr was based on assumptions of a foliar wash-off fraction of 0.9 (Durkin and Follansbee 2004), and a 25% overspray rate. As displayed in Table 14, no HQ values exceeded 1 for salmonids or aquatic invertebrates, and adverse effects are not likely to occur.

Table 14. Peak imazapyr concentrations in stream margins from in-channel applications

Application Rate (pounds/acre)	Depth (inches)	[1, 2] Imazapyr Concentration (mg/l)	Hazard Quotient for Salmonids	Hazard Quotient for Aquatic Invertebrates
0.45	4	0.45	0.09	0.00
1.5	4	1.53	0.3	0.02
0.45	12	0.15	0.03	0.00
1.5	12	0.51	0.1	0.01

[1] Assumes 25% overspray to substrate and foliar wash-off fraction of 0.9, resulting in about 92.5% of applied imazapyr reaching water.
[2] Assumes no leaching contamination from application occurring above high water mark level.

Triclopyr

The stream margin exposure analysis for imazapyr was based on assumptions of a foliar wash-off fraction of 0.95 (Durkin 2003), and a 25% overspray rate. The data displayed in Table 15 shows that triclopyr application to dry areas of perennial channels at rates of about ¼ pound per acre can result in HQ values exceeding 1 in stream margins following a rainfall event. If significant exposures occur, they are likely to be less than or equal to the treated areas in size.

Table 15. Peak triclopyr concentrations in stream margins from in-channel applications

Application Rate (pounds/acre)	Depth (inches)	[1, 2] Triclopyr Concentration (mg/l)	Hazard Quotient for Salmonids	Hazard Quotient for Aquatic Invertebrates
0.1	4	0.10	0.4	0.01
1	4	1.0	3.8	0.07
6	4	6.3	24	0.4
0.1	12	0.035	0.1	0.00

1	12	0.35	1.3	0.03
6	12	2.1	8.1	0.2

[1] Assumes 25% overspray to substrate and foliar wash-off fraction of 0.95, resulting in about 96.25% of applied triclopyr reaching water.
[2] Assumes no leaching contamination from application occurring above high water mark level.

Triclopyr applications to dry areas of perennial channels located near backwater refuges, gravel bars, and other areas containing shallow rearing habitat are the most likely to result in the highest exposure levels. Concurrent applications to adjacent riparian areas (above high water mark) are likely to result in additional exposure.

Exposure of listed fish from treatment of emergent plants with triclopyr is likely to occur via two pathways – overspray and foliar wash-off. Since delivery via each pathway is driven by different factors (overspray and rainfall), exposures from the two pathways are very unlikely to overlap in time.

Assuming the same overspray rate used for stream margin exposure calculations, 25 percent, maximum triclopyr concentrations from overspray of emergent plants at 4 inch water depth would range from 0.03 mg/l at an application rate of 0.1 lbs/acre to 1.9 mg/l at a rate of 6 pounds/acre. The corresponding range of salmonid HQ values is 0.4 – 7.3. For the same application rate values, the maximum exposure concentrations in 12 inch water depth would range from 0.01 – 0.63 mg/l, with salmonid HQ values ranging from 0.04 – 2.4.

Triclopyr exposure via rain wash-off from treatment of emergent plants, assuming a foliar wash-off fraction of 0.95 and application rates ranging from 0.1 to 6 pounds/acre, would range from 0.08 – 4.7 mg/l at 4 inch depth, with salmonid HQ values ranging from 0.3 – 18.1. For the same application range, maximum exposure concentrations at 12 inch depth range from 0.026 -1.6 mg/l, with salmonid HQ values ranging from 0.1 – 6.2.

4.3.1.3.3. Drift to streams from boom spray applications

This section addresses exposure risk in streams associated with drift from boom spray applications of herbicide adjacent to streams. Because no boom spray analysis was available in the risk assessments performed by Syracuse Environmental Research Associates (SERA) for the USFS[6], the analysis is based on the aerial application scenario used in the SERA assessments and provides a high risk exposure scenario. The scenario is based on the program AgDrift Version 1.16 defaults and assumes an 8 foot boom height and 4 miles per hour wind speed.

For each herbicide proposed to be used (except aminopyralid and sethoxydim because worksheets were not available), the SERA worksheets model concentration in water at distances downwind, in feet, from the direct spray or aerial application site at a typical application rate. The concentrations were also calculated in water using the maximum application rate. The risk of adverse effects of these modeled concentrations to listed salmonids and their habitat was then evaluated in terms of hazard quotient (HQ) values. Hazard quotients are calculated by dividing

[6] Syracuse Environmental Research Associates risk assessments are available at: http://www.fs.fed.us/foresthealth/pesticide/risk.shtml

the expected environmental concentration by the effects threshold concentration. If this value is >1, then adverse effects are likely to occur. Hazard quotient values were calculated for fish, aquatic invertebrates, algae, and aquatic macrophytes. Table 16 summarizes the results of the analysis.

Table 16. HQ values exceeding 1 at various application distances from streams and ponds

Herbicide	Waterbody	Fish	Invertebrates	Algae	Aquatic Macrophytes
Chlorsulfuron	Stream	-	-	-	0-50 ft – B 100 --
	Pond	-	-	-	0-100 ft - B 300 ft – A
Clopyralid	Stream	-	-	-	-
	Pond	-	-	-	-
Dicamba	Stream	-	-	0 ft – B 25-50 ft – A 100 ft --	-
	Pond	-	-	0 ft – B 25-50 ft. – A 100 ft --	-
Glyphosate	Stream	0 ft – A 25 ft --	-	-	-
	Pond	-	-	-	-
Hexazinone	Stream	-	-	0-50 ft - B 100 ft – A 300 ft --	0-50 ft – B 100 ft – A 300 ft --
	Pond	-	-	0-50 ft – B 100 ft – A 300 ft --	0-50 ft – B 100 ft – A 300 ft --
Imazapic	Stream	-	-	-	0-25 ft –B 50 ft -
	Pond	-	-	-	0 ft – B 25 ft-
Imazapyr	Stream	-	-	0 ft – B 25 ft – A 50 ft --	0 ft – B 25 ft – A 50 ft --
	Pond	-	-	0 ft – B 25 ft --	0 ft – B 25 ft --
Metsulfuron methyl	Stream	-	-	0 ft – A 25 ft --	0-25 – B 50 -100– A 300 --
	Pond	-	-	-	0-25 – B 50-100 – A 300 ft --
Picloram	Stream	0 ft-A 25 ft --	-	-	-
	Pond	0 ft-A 25 ft--	-	-	-
Sulfometuron methyl	Stream	-	-	0 ft – B 25 ft – A 50 ft --	0-50 ft – B 100 ft – A 300 ft --
	Pond	-	-	0 ft – B 25 ft – A 50 ft --	0-25 ft – B 50 -100ft – A 300 ft --
Triclopyr	Stream	0 ft – A 25 ft --	-	0 ft – A 25 ft --	0 ft – A 25 ft --
	Pond	0 ft – A 25 ft --	-	0 ft – A 25 ft --	0 ft – A 25 ft --

Herbicide	Waterbody	Fish	Invertebrates	Algae	Aquatic Macrophytes
2,4-D acid/salt	Stream	-	-	0-100 ft – B 300 ft --	0-100 ft – B 300 ft --
	Pond	-	-	0-50 ft – B 100 ft – A 300 ft --	0-50 ft – B 100 ft – A 300 ft --

[1]A = HQ >1 at maximum application rate only
[2]B = HQ >1 at typical and maximum application rates

4.3.1.4. Effects of Herbicide Applications to Listed Fish

Significant adverse effects to listed fish, and the aquatic invertebrate, algal, and aquatic macrophytes habitat elements, are likely to occur. However, the magnitude and areal extent of adverse effects to listed fish and critical habitat are likely to be low. Herbicides and application scenarios likely to adversely affect listed fish and associated species groups or habitat elements are summarized in Table 17.

Significant adverse effects to listed fish are likely to result from glyphosate and triclopyr application in all four treatment categories (riparian, ditch/dry intermittent channels, perennial streams, and broadcast drift), from picloram in three treatment categories (riparian, ditch/intermittent channels, and broadcast drift), and dicamba in one treatment category (ditches/intermittent channels). Significant adverse effects to listed fish from short-term exposures to low (i.e. single digit) HQ exceedences are reasonably likely to occur – for example, increased respiration, reduced feeding success, impaired olfactory function, and subtle behavioral changes that can increase predation risk. When treatments occur that utilize two or more herbicides in close proximity, exposures to mixtures may occur.

Exposures to estimated maximum concentrations of chlorsulfuron, aminopyralid, clopyralid, imazapyr, imazapic, sulfometuron, metsulfuron, hexazinone, 2,4-D, and sethoxydim are not likely to result in adverse effects to listed fish. However, simultaneous exposure to these herbicides may increase the level of adverse effects from glyphosate, triclopyr, picloram, or dicamba exposure. Additional adverse effects from co-exposure are most likely to manifest as an additive, and not synergistic, response in fish. Dose addition is considered most appropriate for mixtures with components that affect the same endpoint by the same mode of action, and are believed to behave similarly with respect to uptake, metabolism, distribution, and elimination (Choudhury et al., 2000). The precise toxic mechanisms in fish are not clearly documented for the 14 herbicides contained in the activity description, but effects to the kidney and liver are typical endpoints in terrestrial wildlife. In addition, it is known that the proposed herbicides are relatively soluble and have bioconcentration factors that fall within a range that does not indicate bioconcentration risk (all bioconcentration factors <32. Thus, it is believed that the assumption of similar uptake, metabolism, distribution, and elimination is adequately met in fish for dose-addition analysis at low concentrations.

Significant adverse effects to aquatic invertebrates are only likely to occur from dicamba exposure resulting from application in ditches/intermittent channels approaching the maximum labeled rate.

Table 17. Herbicides treatments likely to adversely affect fish and associated species groups

	Treatment Categories			
Species Group	Riparian Areas (above high water mark)	Ditches and Intermittent Channels	Perennial Channel Instream (dry areas within channel and emergent plants)	Broadcast Drift
Fish	glyphosate, picloram, triclopyr	glyphosate, dicamba, picloram, triclopyr	glyphosate, triclopyr	glyphosate, picloram, triclopyr
Aquatic Invertebrates	---	dicamba	---	---
Algae	chlorsulfuron, glyphosate, imazapyr, hexazinone, triclopyr, 2,4-D	glyphosate, imazapyr, dicamba, picloram, hexazinone, triclopyr,	---	dicamba, hexazinone, imazapyr, metsulfuron, sulfometuron, triclopyr, 2,4-D
Aquatic Macrophytes	chlorsulfuron, imazapyr, metsulfuron, sulfometuron, hexazinone, picloram, triclopyr, 2,4-D	imazapic, imazapyr, dicamba, picloram, hexazinone, triclopyr	---	chlorsulfuron, hexazinone, imazapic, imazapyr, metsulfuron, sulfometuron, triclopyr, 2,4-D

As summarized in Table 17, adverse effects to algae and aquatic macrophytes are likely to result from herbicide application in riparian areas, ditches/intermittent channels, and from broadcast drift. Adverse effects to algae and aquatic macrophytes that translate to significant indirect adverse effects (via alteration in food supply, cover, etc.) to listed fish may not result from brief exposures to herbicide concentrations causing lower (single digit) HQ exceedences. The highest risk to aquatic macrophytes is from intensive application to ditches where the HQ values for ditch effluent at stream channel confluences can potentially be greater than 10 (imazapic and triclopyr) or 100 (dicamba, hexazinone, and imazapyr).

The chronic exposure analysis determined that adverse effects to aquatic macrophytes are likely for chlorsulfuron when 10 or more streamside acres are treated at application rates greater than about 0.08 pounds a.i./acre (0.056 pounds a.i./acre is the typical rate, and 0.25 pounds a.i./acre is the maximum rate). No other chronic effect risks were identified.

Since the herbicides included in the activity description target four different plant metabolic pathways, additive and synergistic effects to aquatic macrophytes may occur when co-exposure to multiple herbicides results from treatments utilizing two or more herbicides in close proximity.

The BMPs discussed in section 2.5.2. have been developed to minimize the risks of using herbicides in areas where shortnose, Lost River, Warner and Modoc suckers, Oregon chub and Lahontan cutthroat trout may occur. These are all of the inland fish that are listed as endangered and two threatened species, all of which have a fairly limited distribution in Oregon. The BMPs are designed to reduce the risks of herbicides to these species as well as their designated critical habitats.

Designated critical habitat for Warner sucker includes the streams shown on the map in Appendix C, and 50 feet on either side of the stream banks. Application of herbicide or insecticide along stream courses or lakes inhabited by the Warner sucker poses risks to this species and is specifically recognized as an activity that may adversely modify its critical habitat, along with removal of natural vegetation within or along stream courses and other activities (U.S. Fish and Wildlife Service 1985a). Water quality degradation, including chemical pollution from herbicides, has also contributed to the decline of the Lost River and shortnose suckers (U.S. Fish and Wildlife Service 1988), Modoc sucker (U.S. Fish and Wildlife Service 1985b) and Oregon chub (U.S. Fish and Wildlife Service 1993). Water quality is also a key habitat factor for Lahontan cutthroat trout (U.S. Fish and Wildlife Service 1995). Proposed critical habitat for the Lost River and shortnose suckers includes designated streams as well as the area needed provide long-term stream function, which has been described as the associated 100-year FEMA floodplains, or 300-foot wide setbacks if floodplains are not mapped (U.S. Fish and Wildlife Service 1994). CREP activities will primarily take place within these types of streamside areas.

While herbicides pose a risk to listed fish species and their critical habitats, restoring native riparian vegetation through the CREP program and otherwise can contribute to their recovery. Site preparation and maintenance often involves the use of herbicides to achieve restoration goals. The herbicide-related BMPs developed for some of the inland fish (see section 2.5.2) are designed to allow limited use of the herbicides listed below. These herbicides cover a wide range of noxious weed treatment needs that may be encountered, while minimizing risk to listed inland fish and their critical habitats.

Aminopyralid – selective treatment of broadleaf weeds
Clopyralid – selective treatment of broadleaf weeds
Dicamba – selective treatment of broadleaf weeds and woody vegetation
Glyphosate – nonselective
Imazapic – selective treatment of grasses, broadleaves, and vines
Imazapyr –treatment of woody vegetation
Picloram – treatment of broadleaf weeds and undesirable brush

The above herbicides and associated BMPs were developed based on the combined results of all of the analyses for the various scenarios discussed in section 2.3.2. The specific herbicides, application rates, rainfall levels and distances from aquatic resources described in the BMPs are below threshold risk levels found in the analyses for fish as well as aquatic invertebrates, algae, and aquatic macrophytes, which are related to the PCEs for designated and proposed critical habitats and food resources for listed fish.

4.3.1.5. Effects of Herbicide Applications to Invertebrates

4.3.1.5.1. Effects to fairy shrimp

In counties where vernal pool fairy shrimp occur, herbicides will not be used on CREP projects with vernal pools. If it is determined that herbicide application is necessary on a CREP project with a vernal pool in counties where fairy shrimp occur, the effects of the application will be evaluated through an individual consultation, if needed. Therefore, we expect no effects to fairy shrimp from herbicide applications on CREP projects covered by this programmatic consultation.

4.3.1.5.2. Effects to Fender's blue butterfly

Several effects to Fender's blue butterfly and its critical habitat are possible from herbicide applications. Host and nectar plants for the butterfly may be affected due to exposure to herbicides from drift, spray or runoff reaching these non-target species. These plants may also benefit from reduced competition from other plants resulting from the herbicide applications. The butterfly may also be affected by drift from applied herbicides or may be sprayed directly during the egg or larval stage. However, the BMPs developed for the butterfly greatly reduce these risks (see section 2.5.5). In addition, only the following herbicides will be applied on sites with Fender's blue butterfly: glyphosate, imazapyr, clopyralid, triclopyr BEE, and triclopypr TEA. Herbicides will not be mixed for use in butterfly habitats because some research, as discussed below, has shown that mixing could pose a higher risk to butterflies. We believe this subset of herbicides will provide effective control of weeds while minimizing impacts to the Fender's blue butterfly.

Clopyralid has been tested on a variety of terrestrial invertebrates. Standard bioassays on honeybees (LD_{50} >90 mg/kg) have been conducted as well as exposure of earthworms to clopyralid in soil (LC_{50} >1000 ppm). Also, Hassan et al. (1994) provided a summary of several bioassays and field trials using a variety of terrestrial invertebrates. Clopyralid produced some mortality in insect parasites, predatory mites, *Semiadalia 11-notata* (Coccinellidae), *Anthocoris nemoralis* (Anthocoridae), and *Chrysoperla carnea* (Chrysopidae). Pekar et al. (2002; cited in SERA, 2003 Clopyralid) reported that clopyralid was "harmless" to wild immature spiders (*Theridion impressum*).

There is a low potential for glyphosate to adversely affect terrestrial invertebrates. The honeybee LD_{50} for glyphosate is greater than 1075 mg/kg and the NOEC is 540 mg/kg. Mortality at 134 mg/kg in one study was attributed to equipment failure (SERA 2003 Glyphosate). Direct foliar spray had no effect on the spider mite (*Tetranchys urticae*). One-hundred percent mortality to spider mites was reported after application of RoundUp ULTRA at 3.6 kg a.i./ha, but it was attributed to the solution causing the mites to stick to the glass plates. Studies of the effects of glyphosate on the spider *Lepthyphantes tenuis* resulted in no effects that could be attributed to glyphosate toxicity. No significant effects were noted in studies on rove beetles, butterflies, or terrestrial snail (*Helix aspersa*). The soil LC_{50} for a worm common in Libya, *Aporrectodea caliginosa*, is 177-246 mg glyphosate/kg soil (Mohamed et al. 1995; cited in SERA, 2003 Glyphosate).

Imazapyr has a low acute toxicity to bees with an LD_{50} >1000 mg/kg. No information on effects to other terrestrial invertebrates is available.

Honeybee assays provide the only information on the effects of triclopyr acid and triclopyr TEA to terrestrial invertebrates. In both bioassays, the LD_{50} is greater than 1075 mg/kg (SERA, 2003

Triclopyr).

Some field studies have attempted to determine the effects of herbicide use on butterfly populations. Bramble et al. (1997) investigated butterfly diversity and abundance on electric transmission right-of-ways treated with herbicides versus those treated with only mechanical methods. Herbicides used in the right-of-way treatments included a mixture of picloram and triclopyr, a mixture of triclopyr and metsulfuron methyl, a mixture of glyphosate and fosamine, a mixture of triclopyr and imazapyr, and glyphosate alone. They found no significant differences in diversity or abundance of butterflies between herbicide and no-herbicide units.

Another study investigated the effects of controlling false brome (*Brachypodium sylvaticum*) within areas containing the federally listed Fender's blue butterfly and Kincaid's lupine. Investigators found that although a variety of herbicides were tested, no treatment caused a significant decline in the number of Kincaid's lupine leaves or the number of Fender's blue butterfly larvae (Clark et al., 2003). The most promising treatment used the herbicide Fusilade®, a grass-specific herbicide. This treatment reduced the cover of the invasive false brome, while producing 70 percent more lupine leaves and the highest numbers of butterfly larvae.

Sucoff, et al. (2001) studied the effects of herbicides on host plants, eggs, and larvae of the Karner blue butterfly (*Lycaeides Melissa samuelis*), a federally endangered species. Treatments with glyphosate, glyphosate-sulfometuron methyl mix, and glyphosate-triclopyr mix did not inhibit cover and flowering of *Lupinus perennis*, the sole larval food plant, and may have modestly stimulated the lupine. In contrast, herbicide applications did reduce the percent cover and flowering of most, but not all, nectaring plants. The investigators also measured development and hatching of butterfly eggs, percent of hatched eggs that pupate, percent of pupae that emerge as adults, percent of eggs that produce adults, rate of development, and size of pupae, for eggs drenched with the herbicides, singly or in combination. Glyphosate, triclopyr, and glyphosate-sulfometuron methyl mix treatments did not significantly reduce egg hatching, pupation of larvae, emergence of adults, pupae size, the rate of development, or percent of eggs that produced adults. Treatments with glyphosate-triclopyr mix did significantly lower egg hatching.

In models that evaluated the absorbed doses of clopyralid, chlorsulfuron, dicamba, glyphosate, hexazinone, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, triclopyr acid, triclopyr BEE, and 2,4-D acid in a direct spray of a honeybee, and divided them by toxicity values for honeybees for each herbicide, hazard quotients for each herbicide were below 1 (SERA, 2003, clopyralid, chlorsulfuron, dicamba, glyphosate, hexazinone, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, triclopyr acid, triclopyr BEE, and 2,4-D acid, Worksheet G02).

For backpack applications on sites with listed plants, including Kincaid's lupine (which is a Fender's blue butterfly host plant), the wind velocity will be no more than 3 miles/hour, which is equivalent to approximately 4.4 feet/second (1 mile/hour = 1.467 feet/second). Assuming a wind direction perpendicular to the line of application, 100 μ particles falling from 3 feet above the surface could drift as far as 13.2 feet (3 seconds x 4.4 feet/second).

4.3.1.6. Effects of Herbicide Applications to Plants

Several effects are possible to listed plants from herbicide applications. Listed plants, and host plants for listed invertebrates, may benefit from reduced competition from other plants resulting from the herbicide applications. However, they could be harmed if they come into contact with herbicides due to direct spray, drift, runoff or movement through soil. Table 18 shows the mode of uptake, movement rating and half-life of the most of the herbicides used in the CREP program. Limitations regarding herbide use were developed based on the information presented in this table, and are included with the BMPs for listed plants in section 2.5.6.

Table 18. Summary of herbicides, mode of uptake, movement rating and half-life

Herbicide	Soil half-life in days[1]	Foliar half-life in days[3]	Movement Rating[1]	Mode of Uptake[2]
Aminopyralid	343	19	Not available	Translocates throughout the entire plant.; primarily postemergent herbicide but also provides good preemergent control
Clopyralid	40	2	Very High	Rapidly absorbed across leaf surfaces; much less readily absorbed by plant roots
Dicamba	14	9	Very High	Absorbed by both foliage and roots
Hexazinone	90	30	Very High	Primarily by plant roots; although some foliar absorption may occur
Imazapic	113	4	Not available	Absorbed by leaves and roots
Imazapyr	90	26	High	Toxicity can be induced by either foliar or root absorption
Metsulfuron	30	30	High	Taken up by plants at the roots & on foliage; translocated throughout plant
Chlorsulfuron	40	30	High	Absorbed by roots and foliage; translocates readily after root absorption but less so from foliar
Picloram	90	8	Very High	Readily absorbed by roots, less so by foliage, easily translocated after absorption
Sethoxydim	5	3	Low	Absorbed rapidly by foliage; moves both upward and downward
Sulfometuron	20	10	Moderate	For pre-emergent applications, absorbed by roots; for post-emergent applications, absorbed through foliar and root uptake; most effective before/during early stage of weed growth
Triclopyr amine	46	15	Very High	Taken up by roots or foliage and readily translocated throughout plans
2,4-D amine	10	8.8	Moderate	Absorbed through leaves and roots
2,4-D ester	10	8.8	Moderate	Absorbed through leaves
Glyphosate	47	10	Extremely Low	Absorbed through leaves; may be translocated throughout plant

[1] From Vogue et al. (1994), located at http://npic.orst.edu/ppdmove.htm
[2] From SERA risk assessments and http://extoxnet.orst.edu/
[3]From SERA risk assessments; or from http://www.tifton.uga.edu/sewrl/Gleams/glm30pst.pdf

Off-site drift is more or less a physical process that depends on droplet size and meteorological conditions rather than the specific properties of the herbicide. Estimates of off-site drift can be modeled using AgDRIFT (Teske et al. 2001). AgDRIFT is a model developed as a joint effort by the EPA Office of Research and Development and the Spray Drift Task Force, a coalition of pesticide registrants. AgDRIFT is based on the algorithms in FSCBG (Teske and Curbishley, 1990), a drift model previously used by USDA.

Drift from broadcast applications

For ground broadcast applications, AgDRIFT provides estimates of drift based solely on distance downwind as well as the types of ground application: low boom spray, high boom spray, and orchard airblast (only boom spray is applicable to the CREP program). In risk assessments of various herbicides evaluated by Syracuse Environmental Research Associates for the U.S. Forest Service, the AgDRIFT estimates were used for consistency with comparable exposure assessments conducted by the U.S. EPA. In addition, AgDRIFT represents a detailed evaluation of a very large number of field studies and is likely to provide more reliable estimates of drift. Further details of AgDRIFT are available at http://www.AgDRIFT.com/.

The SERA assessments summarize the results of modeled drift concentrations at various distances from the application site and compare these concentrations with NOECs for both sensitive and tolerant plants. Hazard quotients were then generated for sensitive plants at each distance for each herbicide. For all distances where the hazard quotient was greater than one, herbicides will not be broadcast within those distances of listed plants on CREP projects. Table 19 summarizes the application buffers that will be used for specific herbicides. The distances are based on hazard quotients that were shown to be less than 1 in the SERA assessments.

Table 19. Summary of buffers to be used for broadcast applications at listed plant sites

Herbicide	**Application buffer (feet)**
Clopyralid	900
Glyphosate	50
Imazapyr	900
Triclopyr acid	300
Triclopyr BEE	300

Drift from hand applications

Drift associated with backpack (directed foliar applications) is likely to be much less although studies quantitatively assessing drift after backpack applications have not been encountered. The SERA risk assessments estimate drift from backpack sprays using Stoke's law, which describes the viscous drag on a moving sphere. According to Stoke's law:

$$v = \frac{D^2 (g)}{18n} \quad \text{or} \quad v = 2.87\,(10^5)(D^2)$$

where v is the velocity of fall (cm sec^{-1}), D is the diameter of the sphere (cm), g is the force of-1 gravity (980 cm sec^{-2}), and n is the viscosity of air (1.9)(10^{-4} g sec^{-1} cm^{-1} at 20°C) (Goldstein et al. 1974).

In typical backpack ground sprays, droplet sizes are greater than 100 µ, and the distance from the spray nozzle to the ground is 3 feet or less. In mechanical sprays, raindrop nozzles might be used. These nozzles generate droplets that are usually greater than 400 µ, and the maximum distance above the ground is about 6 feet. In both cases, the sprays are directed downward. Thus, the amount of time required for a 100 µ droplet to fall 3 feet (91.4 cm) is approximately 3.2 seconds,

$91.4 \div (2.87 \times 10^5 (0.01)^2)$.

For backpack applications on sites with listed or host plants, the wind velocity will be no more than 3 miles/hour, which is equivalent to approximately 4.4 feet/second (1 mile/hour = 1.467 feet/second). Assuming a wind direction perpendicular to the line of application, 100 µ particles falling from 3 feet above the surface could drift as far as 13.2 feet (3 seconds x 4.4 feet/second).

4.3.2. Other Chemical Effects

Other chemicals that may be used on CREP projects are associated with vehicle or pump use. These chemicals include fuels and other fluids normally needed to operate farm equipment or other vehicles. Potential effects include impacts to listed aquatic species from runoff of spilled fuel to streams, ingestion by listed terrestrial wildlife of fuel spilled on plants, or spillage of fuel onto listed plant species.

To minimize these potential impacts, the following BMPs will be used.

- Appropriate materials and supplies (e.g., shovels, disposal containers, absorbent materials, first aid supplies, and clean water) will be available on-site to cleanup any small accidental spills in accordance with product Material Safety Data Sheets and labels. Significant hazardous spills will be reported to the Oregon Emergency Response System at 1-800-452-0311 (system available 24 hours a day). (Also see ODEQ emergency response web site at http://www.deq.state.or.us/wmc/cleanup/spl0.htm for more information.) The Oregon Poison Control Center will be contacted at 1-800-222-1222 (24 hours) for assistance in responding to emergency exposures. Project managers will ensure that each applicator is familiar with spill response procedures before commencing herbicide application operations.

5. SUMMARY OF EFFECTS TO LISTED SPECIES AND CRITICAL HABITATS

5.1 Anadromous Fish

Some CREP actions may have short-term negative effects to threatened and endangered fish. The effects from these actions are evaluated in three categories: mechanical, chemical, and biological effects. Appendix B provides more detailed evaluations of these effects.

Mechanical activities include soil disturbance to prepare sites for planting, excavation to install pipelines and off-stream watering facilities, instream work to install livestock crossings, bank shaping to create a suitable bank slope for planting, and driving vehicles to the riparian area. Vehicles driving in the riparian area may also increase soil compaction, reducing infiltration into the soil and making vegetation establishment more difficult; however, this effect will likely be offset by site preparation for planting and from riparian planting establishment. These activities have the potential to cause sediment delivery to waterways, which could have physical effects to fish. Loss of some native vegetation could also occur during site preparation and project construction. In addition, instream activities could disturb or harm fish species.

Increased turbidity can interfere with salmonid respiration and reduce incubation survival. Fine sediments clog gravel interstices reducing water flow over the eggs and limiting oxygen delivery, removal of metabolic wastes, and the ability of fry to emerge. Excessive sediment can clog the gills of juvenile fish, reduce prey availability, and reduce juvenile success in catching prey.

Manual and herbicide treatment activities occurring within occupied stream channels are likely to cause disturbance to juvenile and adult listed fish, and disturb redds. These effects will cause some juveniles and adults to seek alternative habitat, which is likely to contain suboptimal cover and juvenile forage. Fish that seek suboptimal forage and cover will have increased behavioral stress (avoidance, displacement), and sub-lethal responses (increased respiration, reduced feeding success, reduced growth rates). Instream treatment activities are likely to cause some physical injury or death to eggs present in redds or juvenile fish that do not leave the activity area.

Hand pulling or site preparation (for replanting) that is extensive, intensive, and immediately adjacent to a stream course may cause instream fine sediment delivery, resulting in localized sediment deposition or stream turbidity increases.

Hand pulling of emergent vegetation is likely to result in localized turbidity increases and mobilization of fine sediments. The degree of effect will be proportionate to the extent of the infestation treated, type of substrate in which the plants are rooted, rooting depth, and whether a hand tool is required for pulling (weed wrench, shovel, etc.). Treatment of knotweed and other streamside invasive species with herbicides (by stem injection or spot spray) is likely to result in significant short-term increases in localized fine sediment deposition or turbidity only when treatment of locally extensive streamside monocultures occurs. Localized turbidity increases are likely to cause some juveniles and adults to seek alternative habitat, which is likely to contain suboptimal cover and juvenile forage. Fish that seek suboptimal forage and cover will have increased behavioral stress (avoidance, displacement), and sub-lethal responses (increased respiration, reduced feeding success, reduced growth rates).

Other manual, mechanical, solarization, and herbicide (cut-stump, and wicking/wiping) treatment methods are unlikely to cause fine sediment or turbidity increases. Seed clipping, stabbing, girdling, and cutting typically do not involve ground disturbance or result in bare ground. Solarization may result in bare ground, but is typically small-scale, treating less than 0.1 acres at a time at individual sites that typically support only non-native species; listed species do not occur in areas where solarization may be used.

Some mechanical activities may provide immediate benefits to fish species. Breaking tile to restore wetland function increases water storage in wetland areas, increasing habitat for several fish species. Specifically, increased water storage increases the amount of cool water available for release during base flows providing more favorable water temperatures and water volumes during summer and early fall. Exclusion of livestock with fence construction should lessen physical disturbance to fish immediately.

Mechanical activities also have the potential to affect critical habitat for listed fish. Short-term sediment delivery to streams from site preparation for planting, excavation to install pipelines and off-stream watering facilities, instream work to install livestock crossings, bank shaping, and driving vehicles to the riparian area could cause silting in of spawning areas, increased turbidity in streams, and a temporary reduction of shade from weedy vegetation. Decreased shade can increase stream temperatures, causing physical stress to fish and reducing dissolved oxygen levels.

However, long-term effects to listed fish critical habitat are expected to be highly beneficial, including reduced trampling and sedimentation in spawning grounds, improved water quality, increased shade, increased overhanging banks and other refugia, and increased large woody debris.

To prevent disturbance and harm to fish species from instream work, the following BMP will be used.

- Oregon guidelines for the timing of in-water work will be followed for each affected stream reach, unless the Oregon Department of Fish and Wildlife and NOAA Fisheries approve an extension based on current year site-specific conditions. In reaches where the ODFW in-water work period conflicts with the needs for resident listed fish, ODFW should be contacted for a waiver to the timing restrictions.

To minimize sediment delivery to streams from mechanical activities and possible physical effects to fish and critical habitat, the following BMPs will be used.

- Use existing roads or travel paths to access project sites whenever possible.
- Survey any potential spawning habitat for listed species within 300 feet downstream of a proposed stream crossing. Do not construct a stream crossing at known or suspected spawning areas, or within 300 feet upstream of such areas if spawning areas may be affected.
- Vehicles and machinery must cross streams and riparian areas at right angles to the main channel whenever possible.
- Minimize the use of equipment in or adjacent to a stream channel to reduce sedimentation rates and channel instability.
- Hand planting is the preferred technique for all plantings, except for filter strips. Plantings will occur during the appropriate seasonal period for the respective plant species involved.

- Streambank shaping will only be implemented where streambank stability is extremely poor or where necessary to restore riparian functions. Streambank modification for planting purposes will be thoroughly documented, and on each CREP contract where more than 30 linear feet of streambank is shaped by mechanical equipment, USDA will consult with the Services (this consultation only covers projects that involve shaping of up to 30 linear feet of streambank). Design of all streambank modification projects will recognize the important wildlife values provided along naturally eroding outside meander curves. Any soil control structures will be bio-engineered to the extent possible. No riprap will be used under this program for streambank stabilization. No streambank stabilization activity will reduce natural stream functions or floodplain connection.
- The boundary of a project site must be flagged to prevent soil disturbance to areas outside the site. Confine construction impacts to the minimum area necessary to complete the project.
- Limit the removal of any native vegetation to the amount that is absolutely necessary to complete a construction activity.
- Slash materials should be gathered by hand or with light machinery to reduce soil disturbance and compaction. Avoid accumulating or spreading slash in upland draws, streams, and springs. Slash control and disposal activities must be conducted in a manner that reduces the occurrence of debris in aquatic habitats.
- Disturbed areas will be reseeded.
- Filter strips will be left between disturbed areas and streams.

Chemical activities include herbicide applications, the use of fuels for mechanized equipment during construction and tillage, and the use of fuel to run water pumps for irrigation or livestock watering.

Herbicide applications may cause negative chemical impacts to fish and their food resources. Herbicides applied to control weeds and competing vegetation on CREP plantings may enter streams through drift, spillage, or overspray; dissolved in surface runoff; or attached to sediment particles that run into streams. Herbicide delivery to surface water can result in mortality during incubation, altered development of embryos, and modified behavior of larval stages. Mortality to juveniles may result or sublethal effects such as reduced growth and development, decreased predator avoidance, or modified behavior.

Forage is a primary constituent element (PCE) of critical habitat for salmon and steelhead. Herbicides can kill or affect growth of fish prey items or affect the growth of aquatic plants that fish or their prey species consume, decreasing food availability. In addition, reduction in overhead cover due to killing non-target vegetation increases the vulnerability of fish to predation.

The effects of herbicide applications to other critical habitat PCEs should be minimal. Herbicides may temporarily reduce cover along streams, but the vegetation removed will generally be non-native vegetation and this removal will result in long-term benefits to critical habitat. If ground cover is reduced through herbicide application, erosion may temporarily increase, resulting in sediment delivery to streams and deposition in spawning gravel and potentially decreasing incubation survival. If overhead cover is temporarily reduced from herbicide application, juvenile salmonids may be temporarily more vulnerable to predation.

Section 2.4.3. includes a list of Best Management Practices that will be followed for all herbicide applications covered in this Biological Assessment.

Other potential chemical impacts to fish come from the use of equipment in the riparian area. There is potential for fuel spills in riparian areas or to streams from any mechanized equipment, including equipment for temporary construction projects and pumps used for water withdrawals.

To prevent impacts to fish from fuel delivery to streams from equipment use, the following BMPs will be used.

- Locate staging and refueling areas at least 150 feet from any stream or other waterbody.
- Limit the size of staging and refueling areas and only store enough supplies, materials, and equipment onsite to complete the project.
- All equipment must be cleaned to remove external oil, grease, dirt, and mud before beginning operations below the high water mark elevation of a stream.
- All equipment operated within 150 feet of an aquatic habitat must be inspected daily for fuel leaks before leaving the equipment staging area. All detected leaks must be repaired in the staging area before the equipment resumes operation.
- All stationary power equipment (e.g., generators) operated within 150 feet of any aquatic habitat must be diapered to prevent leaks and/or enclosed in a containment device (e.g., non permeable drip plan) of adequate capacity to retain equipment fluids (e.g., gasoline, diesel fuel, and oil) if a leak occurs.

In addition to the short-term effects to anadromous fish, long-term effects are expected from CREP projects. Most of these effects are highly positive. Exclusion of livestock from riparian areas should lessen sediment delivery to streams as well as other pollutants. Less sediment delivery results in more suitable spawning sites, better water quality, and increased egg-to-fry survival.

Establishment of native trees, shrubs, grasses and forbs along streams will increase shade, increase dissolved oxygen levels, and promote instream habitat complexity. Tillage and deep ripping to facilitate tree planting also reduces soil compaction, increasing infiltration and soil storage capacity and enhancing the health of riparian plant communities. Increased riparian vegetation and instream cover should increase aquatic insect populations, enhancing food availability for fish.

Most mechanical and herbicidal treatments of invasive plant species in riparian areas are not likely to decrease shading of streams. However, in some situations, decreased shading is likely to result, increasing the amount of incident solar radiation reaching the stream, and resulting in increased water temperatures. Significant shade loss that significantly affects water temperature is likely to be rare, occurring primarily from treating streamside knotweed and blackberry monocultures, and possibly from cutting streamside woody species (tree of heaven, scotch broom, etc.). The loss of shade would persist until native vegetation reaches and surpasses the height of the invasive plants that were removed. Shade recovery may take one to several years, depending on the success of invasive plant treatment, stream size and location, topography, growing conditions for the replacement plants, and the density and height of the invasive plants when treated.

Wetland restoration activities covered in this BA such as breaking tiles and restoring native plant communities increases water storage in wetlands and floodplains, creating additional fish habitat and enhancing subsurface flow into streams during the summer. Some wetland restoration projects may also benefit estuarine areas, which are critical to migrating salmonids as they transition between fresh water and saltwater.

Instream water right leases may be included as a CREP project activity. These should increase water volume in some streams during the summer, benefiting fish and their critical habitat. Also, riparian plants slow overland flows of water and promote infiltration of precipitation into the soil. This can increase subsurface water flow into streams in the summer, increasing flow volume and decreasing stream temperature. Increased release of groundwater during dry periods can improve egg survival and larval development by preventing redds from drying out. Adults migrating during irrigation season would benefit by being able to access more spawning habitat with increased flow.

Increased shade and streamflow should reduce stream temperatures, opening areas to spawning that were not previously available due to high temperatures and increasing survival during incubation.

To ensure maximum long-term benefits of riparian plantings, all plantings will be completed according to NRCS practice standards, which require the use of native vegetation from an appropriate seed zone.

Some possible long-term negative impacts to fish are possible associated with livestock watering devices and stream crossings. Vegetation removal to create livestock crossings will reduce overhead cover and shade, but riparian vegetation improvements along the remainder of the stream should compensate for this loss. There is the potential for sediment runoff from spring developments or troughs used for livestock watering. To minimize the potential for runoff, the following BMP will be used.

- Spring developments will always be fenced when spring developments are constructed to provide off-stream watering for livestock for CREP projects. All troughs and other watering facilities will be equipped with float valves to minimize mud and runoff.

Some livestock watering facilities will involve water withdrawals from streams to provide water to livestock. In addition, some tree and shrub plantings may be watered for their first three years of establishment, prompting water withdrawals using existing water rights and withdrawal equipment. There is the potential for physical harm to fish as water is pumped from the waterbody. To prevent these impacts, the BMPs in section 2.5.1. will be used.

Although BMPs are identified to minimize biological, mechanical, and chemical impacts to fish, certain CREP actions **may affect, and are likely to adversely affect listed anadromous fish and their designated critical habitat** in the short term. Adverse effects include short-term increases in turbidity, fine-sediment deposition, direct disturbance of individuals during instream work, and adverse effects to algae, aquatic macrophytes, aquatic macroinvertebrates, and fish from herbicide delivery to aquatic habitat. Although there will be short-term adverse effects associated with CREP actions, there will be abundant long-term beneficial effects to listed species and designated critical habitat as riparian areas are restored and aquatic-habitat benefits are realized.

5.2. Inland Fish

5.2.1. Bull trout

The potential effects to bull trout are similar to those described for anadromous fish; please also refer to the discussion in section 5.1.

CREP activities could result in short-term adverse effects to bull trout and some of the PCEs of designated bull trout critical habitat. Specifically, reduced shade over streams after weeds are removed and before native vegetation becomes established could slightly increase water temperatures over the short-term. Consequently, it is possible that the optimal temperature range for bull trout in streams where bull trout occur and in designated critical habitats could be exceeded or result in reduced oxygen levels that could cause stress to bull trout or their prey in the short-term.

If water is removed from streams for CREP project site irrigation or watering facilities, this could potentially reduce stream flows during low flow periods. However, the amount of water to be diverted to irrigate or fill watering facilities is not expected to be significant, and a BMP is in place to avoid creating or exacerbating low flow conditions that could impact listed fish. In addition, irrigated areas will typically be riparian areas that drain back toward the stream; water loss from transpiration and evaporation is not expected to exceed natural riparian conditions. If water is pumped from the stream in areas with bull trout, fish screens that meet NOAA Fisheries standards will be used with a requirement that they be kept clean and in properly functioning condition to protect bull trout.

Sediment delivery could occur that results in short-term water quality impacts or increased substrate embeddedness due to project activities such as tillage or weed removal that could cause erosion. In addition, some sediment could be stirred up in the stream or erode from the banks during construction of livestock crossings and watering facilities. While sedimentation could increase in the stream from CREP projects over the short-term, CREP program BMPs are in place to control erosion with the aim of preventing sediment from entering the stream from adjacent areas. In addition, the size, area, locations and construction timing of instream and streambank projects is limited to avoid and minimize impacts to fish.

The use of herbicides poses risks to bull trout. Herbicides could impact bull trout or their food base, which includes terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish. Herbicide-related BMPs will be followed, but the proposed herbicides, application methods and use zones are such that herbicides could still reach areas where bull trout and their critical habitats occur and result in adverse affects.

CREP projects may also benefit bull trout and their critical habitat. Over the long-term, it is anticipated that streams will become more complex with habitat features such as woody debris, pools and undercut banks as riparian areas are improved. If projects affect stream hydrographs, they are likely to more closely resemble more natural conditions due to improved wetland, riparian and floodplain functions and the leasing of instream water rights to maintain or restore stream flows. Springs used for livestock watering facilities are likely to continue to contribute to stream flows and are designed to improve water quality by removing livestock from sensitive areas and using erosion control measures that address sedimentation problems. Spring development projects will not occur from springs where listed fish may occur.

In summary, while CREP projects in areas with bull trout are expected to **benefit the species and its critical habitat over the long-term**, and BMPs will be followed that will avoid and minimize many potential impacts of CREP activities, it has been determined that some CREP activities **may affect, and are likely to adversely affect bull trout and their critical habitat** over the short-term. Adverse effects may include increases in turbidity, fine-sediment deposition, disturbance of individuals during instream work, and adverse effects to algae, aquatic macrophytes, aquatic macroinvertebrates, and fish from herbicide delivery to aquatic habitats.

5.2.2. Lahontan Cutthroat Trout

The potential effects to Lahontan cutthroat trout are similar to those described for anadromous fish (see discussion in section 5.1) and bull trout (see section 5.2.1.). However, one difference is that herbicide use will be limited to chemicals and measures that are expected, based on the herbicide analyses, to result in exposures that are below threshold risk levels for fish as well as aquatic invertebrates, algae, and aquatic macrophytes, which are related to the PCEs for designated and proposed critical habitats and food resources for listed fish. Herbicide limitations are described in the BMPs in section 2.5.2.

Temporary loss of shade after weeds are removed and before native vegetation is established could be of concern for Lahontan cutthroat trout. However, this species is not as susceptible to higher water temperatures as some of the other listed fish. They have been found to be tolerant of high temperatures (>20 C) and large daily fluctuations of up to 20 C (Behnke 1992, LaRivers 1962), although they do require spawning and nursery habitat that is characterized by cool water and relatively silt free rocky substrate in riffle-run areas (USFWS 1995). CREP projects could result in increased stream sediment during project construction and as restoration sites are becoming stable, but this is expected to be minimized with the BMPs in place.

Generally, any CREP projects in areas with Lahontan cutthroat trout are expected to benefit the species over the long-term as habitat is improved. CREP projects may address some of the threats to this species, such as habitat loss associated with livestock grazing practices (by fencing, installing crossings and building watering facilities to protect sensitive areas), water diversions (by leasing water rights for instream use) and poor water quality (by restoring riparian areas and wetlands). BMPs will be followed that will avoid and minimize many potential impacts of CREP activities. The BMPs that limit, but still allow some herbicide use in areas where this species may occur should greatly reduce the potential for adverse effects to the species while restoration projects move forward under this programmatic consultation.

While the potential for adverse affects has been greatly reduced through the BMPs, it has been determined that some CREP activities **may affect, and are likely to adversely affect the Lahontan cutthroat trout over the short-term**. Adverse effects may include short-term increases in turbidity, fine-sediment deposition and direct disturbance of individuals during instream work. In addition, while herbicide use will be limited to chemicals and methods designed to avoid adverse affects to inland fish, there are inherent risks associated with the use of herbicides and uncertainties in the herbicide analyses, and it is possible that herbicide delivery to aquatic habitat could still adversely affect this species or its habitat. CREP projects that occur in areas that support this species are expected to **benefit the species over the long-term**.

5.2.3. Warner Sucker

The potential effects to listed suckers are similar to those described for the other listed fish (see discussions in sections 5.1, 5.2.1. and 5.2.2).

The Warner sucker occurs in streams (including headwaters), lakes and associated marshes. Sedimentation and turbidity caused by CREP activities could impact the silt-free, gravel bottomed flowing sections of creeks used by the Warner sucker for spawning. However, this is not expected to be a great concern with the limited activities proposed and the BMPs in place. Installation of livestock crossings and installation of offstream livestock watering facilities are the only instream activities covered by this biological assessment. The goal of these types of projects is to reduce erosion and water quality problems in sensitive areas. Instream crossings will not occur in areas used for spawning. Pumps will not be installed where listed suckers occur under this programmatic consultation for water diversions over 0.5 cfs., and when they are installed, fish screens that meet NOAA Fisheries fish screening criteria will be met and screens and pumps will be maintained in properly operating condition.

As with other fish species, habitat complexity is important to the Warner sucker. Shallow backwater pools, stream margins where there is no current, deep still pools and faster-flowing areas near the heads of pools are all important at various periods in the life history of the Warner sucker. Adults occupy stretches of stream where the gradient is low enough to allow the formation of long pools. These pools tend to have undercut banks, large beds of aquatic plants, root wads or boulders, a vertical temperature differential of at least 2 degrees Celsius, a maximum depth of 1.5 meters, and overhanging vegetation.

While weed removal may temporarily reduce shade and overhanging vegetation, replacement with native species is likely to improve habitat complexity and features such as pools and undercut banks over the long-term. During project construction instream or elsewhere, there is potential for erosion and sediment delivery to streams, but is will be minimized by the BMPs. Once established, revegetated and restored areas are expected to help retain soils as well as provide other ecological functions that will improve instream habitat.

CREP projects involving the installation of pumps for water diversions over 0.5 cfs in habitat for this species will be evaluated under separate consultations on an as-needed basis so that fish screens and other site-specific design criteria can be developed to minimize potential adverse affects to the species. Allowing screened diversions of under 0.5 cfs should minimize the risk of suckers becoming entrained or impinged on the screens due to the minimal amount of water to be diverted. A BMP is also in place to avoid creating or exacerbating low flow conditions that could adversely affect listed fish.

PCEs of Warner sucker critical habitat include streams 15 feet to 80 feet wide with gravel-bottom shoal and riffle areas and intervening pools. Critical habitat includes 50 feet on either side of the stream banks. Streams should have clean, unpolluted flowing water and a stable riparian zone. The streams should support a variety of aquatic insects, crustaceans, and other small invertebrates for food. Activities that could adversely affect the Warner sucker or adversely modify its critical habitat include application of herbicide in or near streams or lakes inhabited by the Warner sucker, which could be toxic to this species or its food, pollution of stream or lake habitat by silt or other pollutants, and removal of natural vegetation within or along streams.

Generally, any CREP projects that may occur in areas with Warner sucker are expected to benefit the species over the long-term as habitat is improved. CREP projects will address some of the threats to this species by fencing livestock away from streams, improving riparian and stream conditions and leasing water rights for instream flows. BMPs will be followed that will avoid and minimize many of the potential impacts of CREP activities. BMPs that limit, but still allow some herbicide use in areas where this species may occur should greatly reduce the potential for adverse effects to the species while restoration projects move forward under this programmatic consultation.

In summary, while the potential for adverse affects has been greatly reduced through the BMPs, it has been determined that some CREP activities **may affect, and are likely to adversely affect the Warner sucker and its critical habitat over the short-term**. Adverse effects may include short-term increases in turbidity, fine-sediment deposition and direct disturbance of individuals during instream work. In addition, while herbicide use will be limited to chemicals and methods designed to avoid adverse affects to inland fish, there are inherent risks associated with the use of herbicides and uncertainties in the herbicide analyses, and it is possible that herbicide delivery to aquatic habitat could still adversely affect this species or its habitat. CREP projects that occur in areas that support this species are expected to **benefit the species and its critical habitat over the long-term**.

5.2.4. Shortnose and Lost River Suckers

The potential effects to shortnose and Lost River suckers and their proposed critical habitats are similar to those described for the Warner sucker (section 5.2.3.) and other listed fish.

The shortnose and Lost River suckers are found in the deeper water of lakes and streams. Springs or streams are used for spawning, preferably in areas with gravel or cobble and a fairly shallow shoreline with an abundance of aquatic vegetation. Shoreline vegetation in both lake and stream habitats is important for the rearing of larval and juvenile suckers. PCEs of critical habitats for these species include water that is of sufficient quantity and quality (i.e., temperature, dissolved oxygen, flow rate, pH, nutrients, lack of contaminants, turbidity, etc.) to provide conditions required during the various life stages of each species; physical habitats for use as refugia, spawning, nursery, feeding, corridor or rearing areas; and a biological environment with an adequate food supply and a natural scheme of predation, parasitism, and competition.

Some of the factors that have contributed to the decline of the shortnose and Lost River suckers and their habitats include loss of aquatic and riparian vegetation which has lead to increases in stream temperatures, high levels of nutrients, reduction in food resources, unnaturally high levels of predation and competition, and serious sedimentation and turbidity problems in streams. Such water quality problems have reduced the availability of suitable sucker habitat and have resulted in major fish mortality. Other factors affecting the decline of these species include pollution from pesticides, herbicides and other chemicals and altered stream flows.

Generally, any CREP projects that may occur in areas with shortnose or Lost River sucker are expected to improve current conditions for these species as habitat is improved. The CREP program is designed to address some of the threats to these species through activities such as fencing portions of streams to reduce cattle-caused erosion, replanting streambanks with native vegetation, improving agricultural practices and leasing water rights for instream use. Projects that improve wetlands and floodplains can help protect sucker habitat by controlling erosion, recycling organic and inorganic nutrients, and maintaining water quality.

BMPs will be followed that will avoid and minimize many of the potential impacts of CREP activities. CREP projects involving the installation of pumps for water diversions over 0.5 cfs in habitat for this species will be evaluated under separate consultations on an as-needed basis so that fish screens and other site-specific design criteria can be developed to minimize potential adverse affects to the species. Allowing screened diversions of under 0.5 cfs should minimize the risk of suckers becoming entrained or impinged on the screens due to the minimal amount of water to be diverted. A BMP is also in place to avoid creating or exacerbating low flow conditions that could adversely affect listed fish. The BMPs that limit, but still allow some herbicide use in areas where these species may occur should greatly reduce the potential for adverse effects to the species while restoration projects move forward under this programmatic consultation.

While the potential for adverse affects to these species has been greatly reduced through the BMPs, it has been determined that some CREP activities **may affect, and are likely to adversely affect the shortnose and Lost River suckers and their proposed critical habitats**. Adverse effects may include short-term decreases in aquatic and streamside vegetation, increases in turbidity, fine-sediment deposition and direct disturbance of individuals during instream work. In addition, while herbicide use will be limited to chemicals and methods designed to avoid adverse affects to inland fish, there are inherent risks associated with the use of herbicides and uncertainties in the herbicide analyses, and it is possible that herbicide delivery to aquatic habitat could still adversely affect these species or their habitats. CREP projects that occur in areas that support this species are expected to **benefit the species and their proposed critical habitats over the long-term**.

5.2.5. Modoc Sucker

The potential effects to the Warner, shortnose and Lost River suckers and their habitats are similar to those for the Modoc sucker (see sections 5.2.3. and 5.2.4.).

Preferred habitat of the Modoc sucker consists of small streams characterized by large shallow pools with cover, soft sediments, and clear water. Food consists of benthic invertebrates, algae, and detritus. During spring spawning runs, the species ascends creeks or tributaries that may be dry during summer months (i.e., ephemeral and intermittent streams). According to the critical habitat designation for this species, constituent elements used by this species include intermittent and perennial creeks and surrounding areas (50-feet on either side of streams) that provide vegetation for cover and protection from erosion (USFWS 1985). No critical habitat for this species has been designated in Oregon; the species was only recently rediscovered in the state.

Threats faced by Modoc sucker, and opportunities for CREP projects to address them, are similar to those described for other listed fish. Any CREP projects that may occur in areas with Modoc sucker are expected to improve current conditions for this species as habitat is improved. CREP activities such as fencing portions of streams to reduce cattle-caused erosion, replanting streambanks with native vegetation, improving agricultural practices, leasing water rights for instream use, and improving wetlands and floodplains can help protect suckers and their habitat by controlling erosion, supporting the food web, providing inputs of woody material that can contribute to channel complexity, recycling organic and inorganic nutrients, and maintaining water quantity and quality.

BMPs will be followed that will avoid and minimize many of the potential adverse impacts of CREP activities. CREP projects involving the installation of pumps for water diversions over 0.5 cfs in habitat for this species will be evaluated under separate consultations on an as-needed basis so that fish screens and other site-specific design criteria can be developed to minimize potential adverse affects to the species. Allowing screened diversions of under 0.5 cfs should minimize the risk of suckers becoming entrained or impinged on the screens due to the minimal flows. A BMP is also in place to avoid creating or exacerbating low flow conditions that could adversely affect listed fish. The BMPs that limit, but still allow some herbicide use in areas where these species may occur should reduce the potential for adverse effects to the species while restoration projects move forward under this programmatic consultation.

While the potential for adverse affects to these species has been greatly reduced through the BMPs, it has been determined that some CREP activities **may affect, and are likely to adversely affect the Modoc sucker. The will be no effect on Modoc sucker critical habitat.** Adverse effects to the species may include short-term decreases in aquatic and streamside vegetation, increases in turbidity, fine-sediment deposition and direct disturbance of individuals during instream work. In addition, while herbicide use will be limited to chemicals and methods designed to avoid adverse affects to inland fish, there are inherent risks associated with the use of herbicides and uncertainties in the herbicide analyses, and it is possible that herbicide delivery to aquatic habitat could still adversely affect this species. CREP projects that occur in areas that support this species are expected to **benefit the species and their proposed critical habitats over the long-term**.

5.2.6. Oregon Chub

Oregon chub are found in slack water off-channel habitats such as beaver ponds, oxbows, side channels, backwater sloughs, low gradient tributaries, and flooded marshes. Refugia populations also occur in isolated ponds. These habitats usually have little or no water flow, silty and organic substrate, and aquatic vegetation as cover for hiding and spawning. Adults feed on the larvae of aquatic invertebrates, such as mosquitos and other insects. Adult Oregon chub seek dense vegetation for cover and frequently travel in the mid-water column in beaver channels or along the margins of aquatic plant beds. Larval chub congregate in near shore areas in the upper layers of the water column in shallow areas. Juvenile Oregon chub venture farther from shore into deeper areas of the water column. In the winter months, Oregon chub can be found buried in the detritus or concealed in aquatic vegetation.

Some of the factors responsible for the decline of the chub that may be addressed by CREP projects include habitat alteration, runoff from herbicide or pesticide application on farms, desiccation of habitats, water diversions and sedimentation. The types of CREP activities that may remedy these problems include leasing water rights for instream use, restoring native riparian vegetation, and keeping livestock away from sensitive areas.

BMPs will be followed that will avoid and minimize many of the potential impacts of CREP activities. CREP projects involving the installation of pumps for water diversions over 0.5 cfs in habitat for this species will be evaluated under separate consultations on an as-needed basis so that fish screens and other site-specific design criteria can be developed to minimize potential adverse affects to the species. Allowing screened diversions of under 0.5 cfs should minimize the risk of suckers becoming entrained or impinged on the screens due to the minimal flows. The BMPs that limit, but still allow some herbicide use in areas where these species may occur should reduce the potential for adverse effects to the species while restoration projects move forward under this programmatic consultation.

While the potential for adverse affects to these species has been greatly reduced through the BMPs, it has been determined that some CREP activities **may affect, and are likely to adversely affect the Oregon chub over the short-term.** Critical habitat is not yet listed for this species, but may be proposed as soon as March 2009. Potential adverse effects to the species and its habitat include short-term decreases in aquatic and streamside vegetation, increases in turbidity, sedimentation and direct disturbance of individuals during instream work. In addition, while herbicide use will be limited to chemicals and methods designed to avoid adverse affects to inland fish, there are inherent risks associated with the use of herbicides and uncertainties in the herbicide analyses, and it is possible that herbicide delivery to aquatic habitat could still adversely affect this species. CREP projects that occur in areas that support this species are expected to **benefit the species over the long-term**.

5.3. Mammals

5.3.1. Columbian White-Tailed Deer

It is possible that Columbia white-tailed deer adults or fawns may be disturbed or displaced during construction, invasive species removal, tree planting or maintenance activities. However, this potential will be minimized by many of the BMPs listed in sections 2.4 and 2.5.3. Because CREP sites and surrounding areas have been used for agricultural purposes, it is unlikely that CREP project activities will exceed noise and activity levels that currently occur in the area on a regular basis. There is also a BMP to ensure noise and activity levels do not rise above ambient conditions in fawning areas from June 1 to July 15.

Deer food may be temporarily reduced after site preparation for CREP plantings and maintenance of new plantings. Deer generally prefer grasses and forbs, some of which are non-native, compete with new CREP plantings, and may be managed while revegetated sites are becoming established. Vegetation that may be used for cover by adult deer and hiding fawns may be temporarily reduced as blackberry or other weeds are removed. However, these less desirable species will be replaced by native tree and shrub plantings. Revegetated areas are expected to improve food, cover and habitat conditions for the deer once restored areas become established.

Riparian fencing could present a possible movement barrier to the deer. However, the BMPs for the deer include a fencing height restriction so that the deer will be able to traverse over the fence and move through the area. Livestock exclusion from riparian areas should allow more forage for deer as well as more cover for foraging.

Herbicide effects to deer are evaluated in section 4.3.1.1. Based on the analyses presented, typical and/or high rate applications of several of the herbicides in this biological assessment could result in acute or chronic herbicide doses that exceed the NOAELs (no-observed adverse effect levels) to large mammals. To address this concern, landowners will be encouraged to use manual and mechanical methods to control competition around newly planted trees to reduce the need for herbicides on sites that may support the Columbian white-tailed deer. If used, only those herbicides and application rates that were found in the analyses to be below both the acute and chronic NOAELs will be used in areas where the Columbia white-tailed deer may occur (see BMPs in section 2.5.3.).

Due to the limited nature of CREP activities and because of the BMPs that will be followed, it has been determined that CREP actions **may affect, but are not likely to adversely affect** the Columbian white-tailed deer in the short-term, and are **likely to benefit** the deer over the long-term. Even though there are uncertainties about the effects to deer in the herbicide analyses, herbicide use where deer occur will be limited and the risks of herbicides to deer are generally not as great as for other groups of species (e.g., fish) because exposure is not expected from any major pathway other than ingestion of sprayed forage. In addition, the scenarios explored in the mammal analyses overestimate the realistic potential for herbicide consumption by deer on any given CREP project site by assuming that contaminated vegetation is consumed shortly after application, vegetation has the highest residue rates, and 100 percent of the diet is contaminated. This makes the BMP limiting herbicide use very conservative, posing low risk to the deer.

5.4. Invertebrates

5.4.1. Vernal pool fairy shrimp and critical habitat

Physical effects from construction activities to vernal pool fairy shrimp would be possible if the shrimp were to occur in vernal pools in the vicinity where work occurs. There would also be the potential for impacts to critical habitat if mechanical activities disturb the impermeable subsurface soil layer of vernal pools, cause sediment delivery to vernal pools or otherwise impact habitat. However, several BMPs have been developed to prevent potential impacts to the vernal pool fairy shrimp and its habitat, and potentially disturbing activities will be avoided altogether (see BMPs in section 2.5.4).

Therefore, it has been determined that the CREP program **may affect, but is not likely to adversely affect the vernal pool fairy shrimp or its critical habitat**. Projects **may benefit** the shrimp in the long-term. For example, installing fencing to eliminate livestock traffic in vernal pools could improve water quality in vernal pools, potentially benefiting the shrimp and its critical habitat. In addition, vernal pools created through wetland restorations may create additional habitat for the shrimp, thus benefiting the species.

5.4.2. Fender's blue butterfly

CREP activities on project sites that support Fender's blue butterfly have been limited to minimize potential adverse impacts to the butterfly and its habitat. The BMPs in section 2.5.5 were developed specifically to reduce potential adverse short- and long-term impacts on the butterfly, and will be followed in addition to any BMPs that are applicable from section 2.4.

Shading could negatively affect butterfly habitat, which consists of native prairie. Prairie vegetation is an early seral community that requires natural or human-induced disturbance in order for it to be maintained or restored. The vast majority of these prairies would eventually be forested if left undisturbed. CREP projects that involve the removal of invasive trees and shrubs can help to maintain prairie conditions. Subsequent revegetation with woody species could negatively impact prairie habitat. However, trees and shrubs will only be planted outside of habitats where the butterfly or its critical habitat occurs so that activities will not impact butterfly habitat due to shade, or competition with or displacement by woody species.

Adverse effects to the Fender's blue butterfly could be possible from soil disturbance and compaction caused by vehicles and equipment. However, soil disturbing activities, such as disking, tillage and fence building will not take place in locations that could cause physical harm to the Fender's blue butterfly. In addition, with the exception of mowers, vehicles and machinery will not be driven on areas where the Fender's blue butterfly occurs and could be affected. Foot traffic poses a minor risk of crushing larvae that may be in the duff, or eggs or larvae that may be on host plants.

Mowing may result in short-term adverse affects to the Fender's blue butterfly, but long-term benefits are expected (the discussion on mowing to follow is from USFWS 2008a). Mowing in habitat patches with eggs or larvae of Fender's blue butterfly at any time during the year may crush or otherwise kill a small number of individuals of these life stages of the butterfly. However, studies in the southern Willamette Valley have found that both adult and larval Fender's blue butterflies increased in number following mowing to reduce the stature of herbaceous non-native vegetation, (Fitzpatrick 2005, Kaye and Benfield 2005).

A study on the effects of fire and mowing on Fender's blue butterfly and native upland prairie at Baskett Slough National Wildlife Refuge found that Fender's blue butterfly eggs were 10 to 14 times more abundant in plots that were mowed or burned compared to undisturbed, control plots; woody plants were reduced 66 percent with mowing (Wilson and Clark 1997). At the U.S. Army Corps of Engineers' Fern Ridge Reservoir, the Fender's blue butterfly population has increased dramatically since fall mowing of lupine patches has been implemented (Messinger 2006). Fender's blue butterfly population trends have been correlated with lupine vigor; high leaf growth appears to produce larger butterfly populations. The abundance of Fender's blue butterfly eggs was found to be correlated with the abundance of Kincaid's lupine leaves at a number of study sites (Kaye and Cramer 2003); egg abundance increased substantially at sites which had been treated to control non-native weeds (Schultz *et al.* 2003)

The effect of mowing on designated critical habitat for Fender's blue butterfly is a short-term reduction in some PCEs with clear long-term benefits. Spring mowing will temporarily reduce the cover of native prairie species, which would be an adverse effect to that PCE. It will also reduce the cover of larval host plants and reduce the availability of nectar sources for Fender's blue butterfly. Concomitantly, spring mowing will have beneficial effects to critical habitat as it removes competing non-native plant species. Spring mowing will only happen in unoccupied butterfly habitat. Fall mowing is not likely to have any adverse effects to the PCEs. Both spring and fall mowing have clear beneficial effects in the long-term; mowing has been shown to be one of the most effective techniques for increasing native prairie species cover and reducing the dominance of competitive invasive species (Kaye and Benfield 2005, Messinger 2006).

Little is known about the specific impacts of the proposed hericides on Fender's blue butterfly, but several effects to the butterfly and its critical habitat are possible. Butterfly eggs or larvae, host plants or desirable nectar species may be affected due to exposure to herbicides from drift or spray reaching these non-target species. However, the types of herbicides to be used in butterfly habitats is limited, and herbicide-related BMPs in section 2.5.5 have been developed to minimize the potential for herbicides to come into contact with Fender's blue butterflies and their host plants.

Herbicide may only be used on sites with butterflies when they are in diapause. During this time, larvae are typically located at or near the base of host plants. Host plants (i.e., Kincaid's, sickle-keeled, and spur lupine) will be covered during spraying, even if they have senesced, to protect any butterfly larvae that may be on the plant or on the ground in the immediate vicinity. We cannot calculate the number of larvae that will be killed or injured by incidental exposure to herbicides, but expect the actual effect to very low since larvae should be shielded at the time of application, and they are expected to feed on fresh lupine leaflets that have not been sprayed when they emerge. Nectar plants, which are a PCE of butterfly critical habitat, are likely to be impacted if incidentally sprayed.

If there are opportunities to support Fender's blue butterfly recovery efforts or improve butterfly critical habitat on CREP project sites where landowners may be interested, CREP projects may be designed to benefit these species. In addition, other partners such as the U.S. Fish and Wildlife Service may be invited to participate in CREP projects by providing additional technical and possible financial assistance.

In summary, it has been determined that CREP actions covered by this programmatic consultation **may affect, and are likely to adversely affect** Fender's blue butterfly and its critical habitat over the short-term due to the risks associated with mowing, foot traffic and herbicide applications. The level of injury and mortality to butterflies and loss of desirable habitat elements are expected to be very low. Risks have been greatly minimized due to the BMPs and limitations on the activities that may occur in Fender's blue butterfly habitats. Some CREP projects may be designed to **benefit the butterfly and its proposed critical habitat over the long-term.**

5.5. Plants

Threatened and endangered plant species could be physically harmed by tillage and digging, vehicles, site preparation, planting, or follow-up maintenance activities. They could also be removed, buried, inundated, uprooted or cut. However, soil disturbing activities, such as disking, tillage, fence building, and construction of livestock watering facilities, will not take place in locations that could cause physical harm to listed plants. In addition, with the exception of mowers, vehicles and machinery will not be driven on areas where listed plants occur.

Mowing may occur on prairie sites in the Willamette Valley that support Kincaid's lupine, Willamette daisy, Nelson's checker-mallow, Bradshaw's lomatium and golden paintbrush. There are likely to be some short-term adverse effects to these species from mowing, but ultimately, long-term benefits are expected (the discussion on mowing to follow is from USFWS 2008a).

Spring mowing within patches of listed plants may remove much of the above ground growing parts of the plants, which would reduce growth and reproductive success for that year. Fall mowing is not likely to have any adverse effects to listed plants, as the above ground portions of the listed plants will have senesced. Nelson's checker-mallow may be an exception, as it may not become senescent by the beginning of the fall mowing window; in these cases, loss of some of the above ground growing parts of the plant can be expected.

Research on prairie management techniques has shown that mowing is an effective method for reducing non-native plants, with generally positive effects to native prairie species. Annual fall mowing has significant positive effects, including increased leaf, flower and foliar cover, on Kincaid's lupine (Kaye and Thorpe 2006). A recent study found that Willamette daisy did not respond with increased crown cover in mowed plots, but suggests that the indirect effects (*e.g.*, reduced cover of invasive plants) positively affect the species (Thorpe and Kaye 2006). A two-year study on the effects of mowing and burning on Nelson's checker-mallow found that the species did not respond positively to mowing in the short-term, although the reduction in cover of competing woody plants would likely benefit Nelson's checker-mallow in the long-term (Wilson 2004).

The effect of mowing on designated critical habitat for Kincaid's lupine and Willamette daisy is a short-term reduction in some PCEs, with clear long-term benefits. Spring mowing will temporarily reduce the cover of native prairie species, which would be an adverse effect to that PCE for these species. Concomitantly, spring mowing will have beneficial effects to critical habitat for these species as it removes competing non-native plant species. Fall mowing is not likely to have any adverse effects to the PCEs of designed critical habitat for any of the species. Both spring and fall mowing have clear beneficial effects in the long-term; mowing has been shown to be one of the most effective techniques for increasing native prairie species cover and reducing the dominance of competitive invasive species (Kaye and Benfield 2005, Messinger 2006).

The use of herbicides poses significant risks to listed plants. However, the BMPs developed for herbicide use on sites with listed plants greatly reduce the potential for harm. The BMPs address risks related to the types of herbicides to be used, application methods, proximity to listed plants, and potential exposure, greatly minimizing the potential for listed plants to come into contact with herbicides that could harm them.

For all spray applications, listed plants will be physically shielded (e.g., covered with buckets or some other barrier that will not harm the plants) as needed to protect them from drift, unless they are dormant; plants will be uncovered immediately after spraying has been completed. The potential for exposure from drift will be further addressed by minimizing fine particle size, using the lowest nozzle pressure needed, keeping spray nozzles close to the ground, spraying only when there are no or low breezes, directing spray away from listed plants, and maintaining no-spray buffers for some applications. Even if listed plants are physically shielded, a minimum 10-foot buffer will be maintained between listed plants and the application area for herbicides that have a higher tendency to move through the soil and that could get taken up by the roots. Runoff will be minimized by avoiding applications during periods of rain, snow, or melting snow, and by preventing herbicide runoff from plants onto the ground from hand application methods such as wicking, wiping, and hack and squirt. (See section 2.5.6 for a complete listing of herbicide-related BMPs for listed plants.)

Shading has the potential to result in adverse affects to some listed plants. While many listed plant species could benefit from invasive species removal, reduced grazing pressure and reduced physical disturbance from livestock, some could be shaded out by CREP plantings or outcompeted by other vegetation because of the lack of grazing. Also, increased thatch may reduce successful seed establishment of some species. Potentially affected species include Nelson's checkermallow, Bradshaw's lomatium, Howell's spectacular thelypody, rough popcornflower, Willamette daisy, Applegate's milk-vetch, golden paintbrush, Gentner's fritillary, Western lily, large-flowered meadowfoam, Cook's lomatium, Kincaid's lupine, McFarlane's four o'clock, water howellia, and Spalding's catchfly. Many of these species occur in habitats naturally dominated by grasses or open woodlands. However, to avoid long-term shading out of shade-intolerant species, technical staff will recommend species for planting that will maintain or restore habitat conditions needed to support listed plants and that are appropriate to the site based on soil type and plant community type that will not grow tall enough to shade out the listed species. Therefore, shading is not likely to adversely affect listed plants.

To avoid and minimize harm to threatened and endangered plants from CREP activities, all applicable project BMPs listed in section 2.4 will be followed, as well as those listed in section

2.5.6 for plants. Considering CREP activities in light of the BMPs, it has been determined that CREP activities **may affect, but are not likely to adversely affect** Applegate's milk-vetch, gentner mission-bells, howellia, Western lily, large-flowered wooly meadowfoam, Cook's lomatium, MacFarlane's four o'clock, rough popcorn flower, Spalding's campion or Howell's spectacular thelypody during the short-term. CREP actions **may affect, and are likely to adversely affect** Kincaid's lupine, Willamette daisy, Nelson's checker-mallow, Bradshaw's lomatium and golden paintbrush and critical habitat for Kincaid's lupine and Willamette daisy during the short-term due to the risks associated with mowing. The level of injury to listed plants and loss of desirable habitat elements are expected to be very low, and risks have been greatly minimized due to the BMPs and limited activities that may occur in listed plant habitats. Some CREP projects may be designed to benefit threatened and endangered plants and their critical habitats over the long-term.

5.6 Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

It is anticipated that existing threats to the species addressed in this biological assessment are reasonably certain to continue. As discussed for each species in section 3, these include habitat loss and degradation due to invasive non-native plants, pollutants, agriculture and forest practices, commercial and residential development and other factors.

The extent of effects from current and future human activities in the action area is unknown. However, most riparian, wetland and upland habitats on lands eligible for CREP funding are likely to continue to be used for agricultural purposes if they are not enrolled in CREP or similar programs, and are therefore not likely to contribute in new ways toward listed species recovery. CREP projects will primarily occur in riparian areas along streams and rivers, and are expected to contribute to the recovery of some listed species over time, especially listed fish that have extensive distributions on private agricultural lands in Oregon.

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APPENDICES

APPENDIX A: Tables describing actions associated with CREP practices

Appendix A: Tables Describing Actions Associated with CREP Practices[1]

TABLE 1. CREP PRACTICE 21: GRASS FILTER STRIPS (NRCS PRACTICE 393)

Eligibility criteria: **Cropland** next to perennial or seasonal perennial stream or other permanent water body (including open ditches, but no wetlands); minimum width 20 ft, maximum width 120 ft; cropland no more than 100 ft distant

Components	**Optional components**	**Specifications**	**Actions**	**Applicable FOTGs[2]**
Site preparation		Length, width, and slope of the area to accomplish planned purpose	Mechanical 1. Vehicles: Tractor, Truck, ATV, bulldozer with blade 2. Tillage: Subsoiling, disking, plowing 3. Mowing Chemical 1. Vehicles: Tractor, Truck, ATV, spray rig with booms 2. Spray equipment: Hand gun, ATV with spray tanks, Back pack, Spray bottle 3. Hand Application: Wick, wiping, Injection, Cut and wipe 4. Mixing of chemicals: Location, Source of water 5. Chemicals: Soil Absorption, Leaching, Toxicity, Longevity Biological 1. Hand Removal: Pulling by hand, Scalping with hoes, Digging with shovels, Top removal with machete, Weed whacker, Chain saws, Saws	414 (Brush management) 393 (Filter strip)

[1] Actions that are covered in the CREP Programmatic Biological Assessment are discussed in more detail in the main body of the document. Most, but not all of the actions noted in these tables are addressed programmatically.
[2] Available on the internet at www.nrcs.usda.gov/technical/efotg/.

Components	Optional components	Specifications	Actions	Applicable FOTGs[2]
			2. Animal Removal: Grazing with goats or sheep	
Moisture conservation		Sufficient to ensure survival of plantings	Mechanical 1. Vehicles: Truck, ATV, Tractor 2. Placement of geo-textile fabric Chemical 1. Vehicles: Truck, ATV, Tractor, Pack-tank with spray gun 2. Spray equipment: Hand gun, ATV with pack-tank and spray gun, Back pack, Spray bottle 3. Hand Application: Wick, wiping, Injection, Cut and wipe 4. Mixing of chemicals: Location, Source of water 5. Chemicals: Soil Absorption, Leaching, Toxicity, Longevity	NRCS 595 (Pest Management) NRCS 484 (mulching)
Planting		Planting dates Species selection -(regionally adapted plants)	Mechanical 1. Vehicles: Truck, Tractor, ATV, tractor-pulled seed – drill Biological 1. Hand Planting: hand-broadcasting seed	NRCS 342 (Critical area planting) NRCS 327 (Conservation Cover)
	Pipelines	No new water rights	Mechanical 1. Vehicles: Truck, tractor, ATV, backhoe, trencher, gator 2. Digging Trench: Use machinery to dig trench 3. Placement of Pipe: PVC pipe, PVC pipe glue Biological 1. Vehicles: Truck, tractor, ATV 2. Digging Trench: Use of shovel or pick to dig trench 3. Placement of Pipe: PVC pipe, PVC pipe glue	Pipeline: NRCS 516
	Animal control		Biological 1. Vehicles: Truck, Water truck, ATV 2. Tree Protection: Tubes or caging placed around tree trunks, Netting, Bloodmeal, Human hair, Trapping	NRCS 391 specifications
	Irrigation of plantings		Mechanical 1. Vehicles: Truck, Water truck, ATV 2. Water Delivery: Handlines, Pipes, Sprinkler heads, Spray guns, Microsprinklers	NRCS 441 (microirrigation system) Hand line w/

Components	Optional components	Specifications	Actions	Applicable FOTGs[2]
			3. Water Source: Stream, Well, Water truck Biological 1. Vehicles: Truck, ATV 2. Water Delivery: Hand watering using bucket or hose 3. Water Source: Stream, Well	sprinklers
	Upland wildlife habitat management		Mechanical 1. Vehicles: Truck, Tractor, ATV, Mechanical tree planter, stinger, seed –drill 2. Additional Planting: Use of machinery to plant additional trees 3. Nesting Platforms: Use of mechanical auger to dig holes 4. Light disking to promote plant species desirable to upland wildlife or promote plant species of concern Biological 1. Vehicles: Truck, Tractor, ATV 2. Additional Planting: Use of shovels and picks to plant additional trees 3. Nesting Platforms: Use of shovels and picks to dig holes 4. Pruning: Hand tools to prune trees 5. Bird and Bat Boxes: Hand or power tools to build boxes 6. Artificial Snags: Use of blasting charges or chain saws to create snags 7. Meadow Creation/Improvement: Use of hand saws, chain saws or machetes to maintain or create meadow areas.	NRCS 645

TABLE 2. CREP PRACTICE 22: RIPARIAN FOREST BUFFER (NRCS PRACTICE 391)

Eligibility criteria: **Cropland** or **marginal pastureland** next to seasonal perennial stream or other permanent water body; minimum width 35 ft, maximum width 180 ft unless additional width is needed for water quality issues. (Specifications: CRFR-3 Riparian Forest Buffer)

Components	**Optional components**	**Specifications**	**Actions**	**Applicable FOTGs**
Site preparation	Thinning (forest stand improvement)	Length, width, and slope of the area to accomplish planned purpose	Mechanical 1. Vehicles: Tractor, Truck, ATV, bulldozer with blade 2. Tillage: Subsoiling, disking, plowing 3. Mowing Chemical 1. Vehicles: Tractor, Truck, ATV, spray rig with booms 2. Spray equipment: Hand gun, ATV with spray tanks, Back pack, Spray bottle 3. Hand Application: Wick, wiping, Injection, Cut and wipe 4. Mixing of chemicals: Location, Source of water 5. Chemicals: Soil Absorption, Leaching, Toxicity, Longevity Biological 1. Hand Removal: Pulling by hand, Scalping with hoes, Digging with shovels, Top removal with machete, Weed whacker, Chain saws, Saws 2. Animal Removal: Grazing with goats or sheep	414 (Brush management) 490 (Forest site preparation) NRCS 666 (Forest stand impr.)
Moisture conservation		Sufficient to ensure survival of plantings	Mechanical 1. Vehicles: Truck, ATV, Tractor 2. Placement of geo-textile fabric Chemical 1. Vehicles: Truck, ATV, Tractor, Pack-tank with spray gun 2. Spray equipment: Hand gun, ATV with pack-tank and spray gun, Back pack, Spray bottle 3. Hand Application: Wick, wiping, Injection, Cut and wipe 4. Mixing of chemicals: Location, Source of water 5. Chemicals: Soil Absorption, Leaching, Toxicity, Longevity	NRCS 595 (Pest Management) NRCS 484 (mulching)
Planting		Planting dates Species selection - (regionally adapted plants)	Mechanical 1. Vehicles: Truck, Tractor, ATV, Mechanical tree planter, stinger, seed –drill Biological 2. Hand Planting: Digging with shovels or hoe-dad	NRCS 342 (Critical area planting) NRCS 327 (Conservation Cover) 612 (Tree and shrub establ.)

Components	Optional components	Specifications	Actions	Applicable FOTGs
				391 (riparian forest buffer)
	Fencing	Posts set 2-3 ft into soil; woven or single strands; wood or steel posts; Treated wood acceptable Rock jacks acceptable	Mechanical 1. Vehicles: Truck, Tractor, ATV, Auger, Fence-post driver 2. Digging Posts: Auger on tractor 3. Setting Posts: Fence-post driver on tractor, concrete, gravel, excavated soil 4. Wire: barb, smooth 5. Electric Fence: chargers, insulators, batteries, solar collector 6. Rock Cribs: Using rocks from surrounding area. Biological 1. Vehicles: Truck, Tractor, ATV 2. Digging Posts: Hand digging with shovel or pick 3. Setting Posts: Fence-post driver, concrete, gravel, excavated soil 4. Wire: barb, smooth 5. Electric Fence: chargers, insulators, batteries, solar collector 6. Rock Cribs: Using rocks from surrounding area.	NRCS 382 NRCS 472 (Use exclusion)
	Pipelines	No new water rights	Mechanical 1. Vehicles: Truck, tractor, ATV, backhoe, trencher, gator 2. Digging Trench: Use machinery to dig trench 3. Placement of Pipe: PVC pipe, PVC pipe glue Biological 4. Vehicles: Truck, tractor, ATV 5. Digging Trench: Use of shovel or pick to dig trench 6. Placement of Pipe: PVC pipe, PVC pipe glue	Pipeline: NRCS 516
	Watering facilities	No new water rights Spring development: SL-6	Mechanical 1. Vehicles: Truck, tractor, ATV 2. Site Preparation: Tractor to excavate and level site 3. Concrete Pad: cement mixer to mix cement, water and gravel, Forms built for concrete pad, concrete poured into form, water source 4. Facility Placement: Trough or tank bolted onto concrete pad, Pump bolted onto concrete pad 5. Power Source: solar, mechanical (i.e., nose pumps), or electrical (not cost-shared) 6. Heavy Use Protection: Geo-textile fabric, gravel 7. Bank Shaping: Use of machinery to shape bank for pump and	NRCS 648 (wildlife watering facility) 614 (watering facility) 574 (spring development)

Components	Optional components	Specifications	Actions	Applicable FOTGs
			piping 8. Pump Intake: fish screen 9. For spring developments, clearing of vegetation around spring by hand, weed whacker, or shovel; excavate around spring by hand to clear area for spring-box; placement of spring box (either plastic or concrete); placement of pipe into springbox and running pipe to trough. Biological 1. Vehicles: Truck, tractor, ATV 2. Site Preparation: Site is excavated and leveled using shovels or picks. 3. Concrete Pad: container to mix cement, water and gravel, Forms built for concrete pad, concrete poured into form, water source 4. Facility Placement: Trough or tank bolted onto concrete pad, Pump bolted onto concrete pad 5. Power Source: solar, mechanical (i.e., nose pumps), or electrical (not cost-shared) 6. Heavy Use Protection: Geo-textile fabric, gravel 7. Bank Shaping: Use of machinery to shape bank for pump and piping 8. Pump Intake: fish screen Water Gaps: 1. Vehicles: Truck, Tractor, ATV 2. Clearing Vegetation: Use of saws, chain saws, weed whacker to clear riparian vegetation 3. Digging Posts: Hand digging with shovel or pick 4. Setting Posts: Fence-post driver into streambed 5. Wire: barb, smooth 6. Bank Treatment: Geo-textile fabric and gravel	
	Livestock crossing	Gravel or other natural materials; stream size limits Stream Protection: WP-2	Mechanical 1. Vehicles: Truck, tractor, ATV, backhoe, bulldozer 2. Clearing Vegetation: Use of machinery with blade 3. Bank Shaping: Use of machinery to shape bank 4. Heavy Use Protection: Geo-textile fabric, gravel under and over fabric 5. Fencing: Placed across creek Biological 1. Vehicles: Truck, tractor, ATV	NRCS 575, 382

Components	Optional components	Specifications	Actions	Applicable FOTGs
			2. Clearing Vegetation: Use of shovels and picks 3. Bank Shaping: Use of shovels and picks to shape bank 4. Heavy Use Protection: Geo-textile fabric, gravel under and over fabric 5. Fencing: Placed across creek	
	Animal control		Biological 1. Vehicles: Truck, Water truck, ATV 2. Tree Protection: Tubes or caging placed around tree trunks, Netting, Bloodmeal, Human hair, Trapping	NRCS 391 specifications
	Irrigation of plantings		Mechanical 1. Vehicles: Truck, Water truck, ATV 2. Water Delivery: Handlines, Pipes, Sprinkler heads, Spray guns, Microsprinklers 3. Water Source: Stream, Well, Water truck Biological 1. Vehicles: Truck, ATV 2. Water Delivery: Hand watering using bucket or hose 3. Water Source: Stream, Well	NRCS 441 (microirrigation system) Hand line w/ sprinklers
	Upland wildlife habitat management		Mechanical 1. Vehicles: Truck, Tractor, ATV, Mechanical tree planter, stinger, seed –drill 2. Additional Planting: Use of machinery to plant additional trees 3. Nesting Platforms: Use of mechanical auger to dig holes Biological 1. Vehicles: Truck, Tractor, ATV 2. Additional Planting: Use of shovels and picks to plant additional trees 3. Nesting Platforms: Use of shovels and picks to dig holes 4. Pruning: Hand tools to prune trees 5. Bird and Bat Boxes: Hand or power tools to build boxes 6. Artificial Snags: Use of blasting charges or chain saws to create snags 7. Meadow Creation/Improvement: Use of hand saws, chain saws or machetes to maintain or create meadow areas.	NRCS 645

TABLE 3. CREP PRACTICE 23: WETLAND RESTORATION (NRCS PRACTICE 657)

Eligibility criteria: **Cropland** and possibly adjacent upland areas adapted to restoration of wetland functions; adjacent upland buffers can be included in ratio of 3 to 1; eligibility for programmatic coverage is restoration of historically hydric soils (previous wetland)

Components	Optional components	Specifications	Actions	Applicable FOTGs
Site preparation		Length, width, and slope of the area to accomplish planned purpose	Mechanical 4. Vehicles: Tractor, Truck, ATV, bulldozer with blade 5. Tillage: disking, plowing 6. Mowing Chemical 6. Vehicles: Tractor, Truck, ATV, spray rig with booms 7. Spray equipment: Hand gun, ATV with spray tanks, Back pack, Spray bottle 8. Hand Application: Wick, wiping, Injection, Cut and wipe 9. Mixing of chemicals: Location, Source of water 10. Chemicals: Soil Absorption, Leaching, Toxicity, Longevity Biological 3. Hand Removal: Pulling by hand, Scalping with hoes, Digging with shovels, Top removal with machete, Weed whacker, Chain saws, Saws 4. Animal Removal: Grazing with goats or sheep	414 (Brush management)
Moisture conservation		Sufficient to ensure survival of plantings	Mechanical 3. Vehicles: Truck, ATV, Tractor 4. Placement of geo-textile fabric Chemical 6. Vehicles: Truck, ATV, Tractor, Pack-tank with spray gun 7. Spray equipment: Hand gun, ATV with pack-tank and spray gun, Back pack, Spray bottle 8. Hand Application: Wick, wiping, Injection, Cut and wipe 9. Mixing of chemicals: Location, Source of water 10. Chemicals: Soil Absorption, Leaching, Toxicity, Longevity	NRCS 595 (Pest Management) NRCS 484 (mulching)

Components	Optional components	Specifications	Actions	Applicable FOTGs
Planting		Planting dates Species selection - (regionally adapted plants)	Mechanical 2. Vehicles: Truck, Tractor, ATV, Mechanical tree planter, stinger, seed –drill Biological 2. Hand Planting: Digging with shovels or hoe-dad	NRCS 342 (Critical area planting) NRCS 327 (Conservation Cover) 612 (Tree and shrub establ.) 391 (riparian forest buffer)
	Pipelines	No new water rights	Mechanical 3. Vehicles: Truck, tractor, ATV, backhoe, trencher, gator 4. Digging Trench: Use machinery to dig trench 5. Placement of Pipe: PVC pipe, PVC pipe glue Biological 7. Vehicles: Truck, tractor, ATV 8. Digging Trench: Use of shovel or pick to dig trench 9. Placement of Pipe: PVC pipe, PVC pipe glue	Pipeline: NRCS 516
	Animal control		Biological 3. Vehicles: Truck, Water truck, ATV 4. Tree Protection: Tubes or caging placed around tree trunks, Netting, Bloodmeal, Human hair, Trapping	NRCS 391 specifications
	Irrigation of plantings		Mechanical 5. Vehicles: Truck, Water truck, ATV 6. Water Delivery: Handlines, Pipes, Sprinkler heads, Spray guns, Microsprinklers 7. Water Source: Stream, Well, Water truck Biological 4. Vehicles: Truck, ATV 5. Water Delivery: Hand watering using bucket or hose 6. Water Source: Stream, Well	NRCS 441 (microirrigation system) Hand line w/ sprinklers
	Wetland wildlife habitat management		Mechanical 1. Vehicles: Truck, Tractor, ATV, Mechanical tree planter, stinger, seed –drill 2. Additional Planting: Use of machinery to plant additional trees 3. Nesting Platforms: Use of mechanical auger to dig	NRCS 644

Components	Optional components	Specifications	Actions	Applicable FOTGs
			holes Biological 1. Vehicles: Truck, Tractor, ATV 2. Additional Planting: Use of shovels and picks to plant additional trees 3. Nesting Platforms: Use of shovels and picks to dig holes 4. Pruning: Hand tools to prune trees 5. Bird and Bat Boxes: Hand or power tools to build boxes 6. Artificial Snags: Use of blasting charges or chain saws to create snags 7. Meadow Creation/Improvement: Use of hand saws, chain saws or machetes to maintain or create meadow areas.	
	Drainage tile breakage		Mechanical 1. Vehicles: Truck, backhoe, small excavator, tractor with subsoiler 2. Dig small holes along drain tile pathways to break tile then fill in holes with soil	657 (wetland restoration)
	Breaching dikes or levies		Mechanical 1. Vehicles: Truck, excavator, bulldozer 2. Remove soil material from dikes or levies and spread soil outside of CREP area in the uplands on pasture or other previously disturbed area	
	Dike setbacks that do not involve water control structures		Mechanical 1. Vehicles: Truck, backhoe, trackhoe, bulldozer, tractor with disk, tractor pulling drill 2. Remove old dike material and spread spoils outside of CREP area in upland areas that are in pasture or other previously disturbed area 3. Excavate trench along new dike location 4. Fill trench with new dike material and compact; build new dike on top of trench and compact material 5. Disk new dike 6. Seed new dike to prevent erosion by mechanical or hand broadcast seeding	
	Restoration of natural		Mechanical	657 (wetland

Components	Optional components	Specifications	Actions	Applicable FOTGs
	topography		1. Vehicles: Truck, backhoe, ATV, small excavator, bulldozer, tractor-pulled disk or plow 2. Excavate shallow vernal pools 3. Level furrows or other topography created to facilitate growing crops	restoration)

TABLE 4. CREP PRACTICE 29: MARGINAL PASTURELAND WILDLIFE HABITAT BUFFER (NRCS PRACTICE 645)

Eligibility criteria: **Marginal pastureland** next to seasonal perennial stream or other permanent water body; cover primarily grasses and forbs; minimum width 35 ft, maximum width 180 ft unless additional width is needed to solve conservation concern. In addition to establishing herbaceous cover, trees and shrubs are sometimes planted and the area is allowed to passively restore to trees and shrubs.

Components	**Optional components**	**Specifications**	**Actions**	**Applicable FOTGs**
Site preparation		Length, width, and slope of the area to accomplish planned purpose	Mechanical 1. Vehicles: Tractor, Truck, ATV, bulldozer with blade 2. Tillage: Subsoiling, disking, plowing 3. Mowing Chemical 1. Vehicles: Tractor, Truck, ATV, spray rig with booms 2. Spray equipment: Hand gun, ATV with spray tanks, Back pack, Spray bottle 3. Hand Application: Wick, wiping, Injection, Cut and wipe 4. Mixing of chemicals: Location, Source of water 5. Chemicals: Soil Absorption, Leaching, Toxicity, Longevity Biological 1. Hand Removal: Pulling by hand, Scalping with hoes, Digging with shovels, Top removal with machete, Weed whacker, Chain saws, Saws 2. Animal Removal: Grazing with goats or sheep	414 (Brush management)
Moisture conservation		Sufficient to ensure survival of plantings	Mechanical 1. Vehicles: Truck, ATV, Tractor 2. Placement of geo-textile fabric or mulch Chemical 1. Vehicles: Truck, ATV, Tractor, Pack-tank with spray gun 2. Spray equipment: Hand gun, ATV with pack-tank and spray gun, Back pack, Spray bottle 3. Hand Application: Wick, wiping, Injection, Cut and wipe 4. Mixing of chemicals: Location, Source of water	NRCS 595 (Pest Management) NRCS 484 (mulching)

Components	Optional components	Specifications	Actions	Applicable FOTGs
			5. Chemicals: Soil Absorption, Leaching, Toxicity, Longevity	
Planting		WQ-1 Grass filter strip Planting dates Species selection -(regionally adapted plants)	Mechanical 1. Vehicles: Truck, Tractor, ATV, Mechanical tree planter, stinger, tractor-pulled seed –drill Manual 2. Hand Planting: Digging with shovels or hoe-dad or trowels 3. Hand broadcast seeding 4. Plug planting	NRCS 342 (Critical area planting) NRCS 327 (Conservation Cover) 612 (Tree and shrub establ.) 391 (riparian forest buffer) 390 (Riparian herbaceous cover)
	Fencing	Posts set 2-3 ft into soil; woven or single strands; wood or steel posts; Treated wood acceptable Rock jacks acceptable	Mechanical 1. Vehicles: Truck, Tractor, ATV, Auger, Fence-post driver 2. Digging Posts: Auger on tractor 3. Setting Posts: Fence-post driver on tractor, concrete, gravel, excavated soil 4. Wire: barb, smooth; string by hand or tractor 5. Electric Fence: chargers, insulators, batteries, solar collector 6. Rock Cribs: Using rocks from surrounding area. Biological 1. Vehicles: Truck, Tractor, ATV 2. Digging Posts: Hand digging with shovel or pick 3. Setting Posts: Fence-post driver, concrete, gravel, excavated soil 4. Wire: barb, smooth 5. Electric Fence: chargers, insulators, batteries, solar collector 6. Rock Cribs: Using rocks from surrounding area.	NRCS 382 NRCS 472 (Use exclusion)
	Pipelines	No new water rights	Mechanical 1. Vehicles: Truck, tractor, ATV, backhoe, trencher, gator 2. Digging Trench: Use machinery to dig trench 3. Placement of Pipe: PVC pipe, PVC pipe glue 4. Installation of permanent pumps Biological	Pipeline: NRCS 516 Aluminum pipe: 776

Components	Optional components	Specifications	Actions	Applicable FOTGs
			1. Vehicles: Truck, tractor, ATV 2. Digging Trench: Use of shovel or pick to dig trench 3. Placement of Pipe: PVC pipe, PVC pipe glue	
	Watering facilities	No new water rights Spring development: SL-6 (need to add spring development details to list of actions)	Mechanical 1. Vehicles: Truck, tractor, ATV 2. Site Preparation: Tractor to excavate and level site 3. Concrete Pad: cement mixer to mix cement, water and gravel, Forms built for concrete pad, concrete poured into form, water source 4. Facility Placement: Trough or tank bolted onto concrete pad, Pump bolted onto concrete pad 5. Power Source: solar, mechanical (i.e., nose pumps), or electrical (not cost-shared) 6. Heavy Use Protection: Geo-textile fabric, gravel 7. Bank Shaping: Use of machinery to shape bank for pump and piping 8. Pump Intake: fish screen Biological 1. Vehicles: Truck, tractor, ATV 2. Site Preparation: Site is excavated and leveled using shovels or picks. 3. Concrete Pad: container to mix cement, water and gravel, Forms built for concrete pad, concrete poured into form, water source 4. Facility Placement: Trough or tank bolted onto concrete pad, Pump bolted onto concrete pad 5. Power Source: solar, mechanical (i.e., nose pumps), or electrical (not cost-shared) 6. Heavy Use Protection: Geo-textile fabric, gravel 7. Bank Shaping: Use of machinery to shape bank for pump and piping 8. Pump Intake: fish screen Water Gaps: 1. Vehicles: Truck, Tractor, ATV 2. Clearing Vegetation: Use of saws, chain saws, weed whacker to clear riparian vegetation 3. Digging Posts: Hand digging with shovel or pick 4. Setting Posts: Fence-post driver into streambed	NRCS 648 (wildlife watering facility) 614 (watering facility) 574 (spring development) 441 (microirrigation system)

Components	Optional components	Specifications	Actions	Applicable FOTGs
			5. Wire: barb, smooth 6. Bank Treatment: Geo-textile fabric and gravel	
	Livestock crossing	Gravel or other natural materials; stream size limits Stream Protection: WP-2	Mechanical 1. Vehicles: Truck, tractor, ATV, backhoe, bulldozer 2. Clearing Vegetation: Use of machinery with blade 3. Bank Shaping: Use of machinery to shape bank 4. Heavy Use Protection: Geo-textile fabric, gravel under and over fabric 5. Fencing: Placed across creek Biological 1. Vehicles: Truck, tractor, ATV 2. Clearing Vegetation: Use of shovels and picks 3. Bank Shaping: Use of shovels and picks to shape bank 4. Heavy Use Protection: Geo-textile fabric, gravel under and over fabric 5. Fencing: Placed across creek	NRCS 575, 382
	Animal control		Biological 8. Vehicles: Truck, Water truck, ATV 9. Tree Protection: Tubes or caging placed around tree trunks, Netting, Bloodmeal, Human hair, Trapping	NRCS 390, 342 specifications
	Irrigation of plantings		Mechanical 10. Vehicles: Truck, Water truck, ATV 11. Water Delivery: Handlines, Pipes, Sprinkler heads, Spray guns, Microsprinklers 12. Water Source: Stream, Well, Water truck Biological 7. Vehicles: Truck, ATV 8. Water Delivery: Hand watering using bucket or hose 9. Water Source: Stream, Well	NRCS 441 (microirrigation system) Hand line w/ sprinklers
	Upland wildlife habitat management		Mechanical 5. Vehicles: Truck, Tractor, ATV, Mechanical tree planter, stinger, seed –drill 6. Additional Planting: Use of machinery to plant additional trees 7. Nesting Platforms: Use of mechanical auger to dig holes Biological	NRCS 645

Components	Optional components	Specifications	Actions	Applicable FOTGs
			8. Vehicles: Truck, Tractor, ATV 9. Additional Planting: Use of shovels and picks to plant additional trees 10. Nesting Platforms: Use of shovels and picks to dig holes 11. Pruning: Hand tools to prune trees 12. Bird and Bat Boxes: Hand or power tools to build boxes 13. Artificial Snags: Use of blasting charges or chain saws to create snags 14. Meadow Creation/Improvement: Use of hand saws, chain saws or machetes to maintain or create meadow areas.	

TABLE 5. CREP PRACTICE 30: MARGINAL PASTURELAND WETLAND BUFFER (NRCS PRACTICE 657)

Eligibility criteria: **Marginal pastureland** next to either a seasonal or perennial stream or other permanent water body, or wetlands that are permanently flooded, intermittently exposed, semipermanently flooded or seasonally flooded; no size restrictions

Components	Optional components	Specifications	Actions	Applicable FOTGs
Site preparation		Length, width, and slope of the area to accomplish planned purpose	Mechanical 7. Vehicles: Tractor, Truck, ATV, bulldozer with blade 8. Tillage: Subsoiling, disking, plowing 9. Mowing Chemical 11. Vehicles: Tractor, Truck, ATV, spray rig with booms 12. Spray equipment: Hand gun, ATV with spray tanks, Back pack, Spray bottle 13. Hand Application: Wick, wiping, Injection, Cut and wipe 14. Mixing of chemicals: Location, Source of water 15. Chemicals: Soil Absorption, Leaching, Toxicity, Longevity Biological 5. Hand Removal: Pulling by hand, Scalping with hoes, Digging with shovels, Top removal with machete, Weed whacker, Chain saws, Saws 6. Animal Removal: Grazing with goats or sheep	414 (Brush management)
Moisture conservation		Sufficient to ensure survival of plantings	Mechanical 5. Vehicles: Truck, ATV, Tractor 6. Placement of geo-textile fabric Chemical 11. Vehicles: Truck, ATV, Tractor, Pack-tank with spray gun 12. Spray equipment: Hand gun, ATV with pack-tank and spray gun, Back pack, Spray bottle 13. Hand Application: Wick, wiping, Injection, Cut and wipe 14. Mixing of chemicals: Location, Source of water 15. Chemicals: Soil Absorption, Leaching, Toxicity, Longevity	NRCS 595 (Pest Management) NRCS 644 (Wetland wildlife habitat management)
Planting		Planting dates Species selection - (regionally adapted plants)	Mechanical 3. Vehicles: Truck, Tractor, ATV, Mechanical tree planter, stinger, seed –drill Biological	NRCS 342 (Critical area planting) NRCS 327 (Conservation Cover)

Components	Optional components	Specifications	Actions	Applicable FOTGs
			6. Hand Planting: Digging with shovels or hoe-dad	612 (Tree and shrub establ.) 390 (riparian herbaceous cover)
	Fencing	Posts set 2-3 ft into soil; woven or single strands; wood or steel posts; Treated wood acceptable Rock jacks acceptable	Mechanical 7. Vehicles: Truck, Tractor, ATV, Auger, Fence-post driver 8. Digging Posts: Auger on tractor 9. Setting Posts: Fence-post driver on tractor, concrete, gravel, excavated soil 10. Wire: barb, smooth 11. Electric Fence: chargers, insulators, batteries, solar collector 12. Rock Cribs: Using rocks from surrounding area. Biological 7. Vehicles: Truck, Tractor, ATV 8. Digging Posts: Hand digging with shovel or pick 9. Setting Posts: Fence-post driver, concrete, gravel, excavated soil 10. Wire: barb, smooth 11. Electric Fence: chargers, insulators, batteries, solar collector 12. Rock Cribs: Using rocks from surrounding area.	NRCS 382 NRCS 472 (Use exclusion)
	Pipelines	No new water rights	Mechanical 4. Vehicles: Truck, tractor, ATV, backhoe, trencher, gator 5. Digging Trench: Use machinery to dig trench 6. Placement of Pipe: PVC pipe, PVC pipe glue Biological 10. Vehicles: Truck, tractor, ATV 11. Digging Trench: Use of shovel or pick to dig trench 12. Placement of Pipe: PVC pipe, PVC pipe glue	Pipeline: NRCS 516 Aluminum pipe: 776
	Watering facilities	No new water rights Spring development: SL-6	Mechanical 1. Vehicles: Truck, tractor, ATV 2. Site Preparation: Tractor to excavate and level site 3. Concrete Pad: cement mixer to mix cement, water and gravel, Forms built for concrete pad, concrete poured into form, water source 4. Facility Placement: Trough or tank bolted onto concrete pad, Pump bolted onto concrete pad 5. Power Source: solar, mechanical (i.e., nose pumps), or electrical (not cost-shared)	NRCS 648 (wildlife watering facility) 614 (watering facility) 574 (spring development)

Components	Optional components	Specifications	Actions	Applicable FOTGs
			6. Heavy Use Protection: Geo-textile fabric, gravel 7. Bank Shaping: Use of machinery to shape bank for pump and piping 8. Pump Intake: fish screen 9. For spring developments, clearing of vegetation around spring by hand, weed whacker, or shovel; excavate around spring by hand to clear area for spring-box; placement of spring box (either plastic or concrete); placement of pipe into springbox and running pipe to trough. Biological 1. Vehicles: Truck, tractor, ATV 2. Site Preparation: Site is excavated and leveled using shovels or picks. 3. Concrete Pad: container to mix cement, water and gravel, Forms built for concrete pad, concrete poured into form, water source 4. Facility Placement: Trough or tank bolted onto concrete pad, Pump bolted onto concrete pad 5. Power Source: solar, mechanical (i.e., nose pumps), or electrical (not cost-shared) 6. Heavy Use Protection: Geo-textile fabric, gravel 7. Bank Shaping: Use of machinery to shape bank for pump and piping 8. Pump Intake: fish screen Water Gaps: 1. Vehicles: Truck, Tractor, ATV 2. Clearing Vegetation: Use of saws, chain saws, weed whacker to clear riparian vegetation 3. Digging Posts: Hand digging with shovel or pick 4. Setting Posts: Fence-post driver into streambed 5. Wire: barb, smooth 6. Bank Treatment: Geo-textile fabric and gravel	
	Livestock crossing	Gravel or other natural materials; stream size limits Stream Protection: WP-2	Mechanical 1. Vehicles: Truck, tractor, ATV, backhoe, bulldozer 2. Clearing Vegetation: Use of machinery with blade 3. Bank Shaping: Use of machinery to shape bank 4. Heavy Use Protection: Geo-textile fabric, gravel under and over fabric 5. Fencing: Placed across creek	NRCS 575, 382

Components	Optional components	Specifications	Actions	Applicable FOTGs
			Biological 6. Vehicles: Truck, tractor, ATV 7. Clearing Vegetation: Use of shovels and picks 8. Bank Shaping: Use of shovels and picks to shape bank 9. Heavy Use Protection: Geo-textile fabric, gravel under and over fabric 10. Fencing: Placed across creek	
	Animal control		Biological 1. Vehicles: Truck, Water truck, ATV 2. Tree Protection: Tubes or caging placed around tree trunks, Netting, Bloodmeal, Human hair, Trapping	NRCS 391 specifications
	Irrigation of plantings		Mechanical 1. Vehicles: Truck, Water truck, ATV 2. Water Delivery: Handlines, Pipes, Sprinkler heads, Spray guns, Microsprinklers 3. Water Source: Stream, Well, Water truck Biological 1. Vehicles: Truck, ATV 2. Water Delivery: Hand watering using bucket or hose 3. Water Source: Stream, Well	NRCS 441 (microirrigation system) Hand line w/ sprinklers
	Wetland wildlife habitat management		Mechanical 1. Vehicles: Truck, Tractor, ATV, Mechanical tree planter, stinger, seed –drill 2. Additional Planting: Use of machinery to plant additional trees 3. Nesting Platforms: Use of mechanical auger to dig holes Biological 1. Vehicles: Truck, Tractor, ATV 2. Additional Planting: Use of shovels and picks to plant additional trees 3. Nesting Platforms: Use of shovels and picks to dig holes 4. Pruning: Hand tools to prune trees 5. Bird and Bat Boxes: Hand or power tools to build boxes 6. Artificial Snags: Use of blasting charges or chain saws to create snags 7. Meadow Creation/Improvement: Use of hand saws, chain saws or machetes to maintain or create meadow areas.	NRCS 644
	Drainage tile breakage		Mechanical 1. Vehicles: Truck, backhoe, small excavator, tractor with	657 (wetland restoration)

Components	Optional components	Specifications	Actions	Applicable FOTGs
			subsoiler 2. Dig small holes along drain tile pathways to break tile then fill in holes with soil	
	Breaching dikes or levies		Mechanical 1. Vehicles: Truck, excavator, bulldozer 2. Remove soil material from dikes or levies and spread soil outside of CREP area in the uplands on pasture or other previously disturbed area	
	Dike setbacks that do not involve water control structures		Mechanical 1. Vehicles: Truck, backhoe, trackhoe, bulldozer, tractor with disk, tractor pulling drill 2. Remove old dike material and spread spoils outside of CREP area in upland areas that are in pasture or other previously disturbed area 3. Excavate trench along new dike location 4. Fill trench with new dike material and compact; build new dike on top of trench and compact material 5. Disk new dike 6. Seed new dike to prevent erosion by mechanical or hand broadcast seeding	
	Restoration of natural topography		Mechanical 1. Vehicles: Truck, backhoe, ATV, small excavator, bulldozer, tractor-pulled disk or plow 2. Excavate shallow vernal pools 3. Level furrows or other topography created to facilitate growing crops	657 (wetland restoration)

APPENDIX B: CREP Actions, Potential Effects on Listed Species and Applicable FOTG Practices

Appendix B. CREP Actions, Potential Effects on Listed Species and Applicable FOTG Practices

Table 1. Anadromous Fish

Life History Stage	**Needs by Life History Stage**	**Actions that may affect LH stage needs**	**Habitat Effects, including effects to critical habitat**	**Species Effects**	**Applicable FOTG practices**
Spawning	Water quality, water quantity, and substrate to provide for successful spawning, incubation, and larval development	Mechanical: • Tillage: subsoiling, disking, plowing • For wetland restorations, break tiles, spread dike or levee spoils in previously disturbed areas, disk and seed new dike • Vehicle traffic in riparian area Chemical: • Hand application if chemicals, transportation of chemicals to CREP buffer Biological: • Exclusion of livestock from	Mechanical: • Soil disturbance results in potential for sediment to be delivered to streams resulting in increased turbidity and fine sediment deposition in spawning gravel. • Tillage reduces compaction which increases infiltration and water storage capacity of soil, and improves establishment of vegetation allowing water to be stored and slowly released during dry periods. • Breaking of tiles increases water storage in wetland areas. These areas may become functional fish habitat, and stored water can be released during dry periods. • Leveling of dikes and levees allows streams to access floodplains during floods	Mechanical: • Increased turbidity can interfere with salmonid respiration. • Sediment in streams can reduce suitable spawning sites and reduce incubation survival. Fine sediments clog gravel interstices reducing water flow over the eggs limiting oxygen delivery, removal of metabolic wastes, and the ability of fry to emerge. • Increased release of ground water during dry periods can improve egg survival and larval development by preventing redds from drying out. Particularly in areas where irrigation withdrawals are occurring during incubation. Adults migrating during irrigation season would benefit by being able to access more spawning habitat with	390 – Riparian herbaceous cover 391 – riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland

Life History Stage	Needs by Life History Stage	Actions that may affect LH stage needs	Habitat Effects, including effects to critical habitat	Species Effects	Applicable FOTG practices
		riparian areas • Removal of weeds such as blackberry and gorse • Planting of riparian buffer • In-stream leasing of water rights should help increase water quantity, although this may be lessened somewhat in the short-term with irrigation of new plantings. • Livestock use of stream crossings • Spring developments for off-stream water	which reduces stream energy, recharges floodplain groundwater, and encourages reestablishment of riparian vegetation. • Seeding stabilizes soil and reduces compaction which reduces sediment delivery to streams and increases infiltration and water storage capacity of soil. • Vehicle traffic not followed by tillage results in soil compaction which reduces infiltration and water storage capacity of soil, and makes vegetation establishment more difficult. However, effects of this will be offset by decreases in compaction from tilling and vegetation establishment. Chemical: • Herbicides may be delivered to surface water through drift or a spill and degrade water quality. • Non-target vegetation may be killed by overspray or drift which may reduce ground cover or overhead fish cover. • Long-term positive effect because competition is reduced for desirable species. Biological: • Exclusion of livestock from riparian areas will facilitate	increased flow. • Reduction in stream energy by allowing streams to access their floodplains will reduce redd scour so egg-to-fry survival will increase. • Decreased sediment delivery results in more suitable spawning sites, better water quality, and increased egg-to-fry survival. Chemical: • Herbicides delivered to surface water can result in mortality during incubation, altered development of embryos, and modified behavior of larval stages. • Reduced ground cover from overspray or drift can expose soil to erosion which can result in sediment delivery to streams and deposition in spawning gravel. Increased fines in spawning gravel decreases survival during incubation. • Reducing competition for desirable plant species can result in decreased sediment delivery to streams due to their more effective stabilizing nature. Improved water quality and substrate composition increases survival during incubation. Biological:	wildlife habitat management 657 – Wetland restoration

Life History Stage	Needs by Life History Stage	Actions that may affect LH stage needs	Habitat Effects, including effects to critical habitat	Species Effects	Applicable FOTG practices
			growth and establishment of riparian vegetation. This will lessen sediment delivery to streams by stabilizing soils and filtering sediment, increase infiltration and soil water storage by reducing compaction, decrease warming of water by providing shade, and decrease stream energy during high flows by providing floodplain roughness. • Removal of weeds such as blackberry and gorse may temporarily lessen shade over streams. • Planting of riparian buffer may cause short-term soil disturbance and increase potential of sediment delivery to streams. Establishment of riparian vegetation through planting will result in same effects described above under exclusion of livestock. • Leasing of water rights will increase instream flow which will also decrease water temperature. This should more than compensate for irrigating new plantings. • Stream crossings for livestock will result in long-term loss of vegetation at those sites. They will be stabilized so sediment delivery should not be a	• Improved riparian condition will reduce sediment delivery, increase water storage, provide better cover, and reduce water temperatures. Reduced sediment and increased water storage effects are discussed above in the mechanical section. Improved cover will benefit spawning adults by reducing predation through good overhead cover. Reduced water temperature will open areas to spawning that were not previously available due to high temperatures and will increase survival during incubation. • Temporary reductions in shade and cover with the removal of blackberries and other unwanted vegetation will be more than compensated for be increases in shade resulting from livestock exclosures. • Leases of water rights for instream use will have effects the same as those described above for increased ground water releases, but to a greater degree. • Vegetation loss at designated cattle crossings will reduce overhead cover and shade, but these effects will be adequately compensated for by riparian	

Life History Stage	Needs by Life History Stage	Actions that may affect LH stage needs	Habitat Effects, including effects to critical habitat	Species Effects	Applicable FOTG practices
			problem. • Spring developments will result in concentration of cattle in an area away from the stream, but still some potential for sediment delivery to stream.	vegetation improvements associated with exclosures.	
Rearing	Water quantity and floodplain connectivity to provide for juvenile growth and mobility. Water quality and forage to provide for juvenile development. Forage includes aquatic invertebrates and fish species. Natural cover including shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks to provide for juvenile mobility and survival.	Mechanical: • Tillage: subsoiling, disking, plowing • For wetland restorations, break tiles, spread dike or levee spoils in previously disturbed areas, disk and seed new dike • Vehicle traffic in riparian area Chemical: • Hand application if chemicals, transportation of chemicals to CREP buffer Biological: • Exclusion of livestock from riparian areas. • Removal of weeds such as blackberry and gorse	Mechanical: • Soil disturbance results in potential for sediment to be delivered to streams resulting in increased turbidity and fine sediment deposition in spawning gravel. • Tillage reduces compaction which increases infiltration and water storage capacity of soil, and improves establishment of vegetation allowing water to be stored and slowly released during dry periods. • Breaking of tiles increases water storage in wetland areas. These areas may become functional fish habitat, and stored water can be released during dry periods. • Leveling of dikes and levees allows streams to access floodplains during floods which reduces stream energy, recharges floodplain groundwater, and encourages reestablishment of riparian vegetation.	Mechanical: • Excessive sediment can clog gills of juvenile fish, reduce prey availability, and reduce juvenile success in catching prey. • Increased stream temperature can cause physical stress and reduce dissolved oxygen levels. • Increased water quantity associated with improved infiltration, increased soil water storage, restored wetlands, and accessible floodplains can moderate stream temperature changes and increase access to cover and foraging areas. • Rearing habitat will be increased with restored wetlands. Wetlands are highly productive and generally provide moderated temperatures throughout the year due to significant ground water influence. • When stream access to floodplains is restored refuge habitat during high flows is increased and side channel	390 – Riparian herbaceous cover 391 – riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – wetland

Life History Stage	Needs by Life History Stage	Actions that may affect LH stage needs	Habitat Effects, including effects to critical habitat	Species Effects	Applicable FOTG practices
		• Planting of riparian buffer • In-stream leasing of water rights should help increase water quantity, although this may be lessened somewhat in the short-term with irrigation of new plantings. • Livestock use of stream crossings • Spring developments for off-stream water	• Seeding stabilizes soil and reduces compaction which reduces sediment delivery to streams and increases infiltration and water storage capacity of soil. • Vehicle traffic not followed by tillage results in soil compaction which reduces infiltration and water storage capacity of soil, and makes vegetation establishment more difficult. However, effects of this will be offset by decreases in compaction from tilling and vegetation establishment. Chemical: • Herbicides may be delivered to surface water through drift or a spill and degrade water quality. • Non-target vegetation may be killed by overspray or drift which may reduce ground cover or overhead fish cover. • Long-term positive effect because competition is reduced for desirable species. Biological: • Exclusion of livestock from riparian areas will facilitate growth and establishment of riparian vegetation. This will lessen sediment delivery to streams by stabilizing soils and filtering sediment, increase	habitat may form which would increase quality rearing habitat. • Seeding stabilizes soil and reduces sediment delivery to streams which improves water quality for rearing salmonids. Improved water quality will improve foraging efficiency and growth. Chemical: • Herbicides in the water can affect juvenile salmonids in a variety of ways. Mortality may result or sublethal effects such as reduced growth and development, decreased predator avoidance, or modified behavior. • Herbicides can also kill or affect growth of salmonid prey items or affect the growth of aquatic plants that prey species consume. This can decrease prey availability which would reduce juvenile salmonid growth. • Reduction in overhead cover due to killing non-target vegetation increases the vulnerability of juvenile salmonids to predation. Biological: • Recovery of riparian vegetation with exclusion of livestock and riparian planting will result in	restoration

Life History Stage	Needs by Life History Stage	Actions that may affect LH stage needs	Habitat Effects, including effects to critical habitat	Species Effects	Applicable FOTG practices
			infiltration and soil water storage by reducing compaction, decrease warming of water by providing shade, and decrease stream energy during high flows by providing floodplain roughness. • Removal of weeds such as blackberry and gorse may temporarily lessen shade over streams. • Planting of riparian buffer may cause short-term soil disturbance and increase potential of sediment delivery to streams. Establishment of riparian vegetation through planting will result in same effects described above under exclusion of livestock. • Leasing of water rights will increase instream flow which will also decrease water temperature. This should more than compensate for irrigating new plantings. • Stream crossings for livestock will result in long-term loss of vegetation at those sites. They will be stabilized so sediment delivery should not be a problem. • Spring developments will result in concentration of cattle in an area away from the stream, but still some potential	increased juvenile survival due to decreased turbidity and sediment deposition, improved flows and water quality, and improved cover, habitat complexity, and prey availability associated with overhanging vegetation and large wood. These beneficial effects will outweigh short-term negative effects associated with removal of undesirable vegetation, and long-term negative effects of hardened cattle crossings or watering areas. • Leasing of water rights will benefit juvenile salmonids by increasing the amount of habitat available and improving water quality. These benefits will outweigh negative effects from irrigating new plantings. • If concentration of cattle around spring developments results in sediment delivery to streams the effects will be the same as those described above in the Mechanical section.	

Life History Stage	Needs by Life History Stage	Actions that may affect LH stage needs	Habitat Effects, including effects to critical habitat	Species Effects	Applicable FOTG practices
			for sediment delivery to stream.		
Migration	Free of artificial obstructions, water quality and quantity, and natural cover to provide for juvenile and adult mobility and survival. Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.	Mechanical: • Tillage: subsoiling, disking, plowing • For wetland restorations, break tiles, spread dike or levee spoils in previously disturbed areas, disk and seed new dike • Vehicle traffic in riparian area Chemical: • Hand application if chemicals, transportation of chemicals to CREP buffer Biological: • Exclusion of livestock from riparian areas. • Removal of weeds such as blackberry and gorse • Planting of riparian buffer • In-stream leasing of water rights should help	Mechanical: • Soil disturbance results in potential for sediment to be delivered to streams resulting in increased turbidity and pool filling. • Tillage reduces compaction which increases infiltration and water storage capacity of soil, and improves establishment of vegetation allowing water to be stored and slowly released during dry periods. • Breaking of tiles increases water storage in wetland areas. These areas may become functional fish habitat, and stored water can be released during dry periods. • Leveling of dikes and levees allows streams to access floodplains during floods which reduces stream energy, recharges floodplain groundwater, and encourages reestablishment of riparian vegetation. • Seeding stabilizes soil and reduces compaction which reduces sediment delivery to streams and increases infiltration and water storage capacity of soil.	Mechanical: • Excessive suspended sediment can clog gills during migration which will reduce performance or result in death. Excessive suspended sediment may also alter migration behavior. • Increased water quantity can moderate stream temperature changes and increase access to cover. Cooler temperatures will improve swimming performance, and increased cover will protect migrating fish from predators. • Improving stream access to floodplains may result in more favorable migration routes due to reduced stream energy and providing access to side channels and margins with less turbidity. Chemical: • Herbicides in the water can affect juvenile and adult salmonids in a variety of ways. Mortality may result or sublethal effects such as modified migratory behavior or decreased predator avoidance may occur. • Reduction in overhead cover due to killing non-target vegetation increases the	390 – Riparian herbaceous cover 391 – riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – wetland restoration

Life History Stage	Needs by Life History Stage	Actions that may affect LH stage needs	Habitat Effects, including effects to critical habitat	Species Effects	Applicable FOTG practices
		increase water quantity, although this may be lessened somewhat in the short-term with irrigation of new plantings. • Livestock use of stream crossings • Spring developments for off-stream water	• Vehicle traffic not followed by tillage results in soil compaction which reduces infiltration and water storage capacity of soil, and makes vegetation establishment more difficult. However, effects of this will be offset by decreases in compaction from tilling and vegetation establishment. Chemical: • Herbicides may be delivered to surface water through drift or a spill and degrade water quality. • Non-target vegetation may be killed by overspray or drift which may reduce ground cover or overhead fish cover. • Long-term positive effect because competition is reduced for desirable species. Biological: • Exclusion of livestock from riparian areas will facilitate growth and establishment of riparian vegetation. This will lessen sediment delivery to streams by stabilizing soils and filtering sediment, increase infiltration and soil water storage by reducing compaction, decrease warming of water by providing shade, and decrease stream energy during high flows by providing	vulnerability of juvenile salmonids to predation. Biological: • Recovery of riparian vegetation with exclusion of livestock and riparian planting will result in improved migratory conditions for adults and juveniles due to decreased turbidity, improved flows and water quality, and improved cover associated with overhanging vegetation and large wood. These beneficial effects will outweigh short-term negative effects associated with removal of undesirable vegetation, and long-term negative effects of hardened cattle crossings or watering areas. • Leasing of water rights will benefit migrating juveniles and adults by increasing the amount of water and improving water quality during migration. These benefits will outweigh negative effects from irrigating new plantings. • If concentration of cattle around spring developments results in sediment delivery to streams the effects will be the same as those described above in the Mechanical section.	

Life History Stage	Needs by Life History Stage	Actions that may affect LH stage needs	Habitat Effects, including effects to critical habitat	Species Effects	Applicable FOTG practices
			floodplain roughness. • Removal of weeds such as blackberry and gorse may temporarily lessen shade over streams. • Planting of riparian buffer may cause short-term soil disturbance and increase potential of sediment delivery to streams. Establishment of riparian vegetation through planting will result in same effects described above under exclusion of livestock. • Leasing of water rights will increase instream flow which will also decrease water temperature. This should more than compensate for irrigating new plantings. • Stream crossings for livestock will result in long-term loss of vegetation at those sites. They will be stabilized so sediment delivery should not be a problem. • Spring developments will result in concentration of cattle in an area away from the stream, but still some potential for sediment delivery to stream.		
Estuarine	Free of obstruction, water quality and quantity, and salinity suitable to provide for successful juvenile and	Mechanical: • Tillage: subsoiling, disking, plowing	Mechanical: • Soil disturbance results in potential for sediment to be delivered to estuary resulting	Mechanical: • Excessive suspended sediment can clog gills during migration which will reduce performance	390 – Riparian herbaceous cover 391 – riparian

Life History Stage	Needs by Life History Stage	Actions that may affect LH stage needs	Habitat Effects, including effects to critical habitat	Species Effects	Applicable FOTG practices
	adult physiological transitions between salt and freshwater. Natural cover, forage, and water quantity to provide for growth and maturation. Natural cover includes large wood, log jams, aquatic vegetation, side channels, and undercut banks. Forage includes aquatic invertebrates and fish species.	• For wetland restorations, break tiles, spread dike or levee spoils in previously disturbed areas, disk and seed new dike • Vehicle traffic in riparian area Chemical: • Hand application if chemicals, transportation of chemicals to CREP buffer Biological: • Exclusion of livestock from riparian areas. • Removal of weeds such as blackberry and gorse • Planting of riparian buffer • In-stream leasing of water rights should help increase water quantity, although this may be lessened somewhat in the short-term with	in increased turbidity. • Tillage reduces compaction which increases infiltration and water storage capacity of soil, and improves establishment of vegetation allowing water to be stored and released throughout tidal cycle. • Breaking of tiles increases water storage in wetland areas. These areas may become functional fish habitat at varying water levels during tidal cycle. • Leveling of dikes and levees allows areas to be inundated during high tide. • Seeding stabilizes soil and reduces compaction which reduces sediment delivery to estuaries and increases infiltration and water storage capacity of soil. • Vehicle traffic not followed by tillage results in soil compaction which reduces infiltration and water storage capacity of soil, and makes vegetation establishment more difficult. However, effects of this will be offset by decreases in compaction from tilling and vegetation establishment. Chemical: • Herbicides may be delivered to	or result in death. Excessive suspended sediment may also alter migration behavior and reduce forage efficiency. • Increased water quantity can moderate water temperature changes and increase access to cover. Cooler temperatures will improve swimming performance, and increased cover will protect fish from predators. • Improving access to tidal flats may result in access to favorable foraging habitat. Chemical: • Herbicides in the water can affect juvenile and adult salmonids in a variety of ways. Mortality may result or sublethal effects such as modified migratory behavior or decreased predator avoidance may occur. • Reduction in overhead cover due to killing non-target vegetation increases the vulnerability of juvenile salmonids to predation. Biological: • Recovery of riparian vegetation with exclusion of livestock and riparian planting will result in improved estuarine habitat for adults and juveniles due to decreased turbidity, decreased	forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – wetland restoration

Life History Stage	Needs by Life History Stage	Actions that may affect LH stage needs	Habitat Effects, including effects to critical habitat	Species Effects	Applicable FOTG practices
		irrigation of new plantings. • Livestock use of stream crossings	surface water through drift or a spill and degrade water quality. • Non-target vegetation may be killed by overspray or drift which may reduce ground cover or overhead fish cover. • Long-term positive effect because competition is reduced for desirable species. Biological: • Exclusion of livestock from riparian areas will facilitate growth and establishment of riparian vegetation. This will lessen sediment delivery to estuaries by stabilizing soils and filtering sediment, increase infiltration and soil water storage by reducing compaction, and decrease warming of water by providing shade. • Removal of weeds such as blackberry and gorse may temporarily lessen shade over estuarine habitat. • Planting of riparian buffer may cause short-term soil disturbance and increase potential of sediment delivery to estuaries. Establishment of riparian vegetation through planting will result in same effects described above under exclusion of livestock.	water temperatures, and improved cover associated with overhanging vegetation and large wood. These beneficial effects will outweigh short-term negative effects associated with removal of undesirable vegetation, and long-term negative effects of hardened cattle crossings or watering areas. • Leasing of water rights will benefit juveniles and adults by increasing the amount of water and improving water quality. These benefits will outweigh negative effects from irrigating new plantings.	

Life History Stage	Needs by Life History Stage	Actions that may affect LH stage needs	Habitat Effects, including effects to critical habitat	Species Effects	Applicable FOTG practices
			• Leasing of water rights will increase instream flow which will also decrease water temperature. This should more than compensate for irrigating new plantings. • Stream crossings for livestock will result in long-term loss of vegetation at those sites. They will be stabilized so sediment delivery should not be a problem.		
Nearshore marine	Free of obstruction, water quality and quantity, natural cover, and forage to provide for growth, maturation, and survival. Natural cover includes large wood, large rocks and boulders, and aquatic vegetation. Forage includes aquatic invertebrates and fish species.	Mechanical: • Tillage: subsoiling, disking, plowing • Vehicle traffic in riparian area Chemical: • Hand application if chemicals, transportation of chemicals to CREP buffer Biological: • Exclusion of livestock from riparian areas. • Planting of riparian buffer	Mechanical: • Soil disturbance results in potential for sediment to be delivered to marine environment resulting in increased turbidity. • Seeding stabilizes soil and reduces compaction which reduces sediment delivery to marine areas and increases infiltration and water storage capacity of soil. • Vehicle traffic not followed by tillage results in soil compaction which reduces infiltration and water storage capacity of soil, and makes vegetation establishment more difficult. However, effects of this will be offset by decreases in compaction from tilling and vegetation establishment. Chemical: • Herbicides may be delivered to	Mechanical: • Excessive sediment can clog gills of fish, reduce prey availability, and reduce success in catching prey. • Seeding stabilizes soil and reduces sediment delivery to streams which improves water quality of the marine environment being used by salmonids. Improved water quality will improve foraging efficiency and growth. Chemical: • Herbicides in the marine environment can affect salmonids in a variety of ways. Mortality may result or sublethal effects such as modified migratory behavior or decreased predator avoidance may occur. • Reduction in overhead cover due to killing non-target	390 – Riparian herbaceous cover 391 – riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment

Life History Stage	Needs by Life History Stage	Actions that may affect LH stage needs	Habitat Effects, including effects to critical habitat	Species Effects	Applicable FOTG practices
			surface water through drift or a spill and degrade water quality. • Non-target vegetation may be killed by overspray or drift which may reduce ground cover or overhead fish cover. • Long-term positive effect because competition is reduced for desirable species. Biological: • Exclusion of livestock from riparian areas will facilitate growth and establishment of riparian vegetation. This will lessen sediment delivery to marine areas by stabilizing soils and filtering sediment, increase infiltration and soil water storage by reducing compaction. • Planting of riparian buffer may cause short-term soil disturbance and increase potential of sediment delivery to marine environment. Establishment of riparian vegetation through planting will result in same effects described above under exclusion of livestock.	vegetation increases the vulnerability of young salmonids to predation. This will be offset by establishment and recovery of desirable vegetation. Biological: • Increased long-term woody debris recruitment and overhanging banks should increase survival and food availability. • Recovery of vegetation reduces sediment delivery to the marine environment which improves water quality for salmonids. Improved water quality will improve foraging efficiency and growth. This will offset any effects associated with soil disturbance from riparian planting.	645 – Upland wildlife habitat management 657 – wetland restoration

Table 2. Inland Fish

Species	**Habitat component**	**Species needs by habitat component**	**Potential effects of actions on individuals or habitat components**	**Potential species response**	**Applicable FOTG practices**
Bull Trout • Columbia River population • Klamath Lake population	Direct effects on individuals		• Effects of exposure to pesticides and other pollutants	• Sub-lethal effects can occur, including impacts to sensory systems…	
•	Food	Juveniles primarily eat aquatic insects; adults eat fish.	• Short-term sediment delivery from tillage or weed removal, short-term chemical delivery from herbicide use, and short-term shade reduction from riparian weed removal may temporarily affect aquatic invertebrate populations. • Removal of riparian weeds, tillage and vehicle movement in riparian area, and short-term herbicide use may affect terrestrial insect populations, lessening terrestrial insect recruitment into streams over the short-term. • Increase in site capability riparian vegetation should increase invertebrate populations.	• Reduced food availability can cause physical stress and reduce survival. • Increased food availability can reduce physical stress, increase survival, and potentially assist with recovery. • Lethal and sub-lethal effects of herbicides and other pollutants may occur from herbicides that enter streams.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Cover/shelter	Adults prefer deep pools in cold rivers; juveniles frequently live on or within stream	• Short-term sediment delivery from tillage or	• Excessive sediment can clog gills,	390 – Riparian herbaceous

Species	Habitat component	Species needs by habitat component	Potential effects of actions on individuals or habitat components	Potential species response	Applicable FOTG practices
		cobble; use small pockets of slow water near high velocity, food-bearing water. Prefer structural diversity including diverse cobble substrate, large woody debris, undercut banks, pools, and low percentage of fine sediments.	weed removal may cause short-term sedimentation in stream cobble areas • Chemical delivery from herbicide use can cause temporary decrease in water quality • Removal of weeds such as blackberry and gorse may temporarily lessen shade over streams • Weed removal with equipment may cause sediment delivery to streams • Riparian buffer will provide filtration of nutrients and sediment, streambank stabilization, overhanging banks, large woody debris in some regions, and shade as it becomes established.	reduce prey availability, and reduce success in catching prey. • Increased stream temperature can cause physical stress and reduce dissolved oxygen levels. • Increased water quantity can moderate stream temperature changes and increase access to cover. • Decreased water quantity can result in stream temperature increases and decrease access to side channels, cover and foraging areas. • Increased long-term woody debris recruitment and overhanging banks should increase juvenile survival as well as food availability. • Increased exposure to herbicides and other pollutants…	cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Reproductive requirements	Require very cold incubation conditions for eggs; spawn in September/October. Spawning	• Short-term sediment delivery from tillage or	• Sediment and exposure to	390 – Riparian herbaceous

Species	Habitat component	Species needs by habitat component	Potential effects of actions on individuals or habitat components	Potential species response	Applicable FOTG practices
		occurs in gravel, in runs or tails of spring-fed pools. Prefer low-gradient streams with loose, clean gravel.	weed removal may cause short-term sedimentation in spawning areas • Chemical delivery from herbicide use could cause temporary decrease in water quality • Removal of weeds such as blackberry and gorse may temporarily lessen shade over streams • Weed removal with equipment may cause sediment delivery to streams • Riparian buffer should provide filtration of nutrients and sediment, streambank stabilization, overhanging banks, large woody debris in some regions, and shade as it becomes established.	herbicides and other pollutants in streams can reduce suitable spawning sites, affect redds and reduce survival • Decreased sediment delivery results in more suitable spawning sites and better water quality, increasing survival • Increased stream temperatures can cause physical stress to eggs and reduce survival • Decreased stream temperatures can increase spawning success • Decreased water quantity can reduce suitable spawning sites and increase stream temperatures • Increased water quantity can increase spawning sites and buffer stream temperature increases	cover 391 – riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – wetland restoration
Lahontan Cutthroat Trout	Food	Smaller fish eat invertebrates, larger fish eat small fish	• Short-term sediment delivery from tillage or weed removal, short-term chemical delivery from herbicide use, and	• Reduced food availability can cause physical stress and reduce survival. • Increased food	390 – Riparian herbaceous cover 391 – Riparian forest buffer

Species	Habitat component	Species needs by habitat component	Potential effects of actions on individuals or habitat components	Potential species response	Applicable FOTG practices
			short-term shade reduction from riparian weed removal may temporarily affect aquatic invertebrate populations. • Removal of riparian weeds, tillage and vehicle movement in riparian area, and short-term herbicide use may affect terrestrial insect populations, lessening terrestrial insect recruitment into streams over the short-term. • Increase in site capability riparian vegetation should increase invertebrate populations.	availability can reduce physical stress, increase survival, and potentially assist with recovery.	393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Cover/shelter	Prefer well-vegetated streambanks and water with velocity breaks. Prefer cool, flowing water with available cover, velocity breaks, well-vegetated streambanks and silt-free rocky substrate in riffle-run areas. Can tolerate high salinity.	• Short-term sediment delivery from tillage or weed removal may cause short-term sedimentation in stream cobble areas • Chemical delivery from herbicide use could cause temporary decrease in water quality • Removal of weeds such as blackberry and gorse may temporarily lessen shade and cover over streams • Weed removal with	• Excessive sediment can clog gills. • Increased stream temperature can cause physical stress and reduce dissolved oxygen levels. • Increased water quantity can moderate stream temperature changes and increase access to cover. • Decreased water	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest

Species	Habitat component	Species needs by habitat component	Potential effects of actions on individuals or habitat components	Potential species response	Applicable FOTG practices
			equipment may cause sediment delivery to streams • Riparian buffer should provide filtration of nutrients and sediment, streambank stabilization, overhanging banks, large woody debris in some regions, and shade as it becomes established.	quantity can result in stream temperature increases and decrease access to side channels, cover and foraging areas. • Increased long-term woody debris recruitment and overhanging banks should increase juvenile survival as well as food availability and habitat complexity.	site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Reproductive requirements	Spawn in riffles with well-washed gravels	• Short-term sediment delivery from tillage or weed removal may cause short-term sedimentation in spawning areas • Chemical delivery from herbicide use can cause temporary decrease in water quality • Removal of weeds such as blackberry and gorse may temporarily lessen shade over streams • Weed removal with equipment may cause sediment delivery to streams • Riparian buffer will provide filtration of nutrients and sediment, streambank stabilization,	• Sediment in streams can reduce suitable spawning sites, affect redds and reduce survival • Decreased sediment delivery results in more suitable spawning sites and better water quality, increasing survival • Increased stream temperatures can cause physical stress to eggs and reduce survival • Decreased stream temperatures can increase spawning success • Decreased water	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub

Species	Habitat component	Species needs by habitat component	Potential effects of actions on individuals or habitat components	Potential species response	Applicable FOTG practices
			overhanging banks, large woody debris in some regions, and shade as it becomes established.	quantity can reduce suitable spawning sites and increase stream temperatures • Increased water quantity can increase spawning sites and buffer stream temperature increases	establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
Oregon Chub	Food	Adults feed on water column fauna including copepods, cladocerans, and chironomid larveae. Juveniles' diets consist of rotifers, copepods, and cladocerans.	• Short-term sediment delivery from tillage or weed removal, short-term chemical delivery from herbicide use, and short-term shade reduction from riparian weed removal may temporarily affect aquatic invertebrate populations. • Removal of riparian weeds, tillage and vehicle movement in riparian area, and short-term herbicide use may affect terrestrial insect populations, lessening terrestrial insect recruitment into streams over the short-term. • Increase in site capability riparian vegetation should increase invertebrate populations.	• Reduced food availability can cause physical stress and reduce survival. • Increased food availability can reduce physical stress, increase survival, and potentially assist with recovery.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration

Species	Habitat component	Species needs by habitat component	Potential effects of actions on individuals or habitat components	Potential species response	Applicable FOTG practices
	Cover/shelter	Off-channel habitats such as beaver ponds, backwater sloughs, oxbows, side channels, low-gradient tributaries and flooded marshes. Habitats usually have little to no water flow and silty and organic substrate. Often travel in beaver channels or along margins of aquatic plant beds. In early spring, prefer warmer shallow areas of ponds. Larvae prefer shallow areas. In winter, bury in detritus or hide in aquatic vegetation.	• Short-term sediment delivery from tillage or weed removal may cause short-term sedimentation in stream cobble areas • Chemical delivery from herbicide use can cause temporary decrease in water quality • Removal of weeds such as blackberry and gorse may temporarily lessen shade over streams • Weed removal with equipment may cause sediment delivery to streams • Riparian buffer should provide filtration of nutrients and sediment, streambank stabilization, overhanging banks, large woody debris in some regions, and shade as it becomes established. • Wetland restorations near streams should increase habitat by creating additional shallow ponds and increasing vegetation diversity.	• Excessive sediment can clog gills. • Increased stream temperature can cause physical stress and reduce dissolved oxygen levels. • Increased water quantity can moderate stream temperature changes and increase access to cover. • Decreased water quantity can result in stream temperature increases and decrease access to side channels, cover and foraging areas. • Increased long-term woody debris recruitment and overhanging banks should increase juvenile survival as well as food availability	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Reproductive requirements	Spawn April through September. (couldn't find anything about preferred spawning areas???) Prefer considerable aquatic vegetation for hiding and spawning.	• Short-term sediment delivery from tillage or weed removal may cause short-term sedimentation in spawning areas	• Sediment in streams can reduce suitable spawning sites, affect redds and reduce survival	390 – Riparian herbaceous cover 391 – Riparian forest buffer

Species	Habitat component	Species needs by habitat component	Potential effects of actions on individuals or habitat components	Potential species response	Applicable FOTG practices
			• Chemical delivery from herbicide use can cause temporary decrease in water quality • Removal of weeds such as blackberry and gorse may temporarily lessen shade and cover over streams • Weed removal with equipment may cause sediment delivery to streams • Riparian buffer will provide filtration of nutrients and sediment, streambank stabilization, overhanging banks, large woody debris, and shade as it becomes established.	• Decreased sediment delivery results in more suitable spawning sites and better water quality, increasing survival • Increased stream temperatures can cause physical stress to eggs and reduce survival • Decreased stream temperatures can increase spawning success • Decreased water quantity can reduce suitable spawning sites and increase stream temperatures • Increased water quantity can increase spawning sites and buffer stream temperature increases	393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
Warner Sucker	Food	Larvae eat zooplankton and small insects; then switch to algae, detritus and macroinvertebrates. What about Adults?	• Short-term sediment delivery from tillage or weed removal, short-term chemical delivery from herbicide use, and short-term shade reduction from riparian weed removal may temporarily affect aquatic invertebrate populations.	• Reduced food availability can cause physical stress and reduce survival.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water

Species	Habitat component	Species needs by habitat component	Potential effects of actions on individuals or habitat components	Potential species response	Applicable FOTG practices
			• Removal of riparian weeds, tillage and vehicle movement in riparian area, • Increase in site capability riparian vegetation should increase invertebrate populations.		management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Cover/shelter	Larvae are found in shallow backwater pools or on stream margins where there is no current, often among or near macropytes (aquatic plants). Young of the year use deep still pools, but also move into faster flowing areas near the heads of pools. Adults use stretches of stream where the gradient is low enough to allow the formation of long (>50 m) pools. These pools tend to have undercut banks, large beds of aquatic macropytes, root wads or boulders, a vertical temperature differential of at least 2 o C, a maximum depth > 1.5 m, and over-hanging vegetation.	• Short-term sediment delivery from tillage or weed removal may cause short-term sedimentation in stream cobble areas • Chemical delivery from herbicide use can cause temporary decrease in water quality • Removal of weeds such as blackberry and gorse may temporarily lessen shade over streams • Weed removal with equipment may cause sediment delivery to streams • Riparian buffer will provide filtration of nutrients and sediment, streambank stabilization,	• Excessive sediment can clog gills. • Increased stream temperature can cause physical stress and reduce dissolved oxygen levels. • Increased water quantity can moderate stream temperature changes and increase access to cover. • Decreased water quantity can result in stream temperature increases and decrease access to side channels, cover	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub

Species	Habitat component	Species needs by habitat component	Potential effects of actions on individuals or habitat components	Potential species response	Applicable FOTG practices
			overhanging banks, large woody debris in some regions, and shade as it becomes established. • Planting of trees may reduce the amount of macrophytes.	and foraging areas. • Increased long-term woody debris recruitment and overhanging banks should increase juvenile survival as well as food availability	establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Reproductive requirements	Spawn in low to moderate gradient streams with clean, coarse gravel	• Short-term sediment delivery from tillage or weed removal may cause short-term sedimentation in spawning areas • Chemical delivery from herbicide use can cause temporary decrease in water quality • Removal of weeds such as blackberry and gorse may temporarily lessen shade over streams • Weed removal with equipment may cause sediment delivery to streams • Riparian buffer will provide filtration of nutrients and sediment, streambank stabilization, overhanging banks, large woody debris, and shade as it becomes established.	• Sediment in streams can reduce suitable spawning sites, affect redds and reduce survival • Decreased sediment delivery results in more suitable spawning sites and better water quality, increasing survival • Increased stream temperatures can cause physical stress to eggs and reduce survival • Decreased stream temperatures can increase spawning success • Decreased water quantity can reduce suitable spawning sites and increase stream temperatures • Increased water quantity can increase spawning	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration

Species	Habitat component	Species needs by habitat component	Potential effects of actions on individuals or habitat components	Potential species response	Applicable FOTG practices
				sites and buffer stream temperature increases	
Lost River and Shortnose Suckers	Food	Feed on lake bottoms on detritus, zooplankton, algae, and aquatic insects.	• Short-term sediment delivery from tillage or weed removal, short-term chemical delivery from herbicide use, and short-term shade reduction from riparian weed removal may temporarily affect aquatic invertebrate populations. • Removal of riparian weeds, tillage and vehicle movement in riparian area, and short-term herbicide use may affect terrestrial insect populations, lessening terrestrial insect recruitment into streams over the short-term. • Increase in site capability riparian vegetation should increase invertebrate populations.	• Reduced food availability can cause physical stress and reduce survival. • Increased food availability can reduce physical stress, increase survival, and potentially assist with recovery	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Cover/shelter	Vegetated river and lake shoreline habitats important for larval and juvenile rearing. What about Adults?	• Short-term sediment delivery from tillage or weed removal may cause short-term sedimentation in stream cobble areas • Chemical delivery from herbicide use can cause	• Excessive sediment can clog gills. • Increased stream temperature can cause physical stress and reduce dissolved oxygen	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip

Species	Habitat component	Species needs by habitat component	Potential effects of actions on individuals or habitat components	Potential species response	Applicable FOTG practices
			temporary decrease in water quality • Removal of weeds such as blackberry and gorse may temporarily lessen shade and cover over streams • Weed removal with equipment may cause sediment delivery to streams • Riparian buffer will provide filtration of nutrients and sediment, streambank stabilization, overhanging banks, large woody debris in some regions, and shade as it becomes established.	levels. • Increased water quantity can moderate stream temperature changes and increase access to cover. • Decreased water quantity can result in stream temperature increases and decrease access to stream benches, cover and foraging areas. • Increased long-term woody debris recruitment and overhanging banks should increase juvenile survival as well as food availability	414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Reproductive requirements	Spawn in lake tributaries. Spawning substrate is usually gravel or cobble. Larvae drift downstream into lakes.	• Short-term sediment delivery from tillage or weed removal may cause short-term sedimentation in spawning areas • Chemical delivery from herbicide use can cause temporary decrease in water quality • Removal of weeds such as blackberry and gorse may temporarily lessen shade and cover over	• Sediment in streams can reduce suitable spawning sites, affect redds and reduce survival • Decreased sediment delivery results in more suitable spawning sites and better water quality, increasing survival • Increased stream temperatures can	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use

Species	Habitat component	Species needs by habitat component	Potential effects of actions on individuals or habitat components	Potential species response	Applicable FOTG practices
			streams • Weed removal with equipment may cause sediment delivery to streams • Riparian buffer will provide filtration of nutrients and sediment, streambank stabilization, overhanging banks, large woody debris, and shade as it becomes established.	cause physical stress to eggs and reduce survival • Decreased stream temperatures can increase spawning success • Decreased water quantity can reduce suitable spawning sites and increase stream temperatures • Increased water quantity can increase spawning sites and buffer stream temperature increases • Increased water quantity provides a better opportunity for drift of larvae.	exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
Modoc Sucker	Food	Benthic invertebrates, algae, detritus	• Short-term sediment delivery from tillage or weed removal, short-term chemical delivery from herbicide use, and short-term shade reduction from riparian weed removal may temporarily affect aquatic invertebrate populations. • Removal of riparian weeds, tillage and vehicle movement in riparian area, and short-	• Reduced food availability can cause physical stress and reduce survival. • Increased food availability can reduce physical stress, increase survival, and potentially assist with recovery	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest

Species	Habitat component	Species needs by habitat component	Potential effects of actions on individuals or habitat components	Potential species response	Applicable FOTG practices
			term herbicide use may affect terrestrial insect populations, lessening terrestrial insect recruitment into streams over the short-term. • Increase in site capability riparian vegetation should increase invertebrate populations.		site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Cover/shelter	Prefers streams that have large shallow pools with soft sediments, cover, and clear water.	• Short-term sediment delivery from tillage or weed removal may cause short-term sedimentation in stream cobble areas • Chemical delivery from herbicide use can cause temporary decrease in water quality • Removal of weeds such as blackberry and gorse may temporarily lessen shade and cover over streams • Weed removal with equipment may cause sediment delivery to streams • Riparian buffer will provide filtration of nutrients and sediment, streambank stabilization, overhanging banks, large woody debris in some regions, and shade as it	• Excessive sediment can clog gills. • Increased stream temperature can cause physical stress and reduce dissolved oxygen levels. • Increased water quantity can moderate stream temperature changes and increase access to cover. • Decreased water quantity can result in stream temperature increases and decrease access to side channels, cover and foraging areas. • Increased long-term woody debris recruitment and	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management

Species	**Habitat component**	**Species needs by habitat component**	**Potential effects of actions on individuals or habitat components**	**Potential species response**	**Applicable FOTG practices**
			becomes established.	overhanging banks should increase juvenile survival as well as food availability	657 – Wetland restoration
	Reproductive requirements	Spawn in fine to medium gravel in the lower ends of pools in creeks or tributaries, when water temperatures are 13.3 to 16.1 degrees Celsius.	• Short-term sediment delivery from tillage or weed removal may cause short-term sedimentation in spawning areas • Chemical delivery from herbicide use can cause temporary decrease in water quality • Removal of weeds such as blackberry and gorse may temporarily lessen shade over streams • Weed removal with equipment may cause sediment delivery to streams • Riparian buffer should provide filtration of nutrients and sediment, streambank stabilization, overhanging banks, large woody debris, and shade as it becomes established.	• Sediment in streams can reduce suitable spawning sites, affect redds and reduce survival • Decreased sediment delivery results in more suitable spawning sites and better water quality, increasing survival • Increased stream temperatures can cause physical stress to eggs and reduce survival • Decreased stream temperatures can increase spawning success • Decreased water quantity can reduce suitable spawning sites and increase stream temperatures • Increased water quantity can increase spawning sites and buffer stream temperature increases	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration

Table 3. Mammals

Species	Habitat component	Species needs by habitat component	Actions that may affect habitat	Additional effects on species	Applicable FOTG practices
Columbian white-tailed deer (Clatsop and Columbia County population)	Food	Prefers grasses and forbs.	• Mechanical or chemical site preparation for planting may temporarily lessen grasses and forbs available for food. Deer may ingest small amounts of herbicides if they graze grasses and forbs that were sprayed for moisture conservation. • Livestock exclusion from riparian areas should allow more forage for deer as well as more cover for foraging.	• Vehicle traffic, tillage, wetland restoration activities, or fence building adjacent to foraging areas may temporarily disturb animals.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Cover/shelter	Bottomlands and prairie woodlands in the lower Columbia basin. Particularly common in riparian areas along large rivers. Also uses a variety of other lower elevation habitat types, including grassland, grass shrub, oak savannah, oak-hardwood woodland, oak-hardwood savannah shrub, oak-hardwood conifer, conifer, and urban/suburban yards. Need dense stands of	• Blackberry and other invasive shrub removal may temporarily decrease cover available to deer. • Riparian restoration in some areas will provide dense tree and shrub habitat for deer to hide.	• Vehicle traffic, tillage, wetland restoration activities, or fence building adjacent to existing cover may temporarily disturb animals.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management

Species	Habitat component	Species needs by habitat component	Actions that may affect habitat	Additional effects on species	Applicable FOTG practices
		trees and shrubs for hiding.			449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 – Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Reproductive requirements	Need dense stands of trees and shrubs for hiding fawns.	• Riparian restoration will provide dense tree and shrub habitat for fawns to hide. • Blackberry and other invasive shrub removal may temporarily decrease some hiding cover for fawns.	• Vehicle traffic, tillage, wetland restoration activities, or fence building adjacent to existing cover may temporarily disturb animals.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management

Species	Habitat component	Species needs by habitat component	Actions that may affect habitat	Additional effects on species	Applicable FOTG practices
					612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration

Table 4. Invertebrates

Species	**Habitat component**	**Species needs by habitat component**	**Actions that may affect habitat**	**Additional effects on species**	**Applicable FOTG practices**
Fender's blue butterfly	Food	Larvae feed on Kincaid's lupine.	• Vehicle traffic may disturb lupine. • Mechanical or chemical site preparation for tree and shrub planting may destroy some lupine. • Fence construction may damage or destroy some lupine. • Tile breaking or earthmoving for wetland restorations may disturb or destroy some lupine. • Livestock exclusion from riparian area should reduce browsing on lupine and may expand lupine habitat. • Shade from riparian plantings may eventually shade out lupine and lessen butterfly habitat.	• Vehicle traffic, mechanical site preparation, fence construction, or earthmoving for wetland restoration may injure or kill larvae. • Livestock exclusion from riparian area should reduce trampling of larvae.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Cover/shelter	Found on upland prairies in the Willamette Valley. Larvae need leaf litter for cover under Kincaid's lupine during diapause.	• Vehicle traffic, mechanical site preparation, fence construction, or earthmoving for wetland restoration may injure or kill larvae. • Livestock exclusion from riparian area should reduce trampling of larvae.	• Vehicle traffic, mechanical site preparation, fence construction, or earthmoving for wetland restoration may injure or kill larvae. • Livestock exclusion	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management

Species	Habitat component	Species needs by habitat component	Actions that may affect habitat	Additional effects on species	Applicable FOTG practices
				from riparian area should reduce trampling of larvae.	449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Reproductive requirements	Lays eggs in May on Kincaid's lupine. Larvae hatch and eat lupine until the plant reaches senesces. At this time (usually in late June), the caterpillars drop to the base of Kincaid's lupine and enter diapause. The caterpillars will remain tucked under the leaf litter until February/March of the following year. They feed again on lupine in order to shed skin and grow big enough to pupate. They then form cocoons, transform, and emerge in May. Fender's blue completes its lifecycle in one year.	• Vehicle traffic, mechanical site preparation, fence construction, or earthmoving for wetland restoration may injure or kill larvae. • Livestock exclusion from riparian area should reduce trampling of larvae.	See above	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management

Species	Habitat component	Species needs by habitat component	Actions that may affect habitat	Additional effects on species	Applicable FOTG practices
					612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
Vernal pool fairy shrimp	Food	Feed on detritus, algal particles, and bacteria by scraping vegetation or other surfaces with their legs, or by filtering surrounding water.	• Herbicide or other chemical runoff to vernal pools may affect food availability.	See below	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Cover/shelter	Vernal pools in Southern Oregon and northern California	• Exclusion of livestock from riparian and vernal	• Tree planting and fence building,	390 – Riparian herbaceous

Species	Habitat component	Species needs by habitat component	Actions that may affect habitat	Additional effects on species	Applicable FOTG practices
			pool areas, as well as creation of small vernal pools through the wetland restoration practice, should increase and improve vernal pool habitat.	vehicle traffic, wetland construction, and off-stream watering facility construction activities may disturb or kill shrimp. • Riparian or wetland restoration ahs the potential to create habitat.	cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Reproductive requirements	Eggs wait for rains to hatch; after hatching, adults reproduce in as little as two weeks so eggs are laid before pools dry up. Eggs are transported from pool to pool by "hitching a ride" on wading animals.	See above	See above	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management

Species	Habitat component	Species needs by habitat component	Actions that may affect habitat	Additional effects on species	Applicable FOTG practices
					472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration

Table 5. Plants

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
Nelson's Checkermallow	General habitat needs	Willamette Valley in ash swales and meadows with wet depressions, along streams	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Earthmoving to create shallow pools or breaking tile for wetland restorations may crush or uproot some plants. • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. • Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	391 – Riparian forest buffer 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 657 – Wetland restoration
	Soil types	Wapato, Bashaw, Mcalpin series in Willamette Valley; Malabon, Coburg and Salem series in Coast Range	See above	See above
	Other requirements	Will not tolerate shade or woody species encroachment	See above	See above

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
	Flowering period	Mid-May to September in Willamette Valley; slightly later in Coast Range	See above	See above
Bradshaw's Lomatium	General habitat needs	Seasonally saturated or flooded prairies adjacent to creeks and small rivers in Willamette Valley	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Earthmoving to create shallow pools or breaking tile for wetland restorations may crush or uproot some plants. • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. • Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	391 – Riparian forest buffer 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 657 – Wetland restoration
	Soil types	Dense, heavy clays with slowly permeable clay layer 15-30 cm below surface. Wapato, Bashaw and Mcalpin series.	See above	See above

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
	Other requirements		See above	See above
	Flowering period	April and early May	See above	See above
Howell's Spectacular Thelypody	General habitat needs	Moist, moderately well-drained, somewhat alkaline meadow habitats along with salt tolerant species in Baker-Powder River Valley; also occurred historically in Malheur County	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. • Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management
	Soil types	Wingville, Baldock and Haines series	See above	See above
	Other requirements	Appears to be somewhat dependent on periodic flooding	See above	See above
	Flowering period	Biennial plant; flowers June to July.	See above	See above

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
Rough Popcornflower	General habitat needs	Moist, open areas on poorly drained silty clay soils in flat valley bottoms. Now exists in isolated locations in the Yoncalla and Sutherlin areas.	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Earthmoving to create shallow pools or breaking tile for wetland restorations may crush or uproot some plants. • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. • Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	391 – Riparian forest buffer 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 657 – Wetland restoration
	Soil types	Conser silty clay loam	See above	See above
	Other requirements	Seasonal ponding of water maintains habitat.	See above	See above
	Flowering period	Mid to late June	See above	See above

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
Willamette Daisy	General habitat needs	Bottomland and upland prairies in the Willamette Valley	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Earthmoving to create shallow pools or breaking tile for wetland restorations may crush or uproot some plants. • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. • Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	391 – Riparian forest buffer 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management
	Soil types	Wapato, Bashaw and Mcalpin	See above	See above
	Other requirements	N/A	See above	See above
	Flowering period	June and July	See above	See above

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
Applegate's milk-vetch	General habitat needs	Flat, open, seasonally moist floodplain alkaline grassland in Klamath Basin. Bunchgrass flat, with about 10 to 20 percent exposed ground. Substrate is poorly drained, fine silt loam with underlying hardpan at depths of 20 to 40 inches.	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Earthmoving to create shallow pools or breaking tile for wetland restorations may crush or uproot some plants. • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. • Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Soil types	Henley-Laki loams, Hosley loam, Henley loam, Calimus fine sandy loam	See above	See above
	Other requirements	Needs seasonal flooding	See above	See above
	Flowering period	June and July	See above	See above

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
Golden paintbrush	General habitat needs	Open grasslands at elevations below 100m. Most populations occur on glacially derived soils, either gravelly glacial outwash or clayey glacio-lacustrine sediments.	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Earthmoving to create shallow pools or breaking tile for wetland restorations may crush or uproot some plants. • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. • Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Soil types	Not listed in recovery plan	See above	See above
	Other requirements	Frequent, low-intensity fires are important to maintain early successional habitat.	See above • Fire could destroy plants and other T&E plant habitat.	See above

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
	Flowering period	April to June	See above	See above
Gentner's fritillary	General habitat needs	Dry, open oak/fir woodlands, can also grow in chaparral/grassland	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Earthmoving to create shallow pools or breaking tile for wetland restorations may crush or uproot some plants. • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. • Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Soil types	Not listed in recovery plan	See above	See above
	Other requirements	Infrequent, but regular soil disturbance may benefit this species by promoting	See above	See above

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
		seed germination, taller vegetation shades it out		
	Flowering period	April to June	See above	See above
Water howellia	General habitat needs	Vernal, freshwater wetlands in forests bordered by broadleaf deciduous trees with well-developed shrub component	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Earthmoving to create shallow pools or breaking tile for wetland restorations may crush or uproot some plants. • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. • Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Soil types	Not listed in recovery plan	See above	See above

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
	Other requirements	Reduction of competing weeds may benefit	See above	See above
	Flowering period	June to August	See above	See above
Western lily	General habitat needs	Sphagnum bogs, coastal scrub and prairie, and other poorly drained soils, forest and thicket openings along edges of ephemeral ponds and small channels	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Earthmoving to create shallow pools or breaking tile for wetland restorations may crush or uproot some plants. • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration
	Soil types	Strongly acid, poorly drained, sandy orstein soils	See above	See above

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
	Other requirements	Needs low shrubbery, but if the surrounding vegetation becomes too tall or dense, it appears to reduce survival	See above	See above
	Flowering period	May to July	See above	See above
Large-flowered meadowfoam	General habitat needs	Vernal pools in the Agate Desert	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Earthmoving to create shallow pools or breaking tile for wetland restorations may crush or uproot some plants. • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. • Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
	Soil types	Agate-Winlow complex	See above	See above
	Other requirements	Excessive thatch from invasive species may reduce seed germination	See above	See above
	Flowering period	April to May	See above	See above
Cook's lomatium	General habitat needs	Vernal pools in the Agate Desert, also in French Flat and Illinois Valley	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Earthmoving to create shallow pools or breaking tile for wetland restorations may crush or uproot some plants. • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management 657 – Wetland restoration

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
	Soil types	Agate-Winlow complex	See above	See above
	Other requirements	Excessive thatch from invasive species may reduce seed germination	See above	See above
	Flowering period	Mid-March through May	See above	See above
Kincaid's lupine	General habitat needs	Native upland prairie in Willamette and Umpqua Valleys	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. • Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management
	Soil types	Heavier soils and mesic to slightly xeric soil moisture levels.	See above	See above

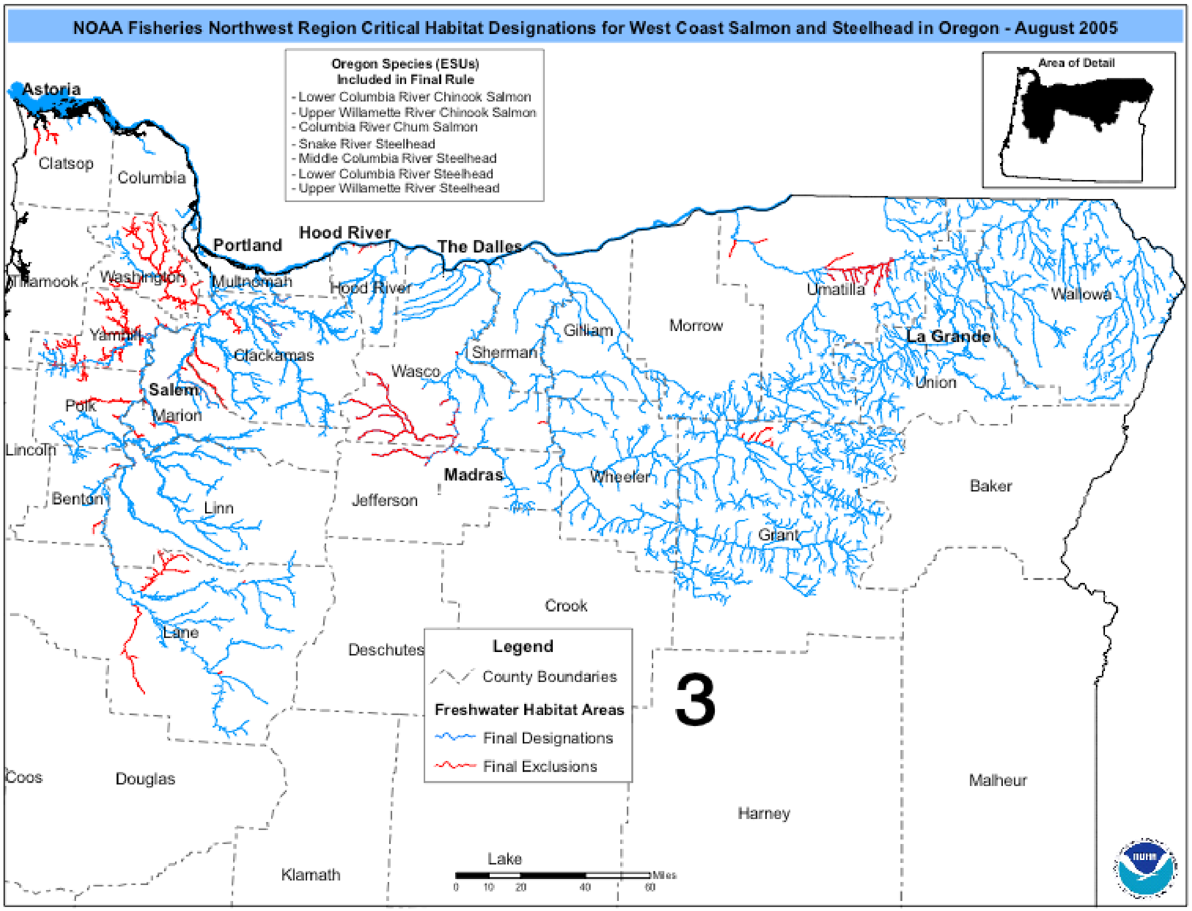
Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
	Other requirements	Not shade tolerant	See above	See above
	Flowering period	May to July	See above	See above
McFarlane's Four o'clock	General habitat needs	Low to mid-elevation river canyon grassland habitats in west-central Idaho and northeastern Oregon, on gravelly to loamy and sandy soils. Sites are generally dry and open, though scattered shrubs may be present. Generally consists of bunchgrass communities.	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Earthmoving to create shallow pools or breaking tile for wetland restorations may crush or uproot some plants. • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. • Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	390 – Riparian herbaceous cover 391 – Riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management
	Soil types	Specific types not identified in recovery plan	See above	See above

Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
	Other requirements	Vulnerable to grazing and exotic weed species; needs maintenance of fire regimes	See above	See above
	Flowering period	May through June	See above	See above
Spalding’s catchfly	General habitat needs	Mesic grasslands with prairie or steppe vegetation; canyon grasslands. Typically associated with grasslands dominated by native perennial grasses such as Idaho or Rough fescue.	• Vehicle traffic and people walking in riparian area during CREP practice completion may crush plants. • Soil disturbance from tillage, fence construction, tree and shrub planting, moisture conservation activities may crush some plants or affect seed-soil contact and ability to germinate. • Mowing to reduce competition may prevent some plants from flowering. • CREP plantings may compete with and eventually shade out plants • Herbicide applications for moisture conservation may kill or weaken plants • Livestock exclusion may reduce browsing/trampling of plants • Livestock exclusion may result in increased thatch and reduce seed germination • Livestock exclusion may facilitate greater competition with plants in riparian area • Required noxious weed control on CREP lands should reduce competition from certain weed species. • Construction of off-stream watering facilities and livestock concentrations around off-stream watering facilities may result in trampling of some plants outside of CREP area.	390 – Riparian herbaceous cover 391 – riparian forest buffer 393 – Filter strip 414 – Brush management 449 – Irrigation water management 472 – Use exclusion 490 – Forest site preparation 516 - Pipeline 595 – Pest management 612 – Tree and shrub establishment 645 – Upland wildlife habitat management
	Soil types	Not specified	See above	See above
	Other requirements		See above	See above

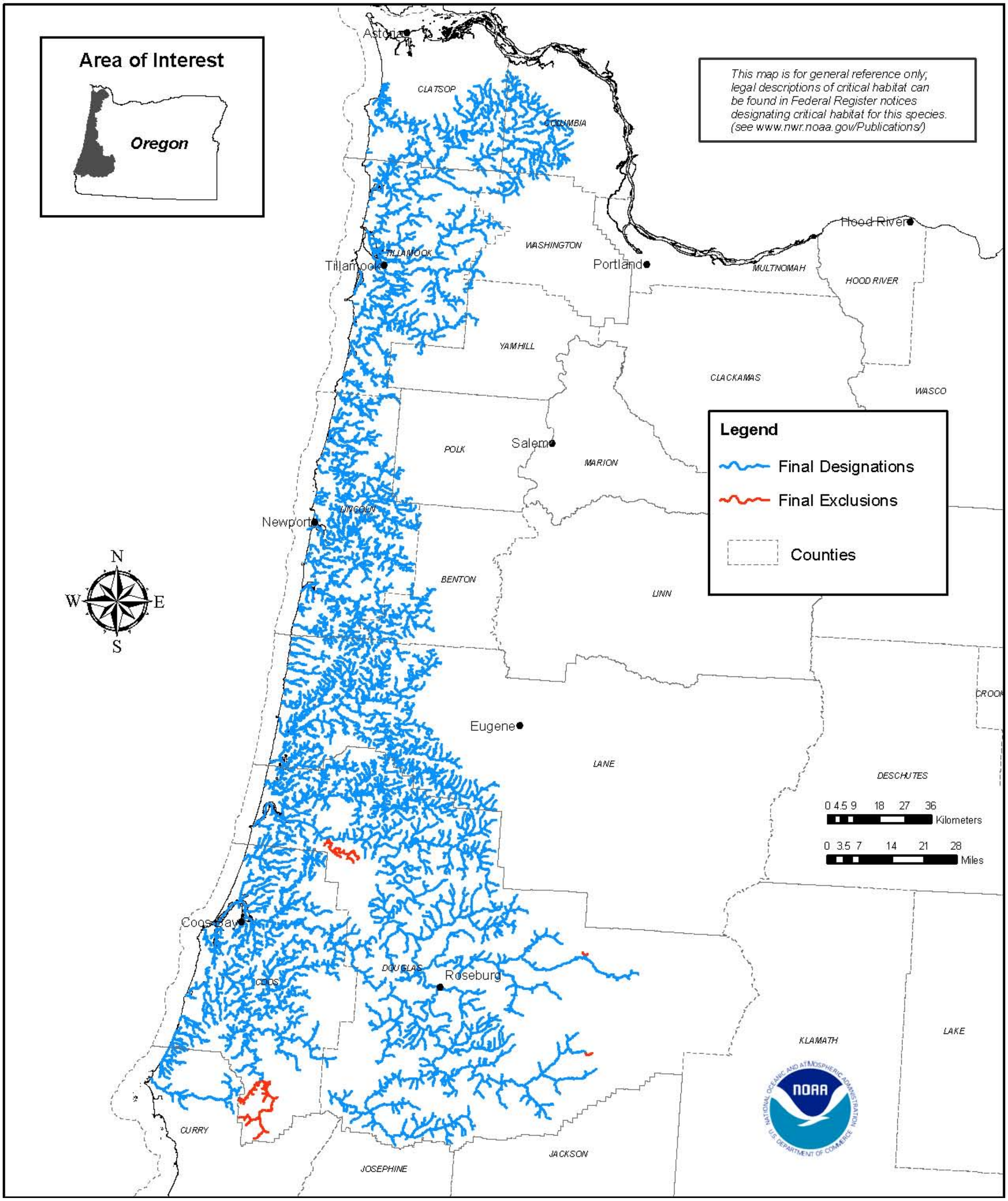
Species	Life history component	Species Needs by life history component	Activities that may affect life history component	Applicable FOTG practices
	Flowering period	June to September	See above	See above

APPENDIX C: Critical Habitat Maps

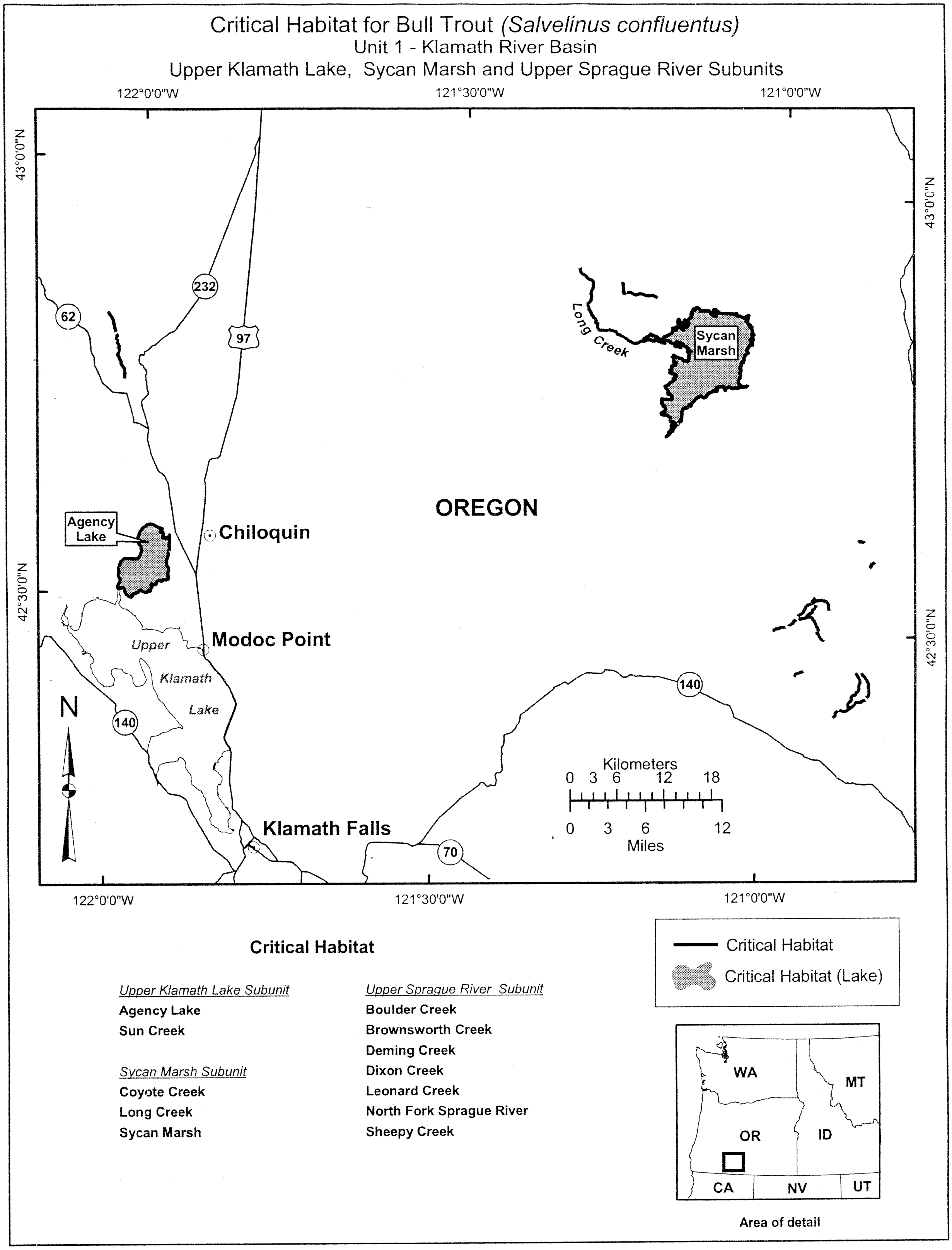
Appendix C. Critical Habitat Maps
Anadromous Fish

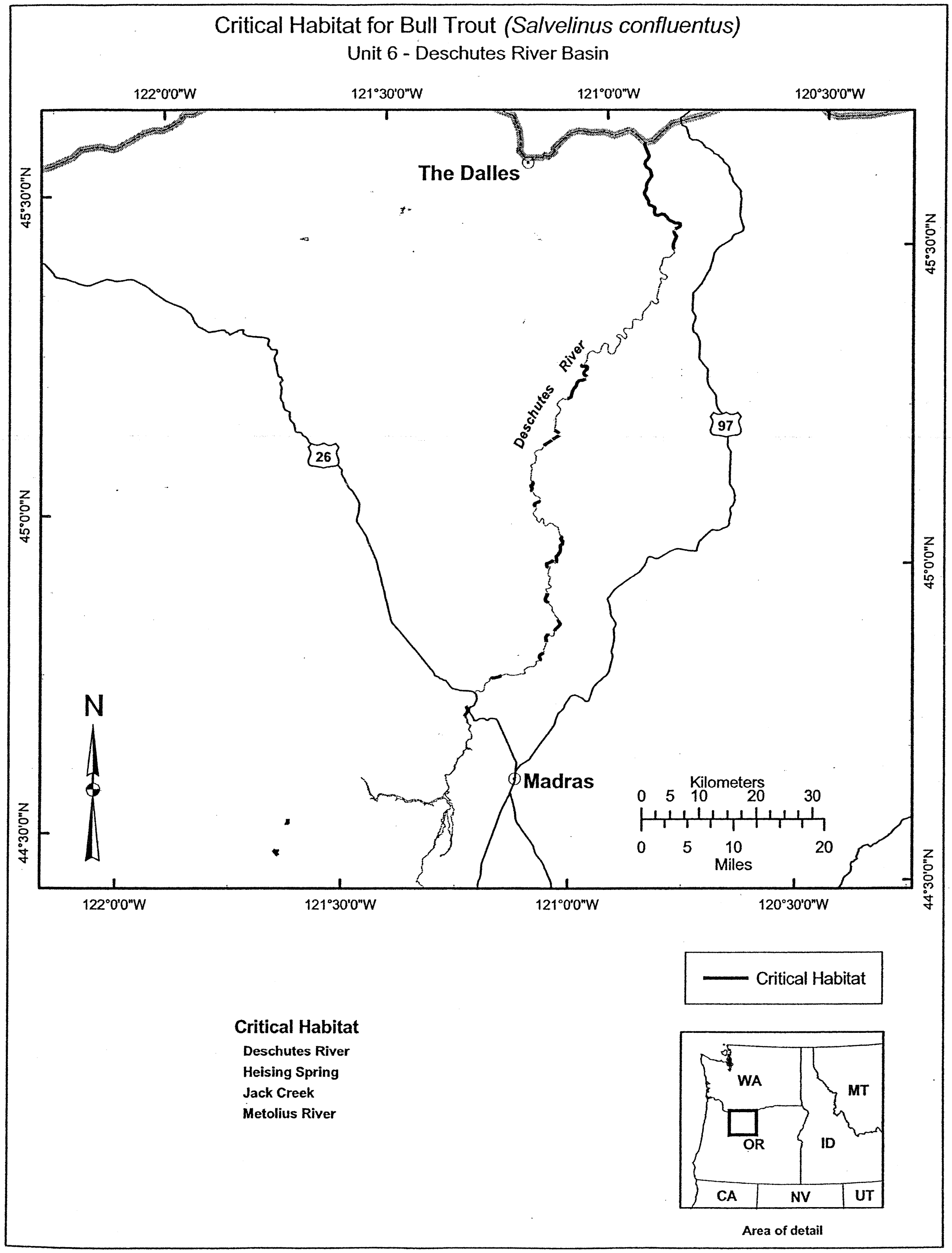


ESA Critical Habitat Designation for Oregon Coast Coho Salmon - February 2008



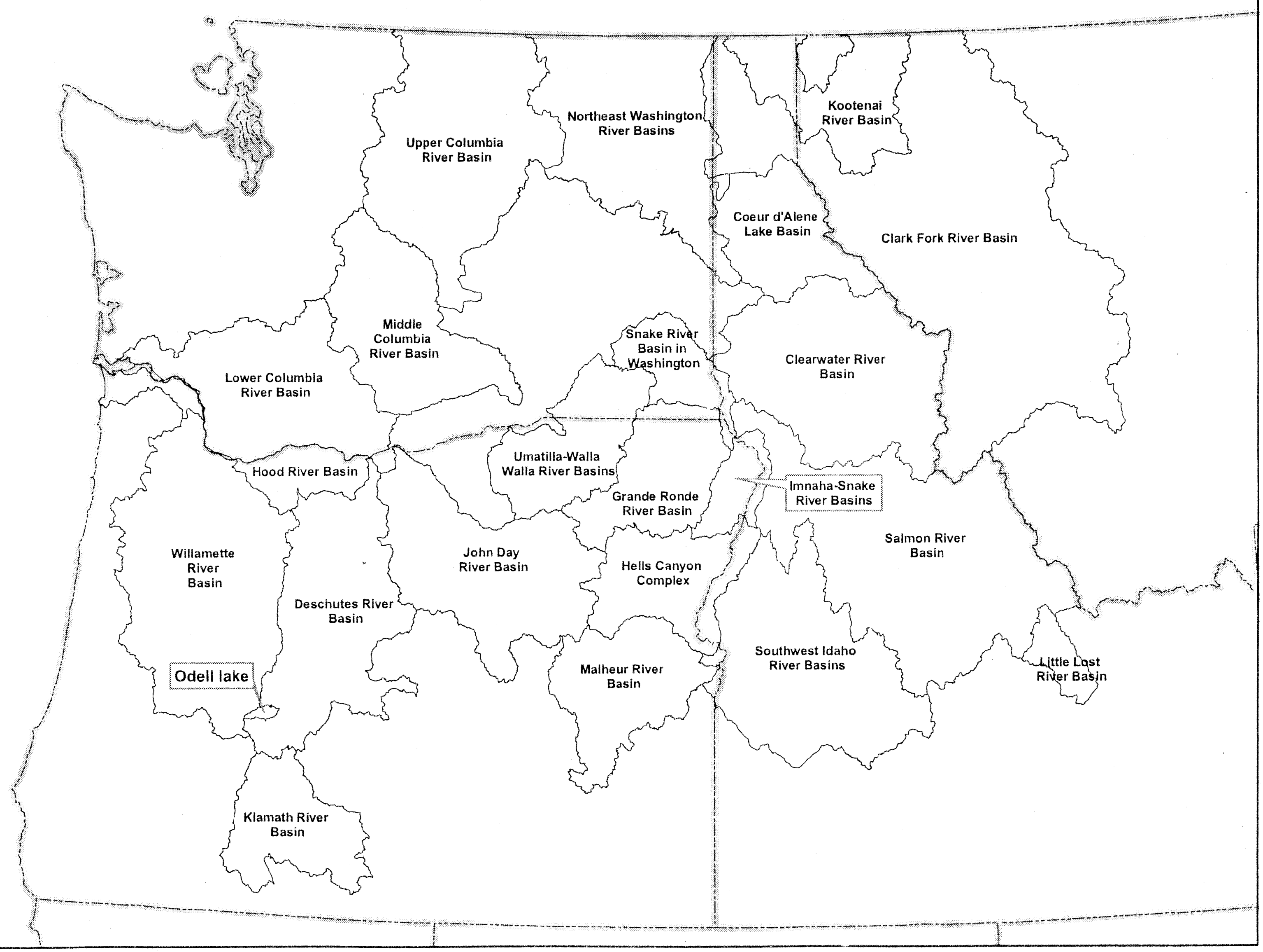
Bull Trout


Critical Habitat for Bull Trout (Salvelinus confluentus)
Unit 1 - Klamath River Basin
Upper Klamath Lake, Sycan Marsh and Upper Sprague River Subunits
122°0'0"W
121°30'0"W
121°0'0"W
43°0'0"N
42°30'0"N
232
62
97
Long Creek
Sycan Marsh
OREGON
Agency Lake
Chiloquin
Modoc Point
Upper Klamath Lake
N
140
140
70
Kilometers
0 3 6 12 18
0 3 6 12
Miles
Klamath Falls
Critical Habitat
Upper Klamath Lake Subunit
Agency Lake
Sun Creek
Sycan Marsh Subunit
Coyote Creek
Long Creek
Sycan Marsh
Upper Sprague River Subunit
Boulder Creek
Brownsworth Creek
Deming Creek
Dixon Creek
Leonard Creek
North Fork Sprague River
Sheepy Creek
Critical Habitat
Critical Habitat (Lake)
WA
MT
OR
ID
CA
NV
UT
Area of detail

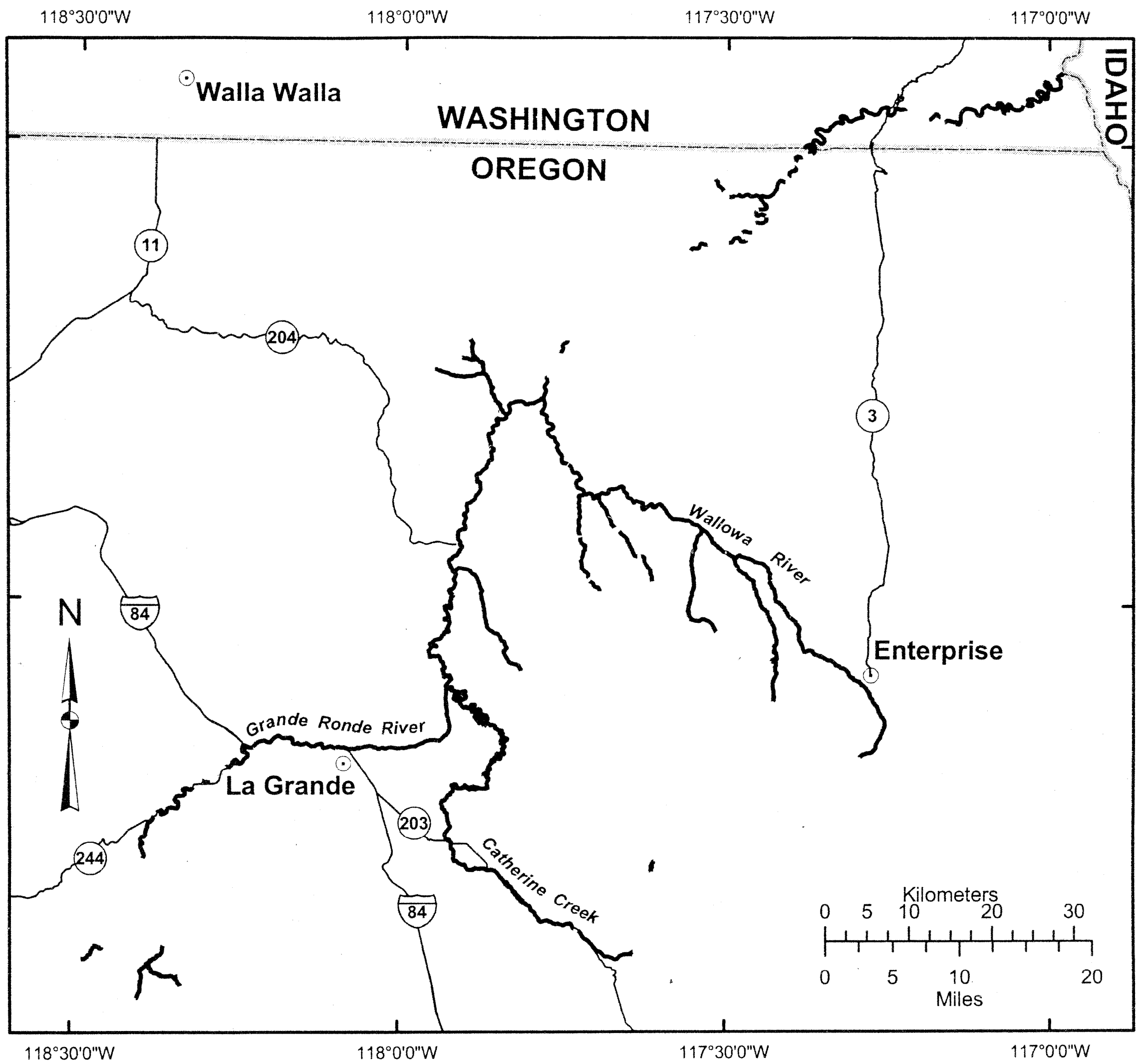


Critical Habitat for Bull Trout (Salvelinus confluentus)
Unit 6 - Deschutes River Basin
122°0'0"W
121°30'0"W
121°0'0"W
120°30'0"W
45°30'0"N
45°0'0"N
44°30'0"N
The Dalles
Deschutes River
26
97
Madras
N
Kilometers
0 5 10 20 30
0 5 10 20
Miles
Critical Habitat
Critical Habitat
Deschutes River
Heising Spring
Jack Creek
Metolius River
WA
MT
OR
ID
CA
NV
UT
Area of detail

Bull Trout *(Salvelinus confluentus)* Critical Habitat Unit Index

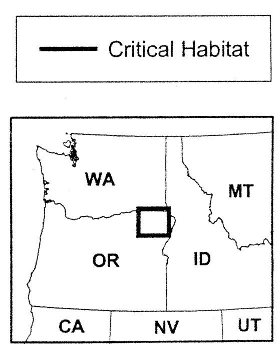


Critical Habitat for Bull Trout *(Salvelinus confluentus)*
Unit 10 - Grande Ronde River Basin

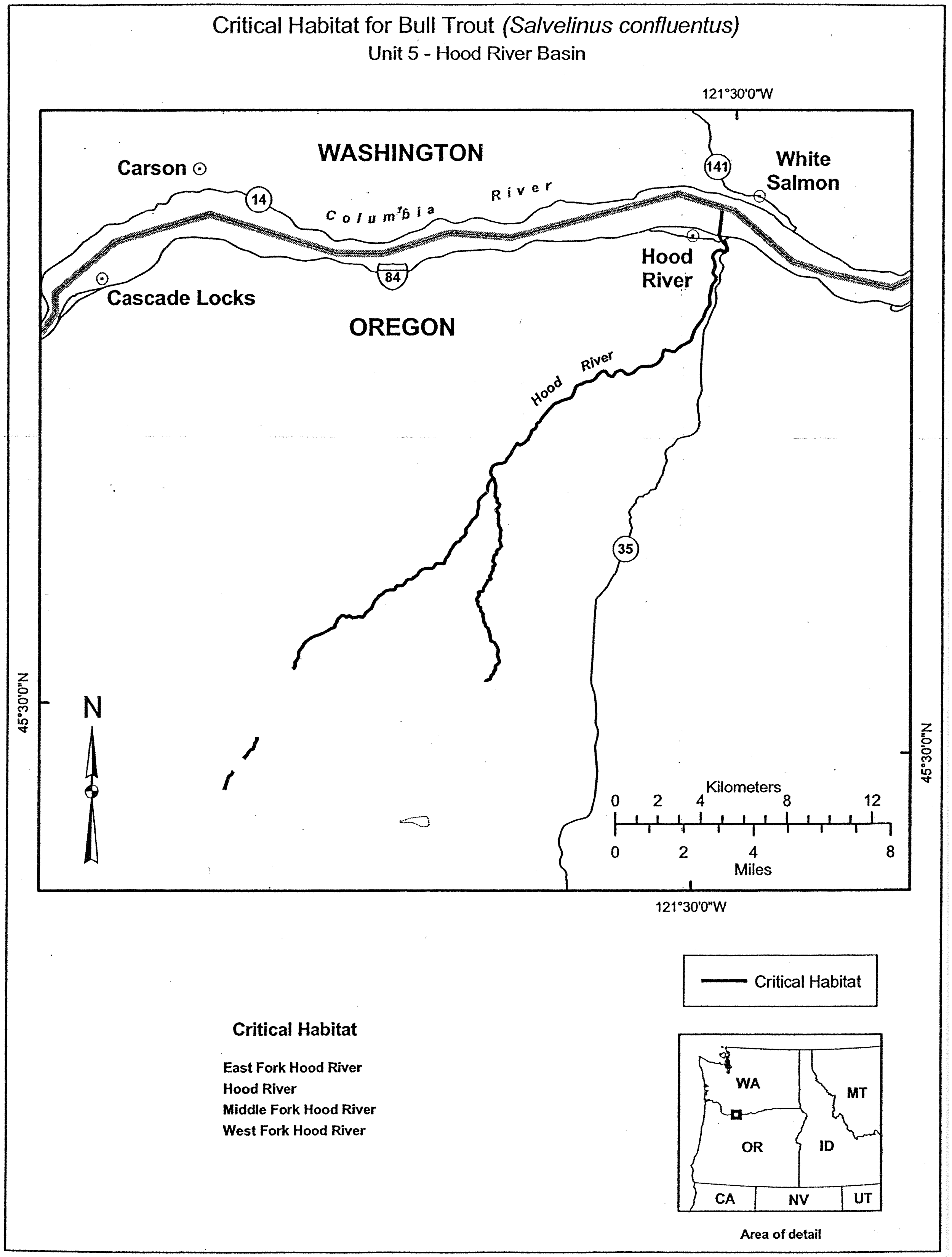


Critical Habitat

Bear Creek
Catherine Creek
Chicken Creek
Deer Creek
Fly Creek
Grande Ronde River
Hurricane Creek
Indian Creek
Limber Jim Creek
Little Bear Creek
Little Fly Creek
Little Lookingglass Creek
Lookingglass Creek
Lookout Creek
Lostine River
Minam River
Mottet Creek
North Fork Catherine Creek
Sheep Creek
South Fork Catherine Creek
Wallowa River
Wenaha River



Area of detail

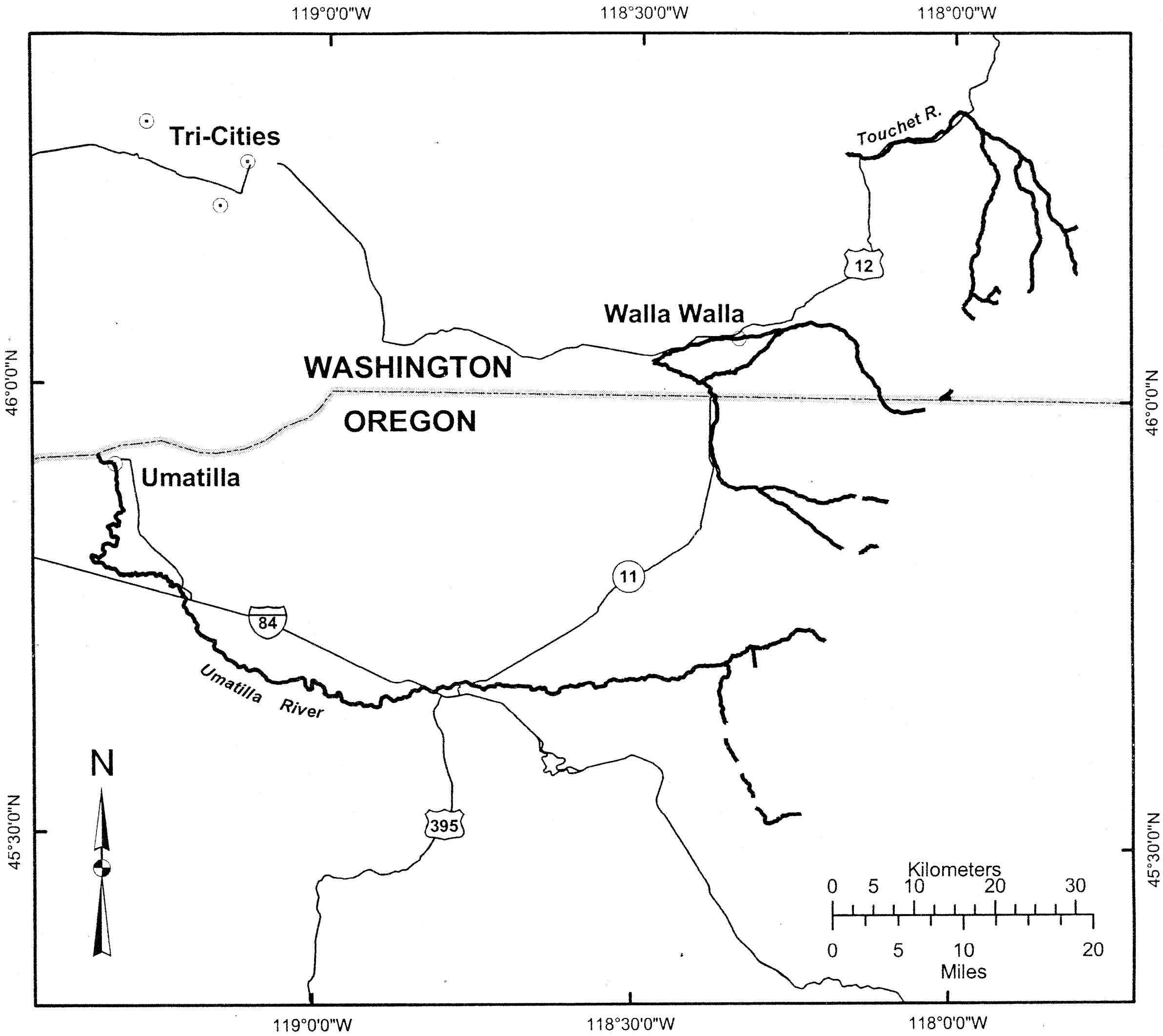


Critical Habitat for Bull Trout (Salvelinus confluentus)
Unit 5 - Hood River Basin
121°30'0"W
WASHINGTON
Carson
14
Columbia River
141
White Salmon
Hood River
84
Cascade Locks
OREGON
Hood River
35
45°30'0"N
N
Kilometers
0 2 4 8 12
0 2 4 8
Miles
121°30'0"W
Critical Habitat
Critical Habitat
East Fork Hood River
Hood River
Middle Fork Hood River
West Fork Hood River
WA
MT
OR
ID
CA
NV
UT
Area of detail

Critical Habitat for Bull Trout *(Salvelinus confluentus)*

Unit 9 - Umatilla - Walla Walla River Basins

Umatilla and Walla Walla Subunits

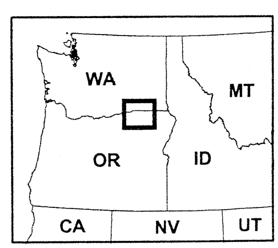


Critical Habitat

Umatilla Subunit
Meacham Creek
North Fork Meacham Creek
Ryan Creek
Umatilla River

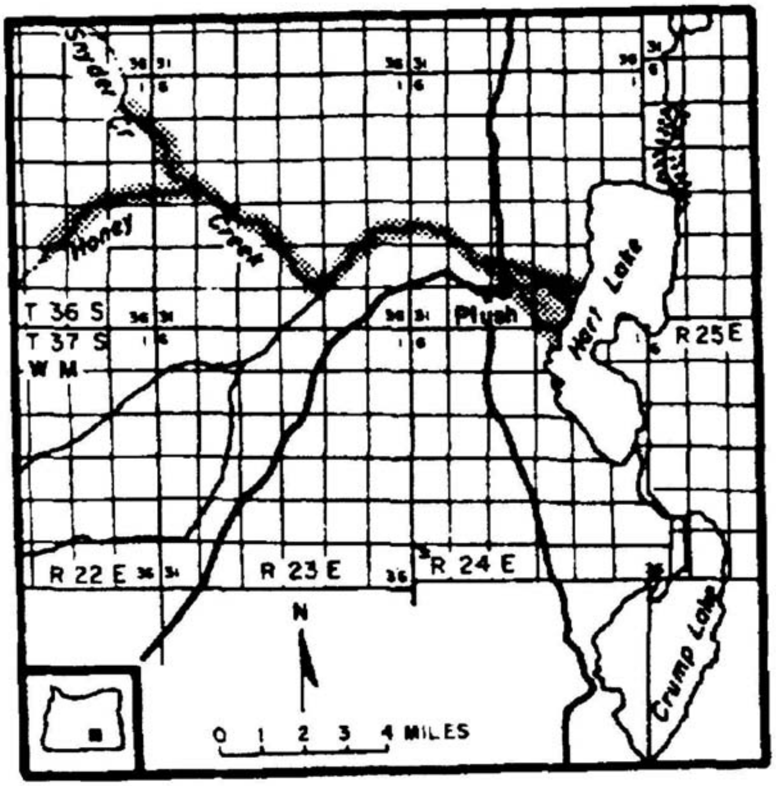
Walla Walla Subunit
Burnt Fork
Griffin Fork
Lewis Creek
Mill Creek
North Fork Touchet River
North Fork Walla Walla River
Paradise Creek
South Fork Touchet River
South Fork Walla Walla River
Spangler Creek
Touchet River
UNNAMED - off Griffin Fork
Walla Walla River
Wolf Fork Touchet River
Yellowhawk Creek

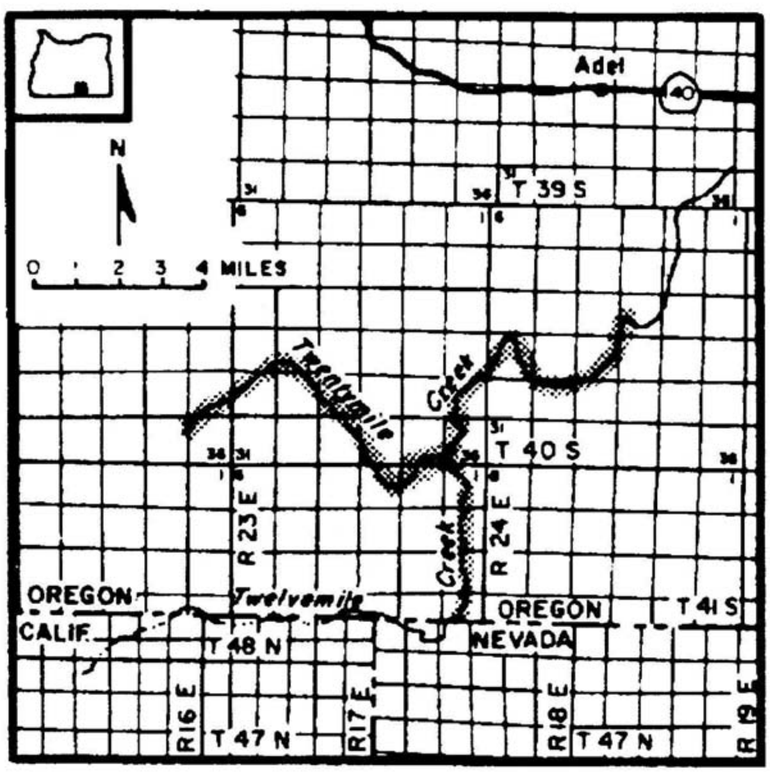
Critical Habitat



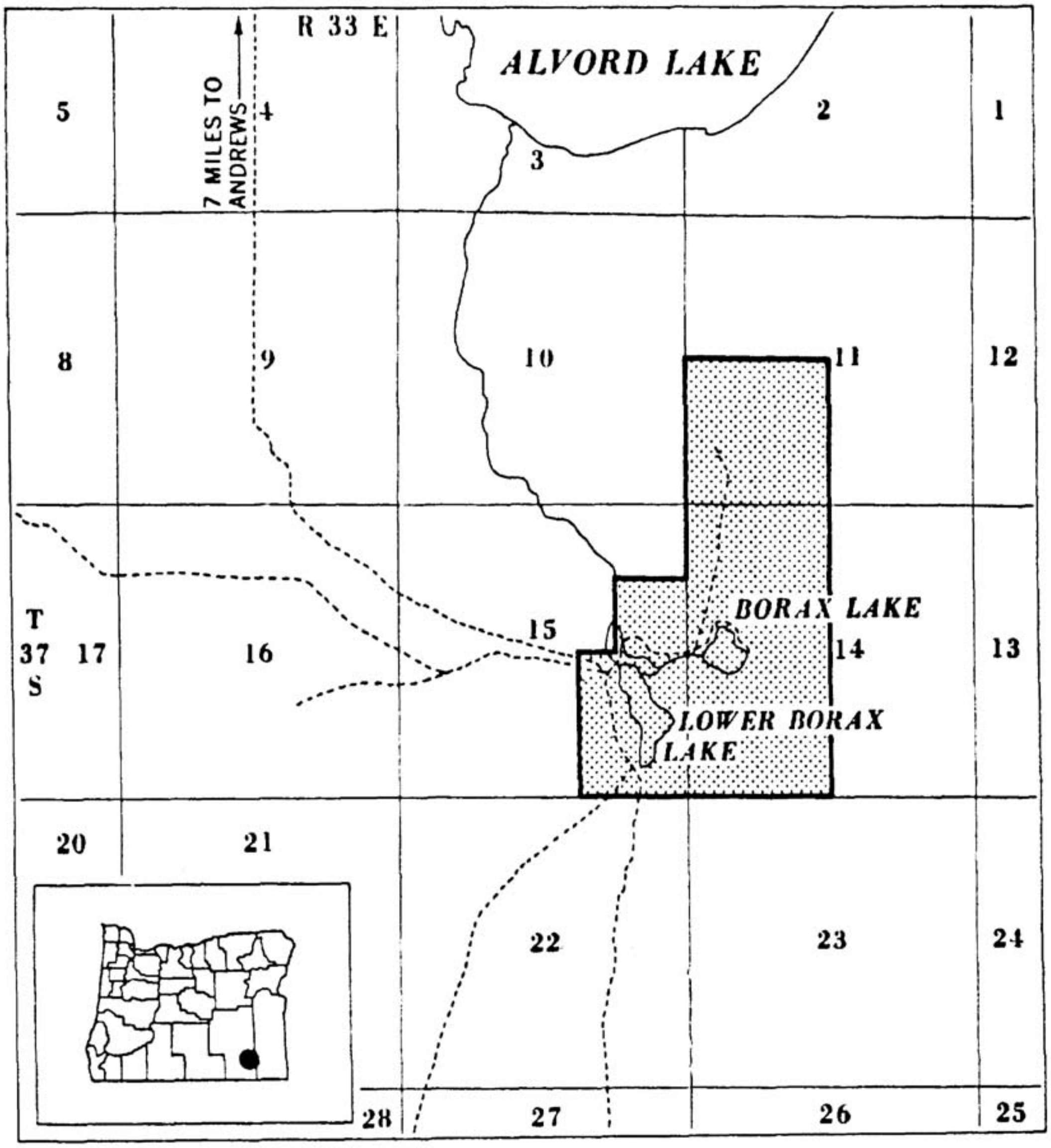
Area of detail

Warner Sucker

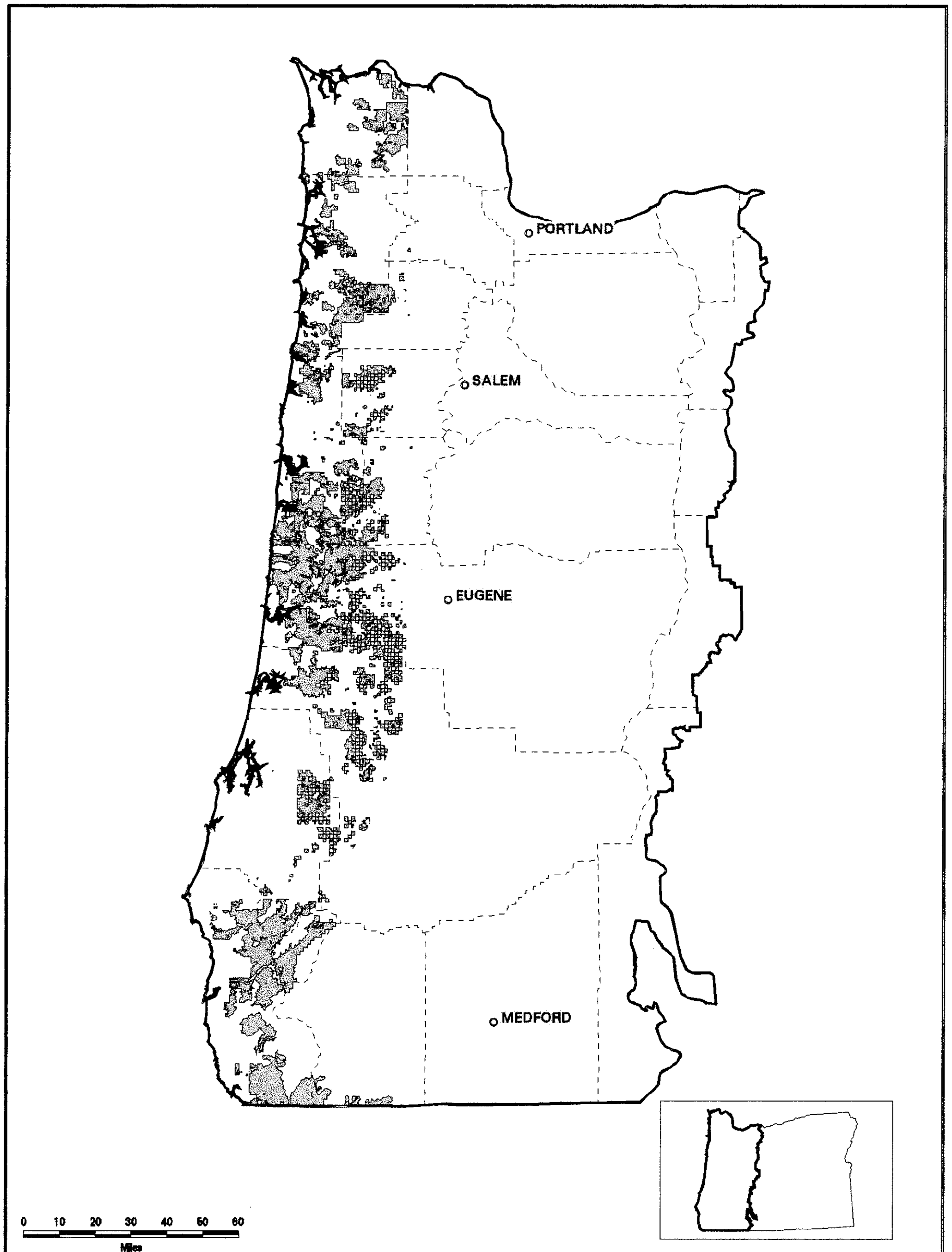




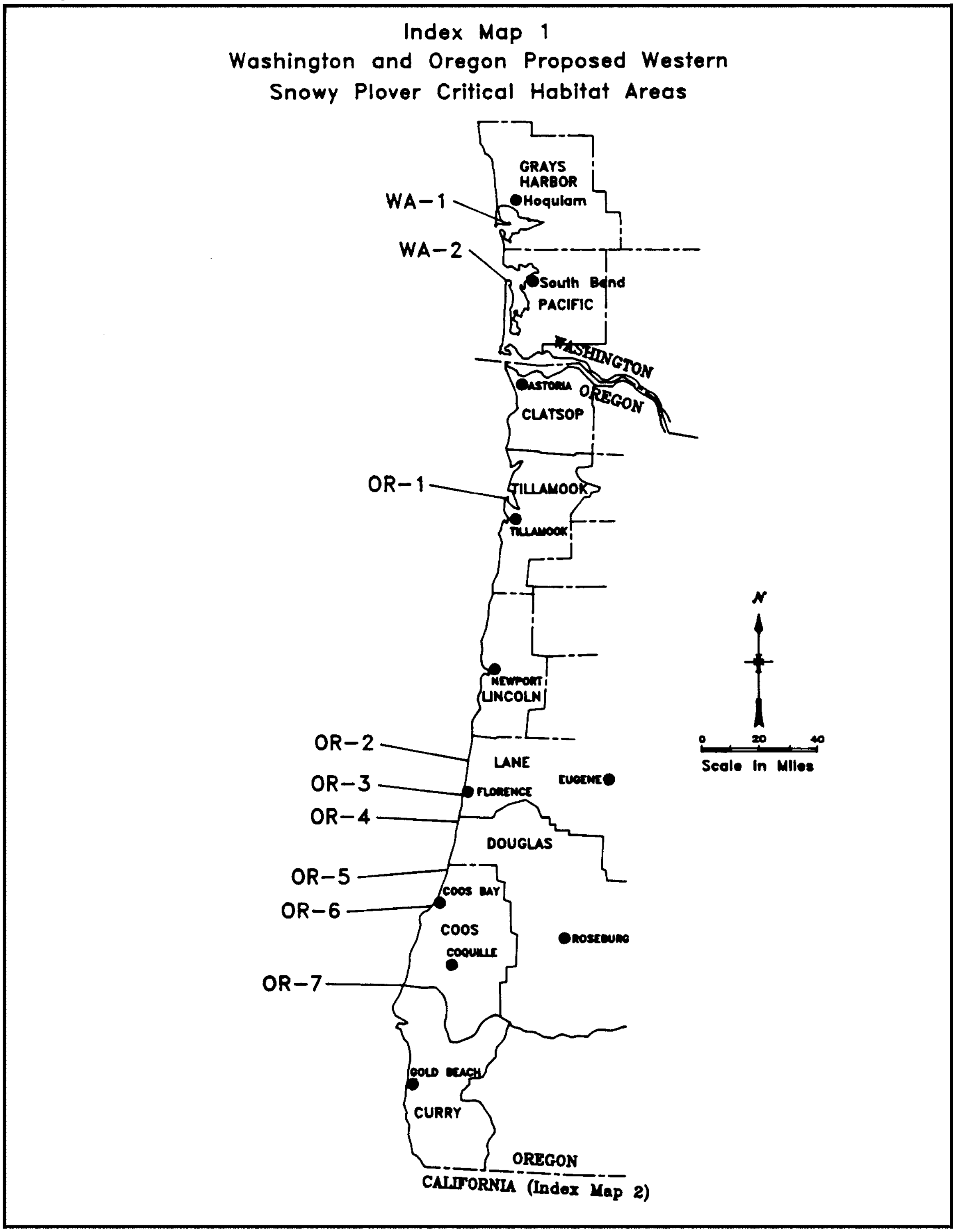
Borax Lake Chub

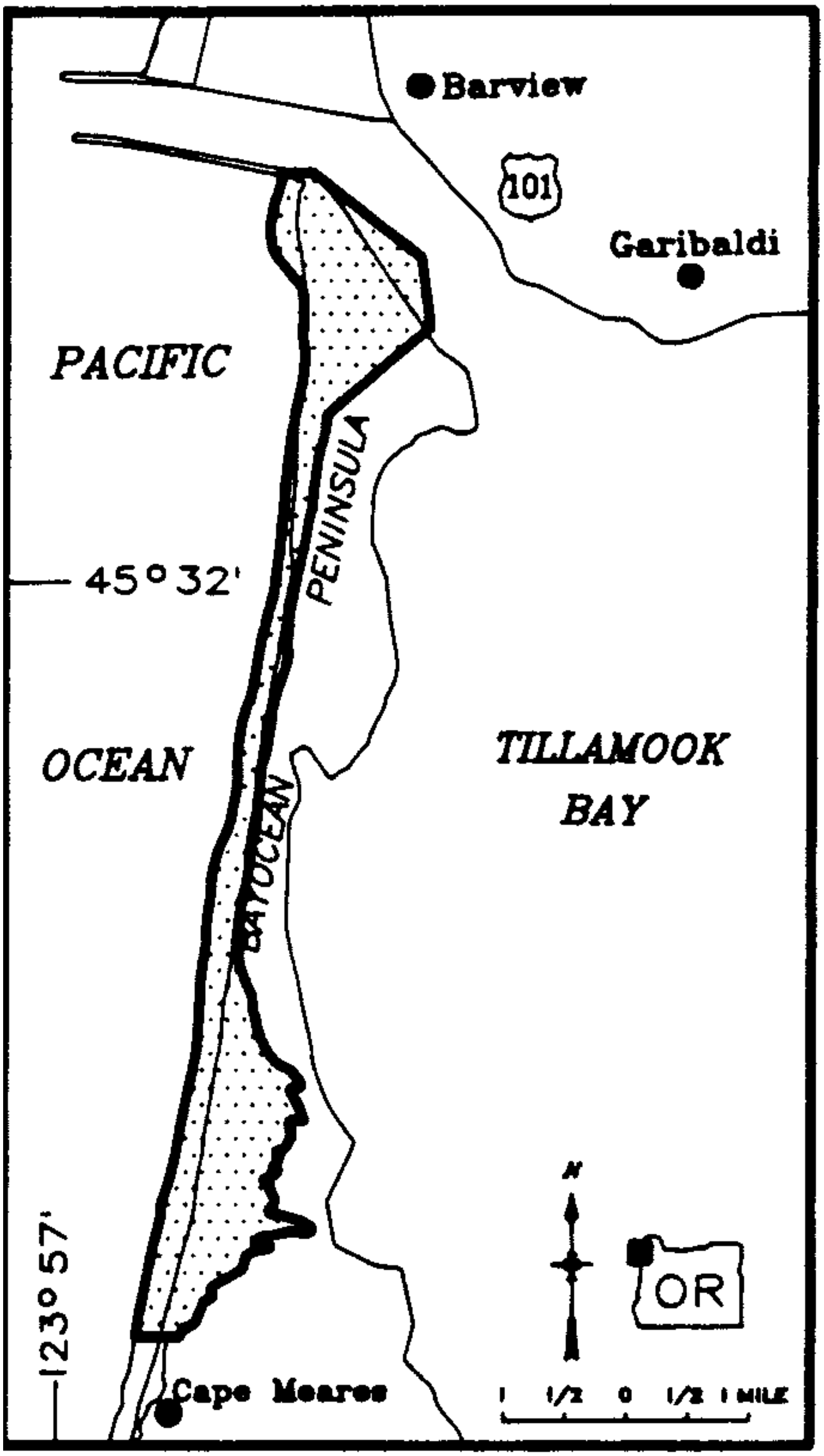


Marbled Murrelet

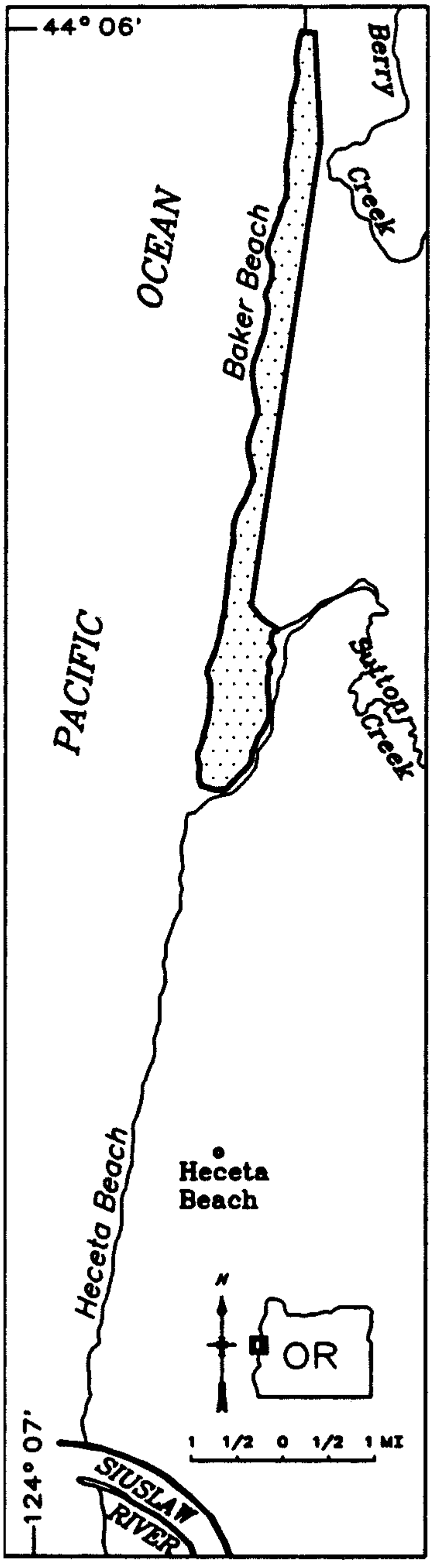


General configuration of final critical habitat in Oregon

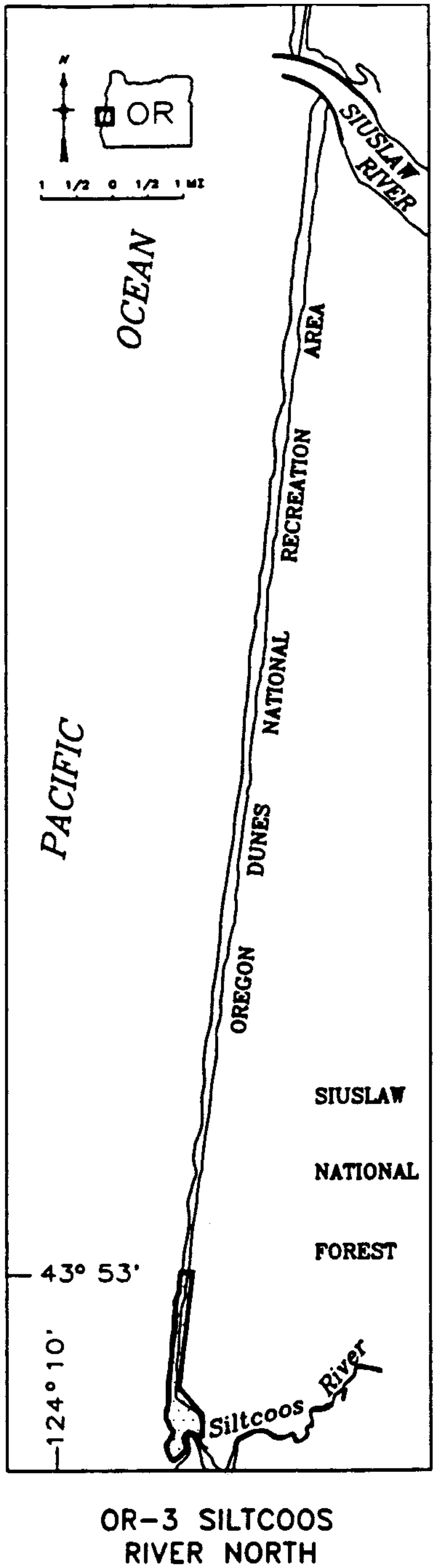

Index Map 1
Washington and Oregon Proposed Western
Snowy Plover Critical Habitat Areas
GRAYS
HARBOR
Hoquiam
WA-1
WA-2
South Bend
PACIFIC
WASHINGTON
OREGON
ASTORIA
CLATSOP
OR-1
TILLAMOOK
TILLAMOOK
NEWPORT
LINCOLN
N
0
20
40
Scale in Miles
OR-2
LANE
OR-3
FLORENCE
EUGENE
OR-4
DOUGLAS
OR-5
COOS BAY
OR-6
COOS
ROSEBURG
COQUILLE
OR-7
GOLD BEACH
CURRY
OREGON
CALIFORNIA (Index Map 2)



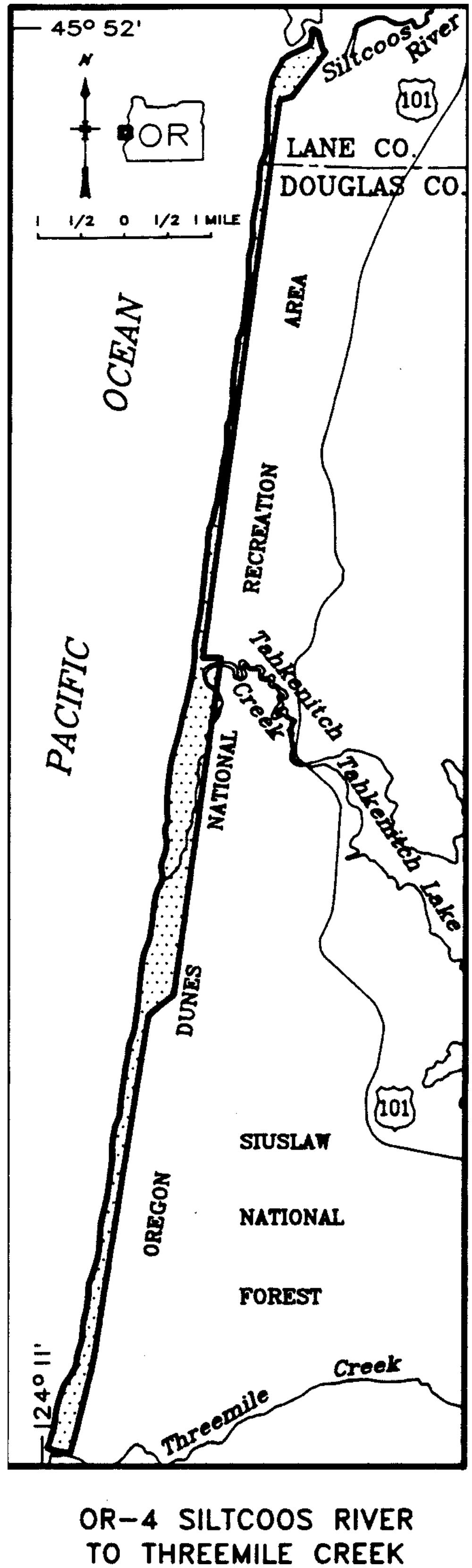
OR—1 BAYOCEAN SPIT



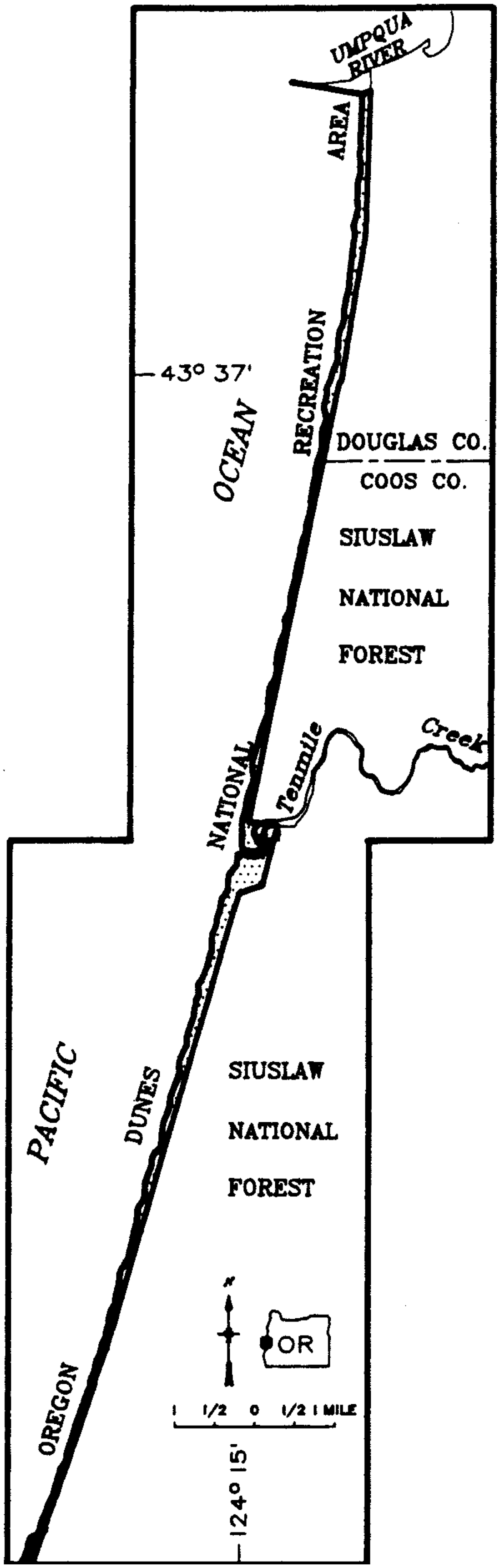
OR–2 HECETA HEAD
TO SUTTON CREEK

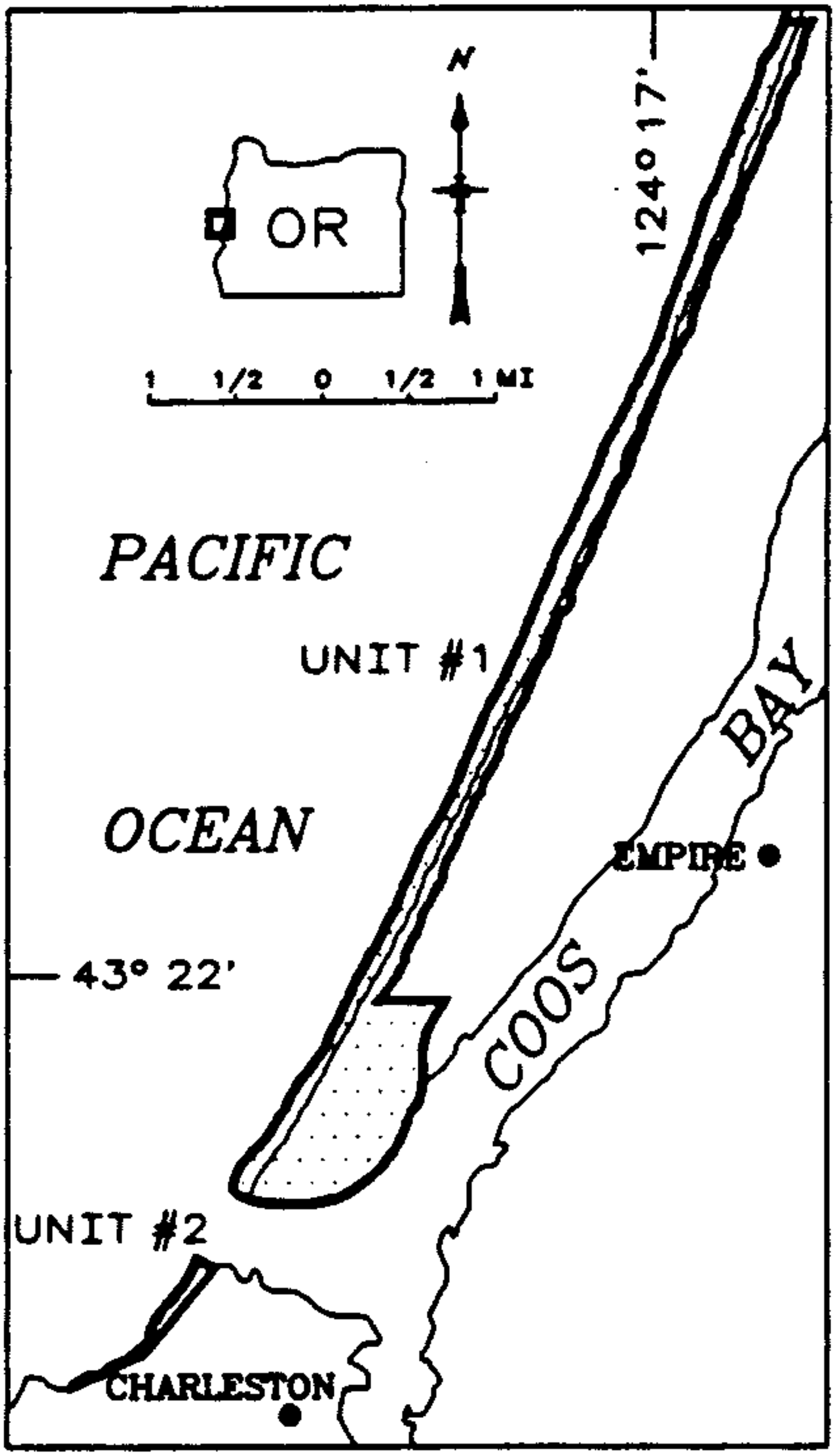


OR–3 SILTCOOS RIVER NORTH

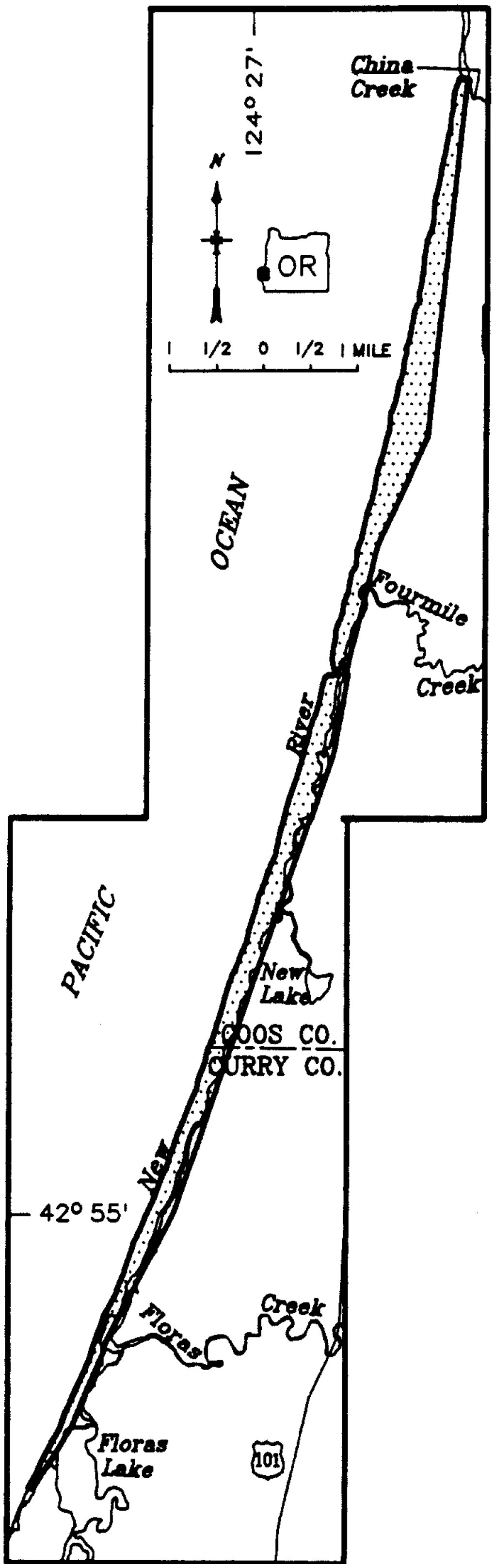


OR–4 SILTCOOS RIVER TO THREEMILE CREEK

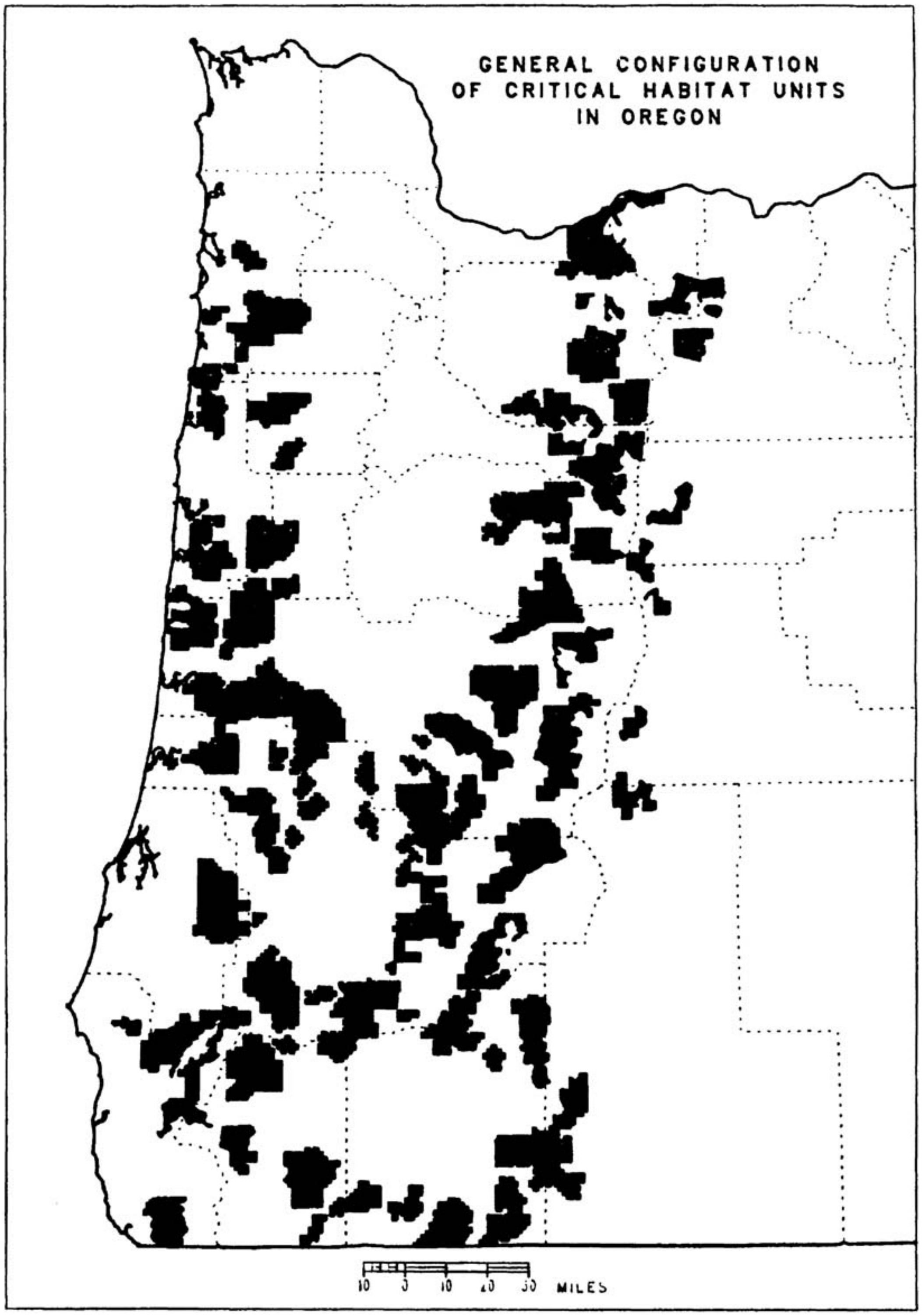

UMPQUA
RIVER
AREA
RECREATION
43° 37'
OCEAN
DOUGLAS CO.
COOS CO.
SIUSLAW
NATIONAL
FOREST
Creek
Tenmile
NATIONAL
DUNES
PACIFIC
SIUSLAW
NATIONAL
FOREST
OR
1 1/2 0 1/2 1 MILE
124° 15'
OREGON



OR-6 HORSFALL BEACH
TO COOS BAY UNIT #1,#2


124° 27'
China Creek
N
OR
1 1/2 0 1/2 1 MILE
OCEAN
Fourmile Creek
River
PACIFIC
New Lake
COOS CO.
CURRY CO.
New
42° 55'
Floras Creek
Floras Lake
101

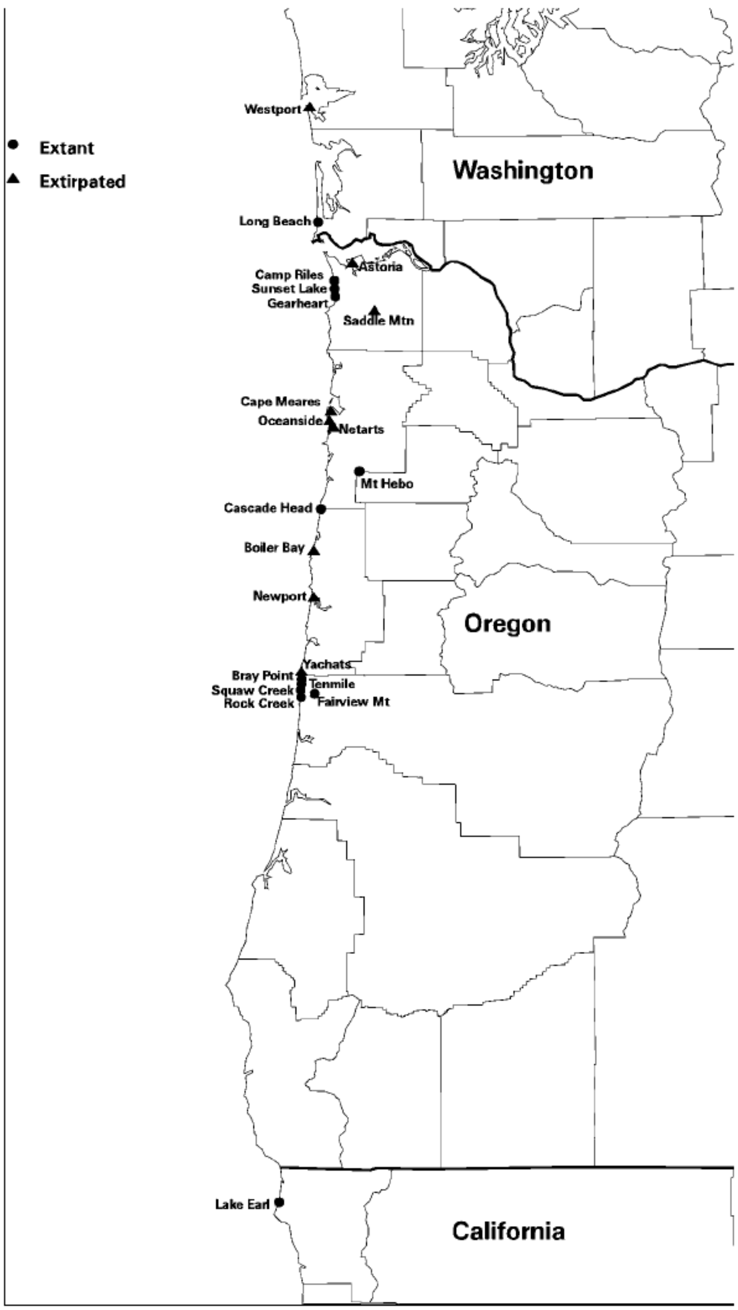
Northern Spotted Owl

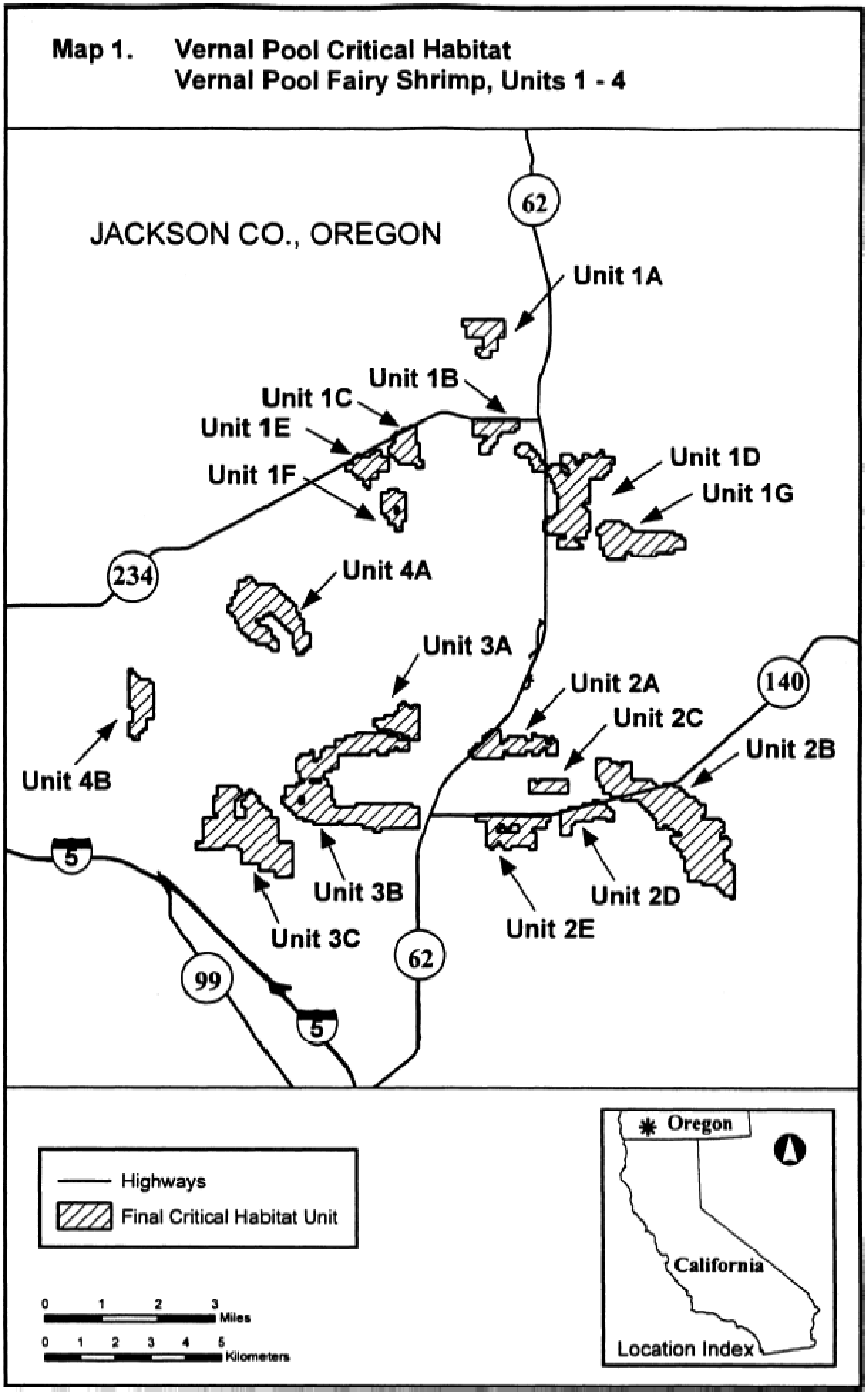


Distribution of Oregon Silverspot butterfly and description of critical habitat

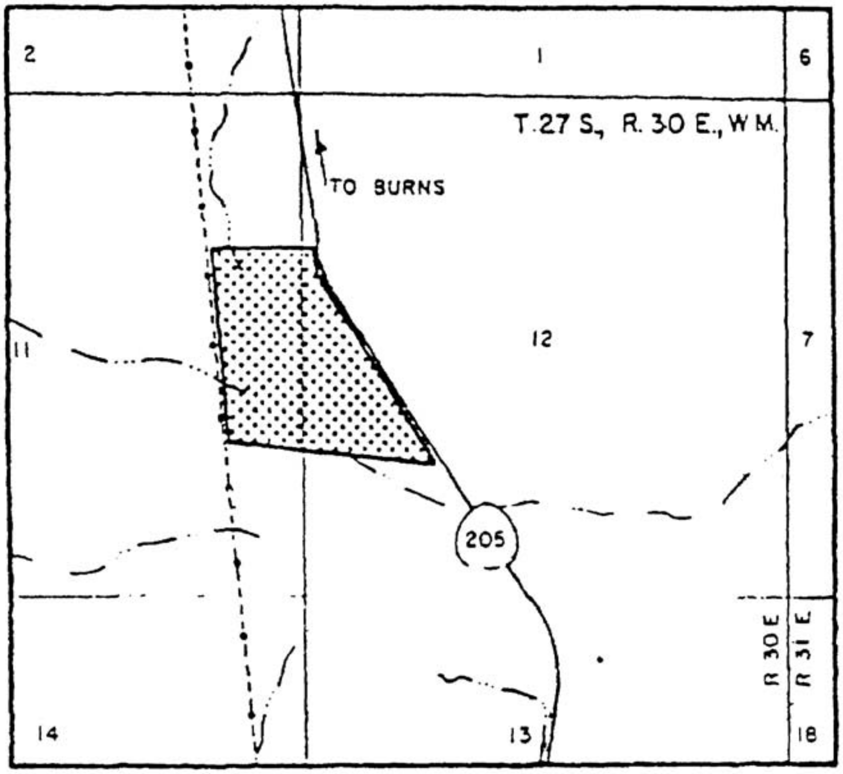
Oregon. Lane County T. 16 S.. R.12 W. Those portions of section *15* and of the south half of section 10 which are west of a line parallel to, and 1500 feet west of, the eastern section boundaries of sections 10 and 15.

Distribution of the Oregon silverspot butterfly.




Map 1. Vernal Pool Critical Habitat
Vernal Pool Fairy Shrimp, Units 1 - 4
JACKSON CO., OREGON
62
Unit 1A
Unit 1B
Unit 1C
Unit 1E
Unit 1F
Unit 1D
Unit 1G
234
Unit 4A
Unit 3A
Unit 2A
140
Unit 2C
Unit 2B
Unit 4B
5
Unit 3B
Unit 2D
Unit 2E
Unit 3C
62
99
5
Highways
Final Critical Habitat Unit
0 1 2 3 Miles
0 1 2 3 4 5 Kilometers
Oregon
California
Location Index

Malheur Wirelettuce



APPENDIX D: Oregon Threatened and Endangered Plant Survey Form

Appendix D. Oregon Threatened and Endangered Plant Survey Form

USDA NRCS
Natural Resources Conservation Service

Oregon Threatened & Endangered Plant Survey Form

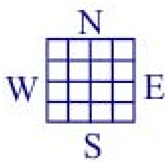
(Attach additional pages as necessary)

GENERAL INFORMATION

Project ID:______________________________

County:______________ Field Office:______________

Survey Location:______________________________



Section:________ Township:________ Range:________

Lat:______________ Lon:______________

UTM:______________ Elevation:______________

Quad Sheet:______________________________

Survey Date(s):______________________________

Surveyor(s):______________________________

Job Title(s):______________________________

Project Description:______________________________

____

____

____

____

____

____

____

Practices:______________________________

____

____

NRCS FINDING:

- [ ] NO EFFECT (BE required– No Consultation)
- [ ] MAY EFFECT, NOT LIKELY TO ADVERSELY AFFECT (BE required–Informal)
- [ ] MAY EFFECT, LIKELY TO ADVERSELY AFFECT (BA required– Formal)

APPENDIX E: Small Stream and Pond Herbicide Analysis Spreadsheets

Not possible if HQ<1, not likely if HQ <100, may be likely if HQ> 100.
If 1 < HQ < 100, then exposure above the chronic mathmatically possible, but not likely, given the amount of herbicide loss resulting from soil breakdown and adsorption, plant uptake, volatilization, and the fact that in reality most stream delivery occurs in rainfall driven pulses.
If the HQ is greater than 100, then chronic exposure may be likely, depending on how the site specific project is designed.

Fish Chronic Toxicity Risk	
Individual herbicide chronic exposure Hazard Quotients (HQ) from each worksheet	
Chlorsulfuron	0.00057
Clopyralid	0.00146
Glyphosate	0.14178
Hexazinone	0.00172
Imazapyr	0.00365
Metsulfuron	0.00024
Picloram	0.20833
Sethoxydim	0.04557
Sulfometuron	0.00237
Triclopyr	0.34722
2,4-D amine	0.262758128
2,4-D ester	0.262758128
Hazard Index (sum of individual HQ values)	1.278

Invertebrate Chronic Toxicity Risk	
Individual herbicidechronic exposure Hazard Quotients (HQ) from each worksheet	
Chlorsulfuron	0.000391
Clopyralid	0.001359
Glyphosate	0.046542
Hexazinone	0.001458
Imazapyr	0.000000
Metsulfuron	0.000047
Picloram	0.011574
Sethoxydim	0.045071
Sulfometuron	0.002639
Triclopyr	0.023496
2,4-D amine	0.000911442
2,4-D ester	0.07292
Hazard Index (sum of individual HQ values)	0.206

Algae Chronic Toxicity Risk	
Individual herbicide chronic exposure Hazard Quotients (HQ) from each worksheet	
Chlorsulfuron	0.78124
Clopyralid	0.04529
Glyphosate	0.24578
Hexazinone	7.29154
Imazapyr	0.00668
Metsulfuron	0.10416
Picloram	0.13587
Sethoxydim	0.04687
Sulfometuron	2.58148
Triclopyr	0.05297
2,4-D amine	0.11218
2,4-D ester	0.112177509
Hazard Index (sum of individual HQ values)	11.516

Macrophyte Chronic Toxicity Risk	
Individual herbicidechronic exposure Hazard Quotients (HQ) from each worksheet	
Chlorsulfuron	312.49449
Clopyralid	0.00035
Glyphosate	0.72915
Hexazinone	8.33319
Imazapyr	6.00951
Metsulfuron	29.29636
Picloram	0.31249
Sethoxydim	0.00651
Sulfometuron	39.58264
Triclopyr	0.08928
2,4-D amine	0.11218
2,4-D ester	0.112177509
Hazard Index (sum of individual HQ values)	397.08

Herbicide	Typical Application Rate (pounds/acre)	Expected Typ. Runoff Concentration (mg/l)	Maximum Application Rate (pounds/acre)	*Expected Max. Runoff Concentration (mg/l)	Species Group	Effects Threshold Concentration (mg/l)	Typical Rate HQ values	Max. Rate HQ values
Aminopyralid	0.08	0.07	0.11	0.095652174	Fish	1.36	0.05	0.07
					Aq. Invertebrates	100	0.00	0.00
					Algae	30	0.00	0.00
					Aq. Macrophytes	88	0.00	0.00
Dicamba	0.3	0.26	2.00	1.74	Fish	1.4	0.2	1.2
					Aq. Invertebrates	0.38	0.7	4.6
					Algae	0.0049	53.2	354.9
					Aq. Macrophytes	0.25	1.0	7.0
Glyphosate	2	0.48	8	1.92	Fish	0.5	1.0	3.8
					Aq. Invertebrates	78	0.006	0.025
					Algae	0.89	0.5	2.2
					Aq. Macrophytes	3	0.2	0.6
Hexazinone	2	1.739130435	4	3.47826087	Fish	12	0.1	0.3
					Aq. Invertebrates	29	0.1	0.1
					Algae	0.004	434.8	869.6
					Aq. Macrophytes	0.004	434.8	869.6
Imazapic	0.13	0.11	0.1875	0.16	Fish	100	0.0	0.0
					Aq. Invertebrates	96	0.0	0.0
					Algae	2.25	0.1	0.1
					Aq. Macrophytes	0.00258	43.8	63.2
Imazapyr	0.45	0.39	1.5	1.30	Fish	5	0.1	0.3
					Aq. Invertebrates	100	0.004	0.01
					Algae	0.02	20	65
					Aq. Macrophytes	0.013	30	100
Picloram	0.35	0.304347826	1	0.869565217	Fish	0.04000	8	22
					Aq. Invertebrates	2.68000	0	0
					Algae	0.23000	1	4
					Aq. Macrophytes	0.10000	3	9
Triclopyr	1	0.869565217	10	8.695652174	Fish	0.21	4.1	41.4
					Aq. Invertebrates	13.9	0.1	0.6
					Algae	0.42	2.1	20.7
					Aq. Macrophytes	0.42	2.1	20.7

* Formula for extrapolation was obtained by treating application rate as the independent variable, runoff concentration as the dependent variable, and solving for the slope of the line intersecting 0,0 (no herbicide in runoff if none applied); data for sulfometuron from USGS (2001, http://or.water.usgs.gov/pubs_dir/WRIR01-4065/wri014065.pdf), figure 4.

Equation for slope of line is: 0.2 mg/l/0.23 lbs/acre = 0.87 mg/l in runoff per pound/acre applied

	App. Rate (pounds/acre)	Precipitation Rate	Fish	Inverts	Algae	Aq. Plants	Low WCR	soil	Lo Wa Conc (mg/l)	Hi WCR	Soil Type	Hi Wa Conc (mg/l)
			Effects Threshold (mg/l)									
Clopyralid	Typical											
	0.35	15	5	21	0.69	0.69	0.0000	loam	0.00000	0.004	clay	0.0014
		50	5	21	0.69	0.69	0.0070	loam	0.00245	0.017	sand	0.0060
		150	5	21	0.69	0.69	0.0100	clay	0.00350	0.058	sand	0.0203
	High											
	0.5	15	5	21	0.69	0.69	0.0000	loam	0.00000	0.004	clay	0.0020
		50	5	21	0.69	0.69	0.0070	loam	0.00350	0.017	sand	0.0085
		150	5	21	0.69	0.69	0.0100	clay	0.00500	0.058	sand	0.0290
Glyphosate	Typical											
	2	15	0.5	78	0.89	3	0.0011	clay	0.00220	0.006	sand	0.0120
		50	0.5	78	0.89	3	0.0180	clay	0.03600	0.056	sand	0.1120
		150	0.5	78	0.89	3	0.0924	clay	0.18480	0.227	sand	0.4540
	High											
	8	15	0.5	78	0.89	3	0.0011	clay	0.00880	0.006	sand	0.0480
		50	0.5	78	0.89	3	0.0180	clay	0.14400	0.056	sand	0.4480
		150	0.5	78	0.89	3	0.0924	clay	0.73920	0.227	sand	1.8160
Imazapyr	Typical											
	0.45	15	5	100	0.02	0.013	0.00000	loam	0.00000	0.00005	clay	0.0000
		50	5	100	0.02	0.013	0.00000	loam	0.00000	0.0006	clay	0.0003
		150	5	100	0.02	0.013	0.00010	loam	0.00005	0.017	clay	0.0077

	High 1.5	15	5	100	0.02	0.013	0.00000	loam	0.00000	0.00005	clay	0.0001
		50	5	100	0.02	0.013	0.00000	loam	0.00000	0.0006	clay	0.0009
		150	5	100	0.02	0.013	0.00010	loam	0.00015	0.017	clay	0.0255
Metsulfuron	Typical 0.03	15	4.50	17.00	0.01	0.00016	0.00000	loam	0.00000	0.0001	clay	0.0000
		50	4.50	17.00	0.01	0.00016	0.00005	loam	0.00000	0.0011	clay	0.0000
		150	4.50	17.00	0.01	0.00016	0.00010	loam	0.00000	0.0020	clay	0.0001
	High 0.15	15	4.50	17.00	0.01	0.00016	0.00000	loam	0.00000	0.0001	clay	0.0000
		50	4.50	17.00	0.01	0.00016	0.00005	loam	0.00001	0.0011	clay	0.0002
		150	4.50	17.00	0.01	0.00016	0.00010	loam	0.00002	0.0020	clay	0.0003
Sulfometuron	Typical 0.03	15	1.2	6.1	0.0025	0.00021	0.00000	loam	0.00000	0.0001	clay	0.0000
		50	1.2	6.1	0.0025	0.00021	0.00000	loam	0.00000	0.0008	clay	0.0000
		150	1.2	6.1	0.0025	0.00021	0.00005	loam	0.00000	0.0021	clay	0.0001
	High 0.38	15	1.2	6.1	0.0025	0.00021	0.00000	loam	0.00000	0.0001	clay	0.0000
		50	1.2	6.1	0.0025	0.00021	0.00000	loam	0.00000	0.0008	clay	0.0003
		150	1.2	6.1	0.0025	0.00021	0.00005	loam	0.00002	0.0021	clay	0.0008
Hexazinone	Typical 2	15	12	29	0.004	0.004	0.0000	loam	0.00000	0.032	clay	0.0630
		50	12	29	0.004	0.004	0.0060	loam	0.01200	0.270	clay	0.5400
		150	12	29	0.004	0.004	0.0230	loam	0.04600	0.420	clay	0.8400
	High 4	15	12	29	0.004	0.004	0.0000	loam	0.00000	0.032	clay	0.1260
		50	12	29	0.004	0.004	0.0060	loam	0.02400	0.270	clay	1.0800
		150	12	29	0.004	0.004	0.0230	loam	0.09200	0.420	clay	1.6800

Picloram	Typical												
		15	0.04	2.68	0.23	0.1	0.0000	loam	0.00000	0.019	sand	0.0067
	0.35	50	0.04	2.68	0.23	0.1	0.0120	loam	0.00420	0.098	clay	0.0343
		150	0.04	2.68	0.23	0.1	0.0180	loam	0.00630	0.190	clay	0.0665
	High											
		15	0.04	2.68	0.23	0.1	0.0000	loam	0.00000	0.019	sand	0.0190
	1	50	0.04	2.68	0.23	0.1	0.0120	loam	0.01200	0.098	clay	0.0980
		150	0.04	2.68	0.23	0.1	0.0180	loam	0.01800	0.190	clay	0.1900
2,4-D	Typical											
		15	1	2.5	0.0013	0.0013	0.0000	loam and sanc	0.00000	0.092	clay	0.0920
	1	50	1	2.5	0.0013	0.0013	0.0001	sand	0.00006	0.380	clay	0.3800
		150	1	2.5	0.0013	0.0013	0.0037	loam	0.00373	0.390	clay	0.3900
	High											
		15	1	2.5	0.0013	0.0013	0.0000	loam and sanc	0.00000	0.092	clay	0.1840
	2	50	1	2.5	0.0013	0.0013	0.0001	sand	0.00012	0.380	clay	0.7600
		150	1	2.5	0.0013	0.0013	0.0037	loam	0.00746	0.390	clay	0.7800
Dicamba	Typical											
		15	1.4	0.38	0.0049	0.25	0.0000	loam and sanc	0.00000	0.000	clay	0.0000
	0.3	50	1.4	0.38	0.0049	0.25	0.0000	loam	0.00001	0.000	clay	0.0001
		150	1.4	0.38	0.0049	0.25	0.0001	loam	0.00004	0.000	sand	0.0001
	High											
		15	1.4	0.38	0.0049	0.25	0.0000	loam and sanc	0.00000	0.000	clay	0.0001
	2	50	1.4	0.38	0.0049	0.25	0.0000	loam	0.00005	0.000	clay	0.0003
		150	1.4	0.38	0.0049	0.25	0.0001	loam	0.00026	0.000	sand	0.0008
Triclopyr	Typical											
		15	0.21	13.9	0.42	0.42	0.0170	clay	0.01700	0.018	loam	0.0180
	1	50	0.21	13.9	0.42	0.42	0.0550	sand	0.05500	0.130	clay	0.1300
		150	0.21	13.9	0.42	0.42	0.1100	sand	0.11000	0.320	clay	0.3200
	High											
		15	0.21	13.9	0.42	0.42	0.0170	clay	0.17000	0.018	loam	0.1800

	10	50	0.21	13.9	0.42	0.42	0.0550	sand	0.55000	0.130	clay	1.3000
		150	0.21	13.9	0.42	0.42	0.1100	sand	1.10000	0.320	clay	3.2000
Chlorsulfuron	Typical											
		15	2	10	0.01	0.000047	0.0000	loam	0.00000	0.012	clay	0.0007
	0.056	50	2	10	0.01	0.000047	0.0004	loam	0.00002	0.110	clay	0.0062
		150	2	10	0.01	0.000047	0.0040	loam	0.00022	0.200	clay	0.0112
	High											
		15	2	10	0.01	0.000047	0.0000	loam	0.00000	0.012	clay	0.0030
	0.25	50	2	10	0.01	0.000047	0.0004	loam	0.00010	0.110	clay	0.0275
		150	2	10	0.01	0.000047	0.0040	loam	0.00100	0.200	clay	0.0500
Sethoxydim	Typical											
		15	0.06	0.26	0.25	0.25	0.00462	clay	0.00139	0.0198	sand	0.0059
	0.3	50	0.06	0.26	0.25	0.25	0.05490	clay	0.01647	0.1280	loam	0.0384
		150	0.06	0.26	0.25	0.25	0.22600	sand	0.06780	0.4060	loam	0.1218
	High											
		15	0.06	0.26	0.25	0.25	0.00462	clay	0.00208	0.0198	sand	0.0089
	0.45	50	0.06	0.26	0.25	0.25	0.05490	clay	0.02471	0.1280	loam	0.0576
		150	0.06	0.26	0.25	0.25	0.22600	sand	0.10170	0.4060	loam	0.1827
Sethoxydim	Typical											
		15	0.06	0.26	0.25	0.25	0.00462	clay	0.00139	0.0198	sand	0.0059
	0.3	50	0.06	0.26	0.25	0.25	0.05490	clay	0.01647	0.1280	loam	0.0384
		150	0.06	0.26	0.25	0.25	0.22600	sand	0.06780	0.4060	loam	0.1218
	High											
		15	0.06	0.26	0.25	0.25	0.00462	clay	0.00208	0.0198	sand	0.0089
	0.45	50	0.06	0.26	0.25	0.25	0.05490	clay	0.02471	0.1280	loam	0.0576
		150	0.06	0.26	0.25	0.25	0.22600	sand	0.10170	0.4060	loam	0.1827
Imazapic	Typical											
		15	100	100	0.05	0.00127	0.00000	loam and sanc	0.00000	0.0000	clay	0.0000
	0.13	50	100	100	0.05	0.00127	0.00001	loam	0.00000	0.0005	clay	0.0001
		150	100	100	0.05	0.00127	0.00012	loam	0.00002	0.0014	clay	0.0002

	High											
	0.1875	15	100	100	0.05	0.00127	0.00000	loam and sanc	0.00000	0.0000	clay	0.0000
		50	100	100	0.05	0.00127	0.00001	loam	0.00000	0.0005	clay	0.0001
		150	100	100	0.05	0.00127	0.00012	loam	0.00002	0.0014	clay	0.0003
Aminopyralid	Typical											
	0.078	15	100	98.6	6	44	0.02260	loam	0.00000	0.1840	sand	0.0000
		50	100	98.6	6	44	0.07140	clay	0.00000	0.2410	sand	0.0000
		150	100	98.6	6	44	0.03300	clay	0.00000	0.2020	sand	0.0000
	High											
	0.11	15	100	98.6	6	44	0.02260	loam	0.00000	0.0198	sand	0.0000
		50	100	98.6	6	44	0.07140	clay	0.00000	0.1280	sand	0.0000
		150	100	98.6	6	44	0.03300	clay	0.00000	0.4060	sand	0.0000

Hazard Quotient values (HQ) for lowest and highest peak Water Contamination Rates (WCR) for typical and maximum application rates at annual rainfall r

Species Group	Annual Rainfall	Application Rate	Clopyralid				Glyphosate (aquatic)				
			Low WCR	Soil Type	High WCR	Soil Type	Low WCR	Soil Type	High WCR	Soil Type	Low WCR
Fish	15	Typical	0.00000	loam	0.0003	clay	0.004	clay	0.02	sand	0.00000
		Maximum	0.00000		0.0004		0.02		0.1		0.00000
	50	Typical	0.0005	loam	0.001	sand	0.07	clay	0.2	sand	0.00000
		Maximum	0.0007		0.002		0.3		0.9		0.00000
	150	Typical	0.0007	clay	0.004	sand	0.4	clay	0.9	sand	0.00001
		Maximum	0.001		0.01		1.5		3.6		0.00003
Aquatic Invertebrates	15	Typical	0.00000	loam	0.00007	clay	0.00003	clay	0.0002	sand	0.00000
		Maximum	0.00000		0.0001		0.0001		0.0006		0.00000
	50	Typical	0.0001	loam	0.0003	sand	0.0005	clay	0.001	sand	0.00000
		Maximum	0.0002		0.0004		0.002		0.006		0.00000
	150	Typical	0.0002	clay	0.001	sand	0.002	clay	0.006	sand	0.00000
		Maximum	0.0002		0.001		0.009		0.02		0.00000
Algae	15	Typical	0.00000	loam	0.002	clay	0.002	clay	0.01	sand	0.00000
		Maximum	0.00000		0.003		0.01		0.05		0.00000
	50	Typical	0.00	loam	0.009	sand	0.04	clay	0.1	sand	0.00007
		Maximum	0.01		0.01		0.2		0.5		0.0002
	150	Typical	0.01	clay	0.03	sand	0.2	clay	0.5	sand	0.002
		Maximum	0.01		0.04		0.8		2.0		0.008
Aquatic Macrophytes	15	Typical	0.00000	loam	0.002	clay	0.0007	clay	0.004	sand	0.00000
		Maximum	0.00000		0.003		0.003		0.02		0.00000
	50	Typical	0.00	loam	0.03	sand	0.01	clay	0.04	sand	0.0001
		Maximum	0.01		0.01		0.05		0.1		0.0003
	150	Typical	0.01	clay	0.03	sand	0.06	clay	0.2	sand	0.003
		Maximum	0.01		0.04		0.2		0.6		0.01

rates of 15, 50, and 150 inches

Imazapyr			Metsulfuron				Sulfometuron				
Soil Type	High WCR	Soil Type	Low WCR	Soil Type	High WCR	Soil Type	Low WCR	Soil Type	High WCR	Soil Type	Low WCR
loam	0.00000	clay	0.00000	loam	0.00000	clay	0.00000	loam	0.00000	clay	0.00000
	0.00002		0.00000		0.00000		0.00000		0.00002		0.00000
loam	0.0001	clay	0.00000	loam	0.00000	clay	0.00000	loam	0.00002	clay	0.00100
	0.0002		0.00000		0.00004		0.00000		0.00025		0.00200
loam	0.002	clay	0.00000	loam	0.00000	clay	0.00000	loam	0.00005	clay	0.00383
	0.01		0.00000		0.00007		0.00001		0.0007		0.00767
loam	0.00000	clay	0.00000	loam	0.00000	clay	0.00000	loam	0.00000	clay	0.00000
	0.00000		0.00000		0.00000		0.00000		0.00000		0.00000
loam	0.00000	clay	0.00000	loam	0.00000	clay	0.00000	loam	0.00000	clay	0.00041
	0.00001		0.00000		0.00001		0.00000		0.00005		0.00083
loam	0.00008	clay	0.00000	loam	0.00000	clay	0.00000	loam	0.00001	clay	0.00159
	0.0003		0.00000		0.00002		0.00000		0.00013		0.00317
loam	0.001	clay	0.00000	loam	0.0004	clay	0.00000	loam	0.0008	clay	0.00000
	0.004		0.00000		0.002		0.00000		0.011		0.00000
loam	0.01	clay	0.0002	loam	0.003	clay	0.00001	loam	0.01	clay	3.00000
	0.05		0.0008		0.02		0.00015		0.12		6.00000
loam	0.4	clay	0.0003	loam	0.006	clay	0.0006	loam	0.03	clay	11.5000
	1.3		0.002		0.03		0.007		0.3		23.000
loam	0.002	clay	0.00000	loam	0.02	clay	0.00000	loam	0.01	clay	0.00000
	0.006		0.00000		0.1		0.00000		0.13		0.00000
loam	0.02	clay	0.009	loam	0.2	clay	0.0001	loam	0.1	clay	3.0000
	0.07		0.05		1.0		0.0018		1.4		6.0000
loam	0.6	clay	0.02	loam	0.4	clay	0.007	loam	0.3	clay	11.500
	2.0		0.09		1.9		0.08		3.8		23.00

Hexazinone			Picloram				2,4-D				Dica	
Soil Type	High WCR	Soil Type	Low WCR	Soil Type	High WCR	Soil Type	Low WCR	Soil Type	High WCR	Soil Type	Low WCR	Soil Type
loam	0.00525 0.01050	clay	0.00000 0.00000	loam	0.16625 0.47500	sand	0.00000 0.00000	loam,sand	0.09200 0.18400	clay	0.00000 0.00000	loam,sand
loam	0.04500 0.09000	clay	0.10500 0.30000	loam	0.85750 2.45000	clay	0.00006 0.00012	sand	0.38000 0.76000	clay	0.00001 0.00004	loam
loam	0.07000 0.1400	clay	0.15750 0.45000	loam	1.66250 4.7500	clay	0.00373 0.00746	loam	0.39000 0.7800	clay	0.00003 0.00019	loam
loam	0.00217 0.00434	clay	0.00000 0.00000	loam	0.00248 0.00709	sand	0.00000 0.00000	loam,sand	0.03680 0.07360	clay	0.00000 0.00000	loam,sand
loam	0.01862 0.03724	clay	0.00157 0.00448	loam	0.01280 0.03657	clay	1.00000 0.00005	sand	0.15200 0.30400	clay	0.00002 0.00014	loam
loam	0.02897 0.05793	clay	0.00235 0.00672	loam	0.02481 0.07090	clay	0.00149 0.00298	loam	0.15600 0.31200	clay	0.00010 0.00068	loam
loam	15.7500 31.500	clay	0.00000 0.00000	loam	0.0289 0.083	sand	0.00000 0.00000	loam,sand	70.7692 141.538	clay	0.00000 0.00000	loam,sand
loam	135.00 270.00	clay	0.01826 0.05217	loam	0.15 0.43	clay	0.04769 0.09538	sand	292.31 584.62	clay	0.00165 0.01102	loam
loam	210.00 420.0	clay	0.0274 0.078	loam	0.29 0.8	clay	2.8692 5.738	loam	300.00 600.0	clay	0.0080 0.053	loam
loam	15.75 31.50	clay	0.00000 0.00000	loam	0.07 0.19	sand	0.00000 0.00000	loam,sand	70.77 141.54	clay	0.00000 0.00000	loam,sand
loam	135.0 270.0	clay	0.0420 0.1200	loam	0.3 1.0	clay	0.0477 0.0954	sand	292.3 584.6	clay	0.0000 0.0002	loam
loam	210.0 420.0	clay	0.063 0.18	loam	0.7 1.9	clay	2.869 5.74	loam	300.0 600.0	clay	0.000 0.00	loam

mba		Triclopyr				Chlorsulfuron				Sethoxydim		
High WCR	Soil Type	Low WCR	Soil Type	High WCR	Soil Type	Low WCR	Soil Type	High WCR	Soil Type	Low WCR	Soil Type	High WCR
0.00001	clay	0.08095	clay	0.08571	loam	0.00000	loam	0.0003	clay	0.02	clay	0.1
0.00008		0.80952		0.85714		0.00000		0.002		0.03		0.1
0.00004	clay	0.26190	sand	0.61905	clay	0.00001	loam	0.003	clay	0.3	clay	0.6
0.00024		2.61905		6.19048		0.00005		0.01		0.4		1.0
0.00009	clay	0.52381	sand	1.52381	clay	0.0001	loam	0.006	clay	1.1	sand	2.0
0.0006		5.23810		15.2381		0.0005		0.03		1.7		3.0
0.00005	clay	0.00122	clay	0.00129	loam	0.00000	loam	0.00007	clay	0.005	clay	0.02
0.00030		0.01223		0.01295		0.00000		0.0003		0.008		0.03
0.00013	clay	0.00396	sand	0.00935	clay	0.00000	loam	0.001	clay	0.06	clay	0.1
0.00089		0.03957		0.09353		0.00001		0.003		0.10		0.2
0.00032	clay	0.00791	sand	0.02302	clay	0.00002	loam	0.001	clay	0.3	sand	0.5
0.00216		0.07914		0.23022		0.0001		0.005		0.4		0.7
0.0035	clay	0.04048	clay	0.0429	loam	0.00000	loam	0.07	clay	0.006	clay	0.02
0.023		0.40476		0.429		0.00000		0.3		0.008		0.04
0.01	clay	0.13095	sand	0.31	clay	0.002	loam	0.6	clay	0.07	clay	0.2
0.07		1.30952		3.10		0.01		2.8		0.10		0.2
0.03	clay	0.2619	sand	0.76	clay	0.02	loam	1.1	clay	0.3	sand	0.5
0.2		2.619		7.6		0.1		5.0		0.4		0.7
0.00	clay	0.04048	clay	0.04	loam	0.00000	loam	14	clay	0.006	clay	0.02
0.00		0.40476		0.43		0.00000		64		0.008		0.04
0.0	clay	0.1310	sand	0.3	clay	0.5	loam	131	clay	0.07	clay	0.2
0.0		1.3095		3.1		2.1		585		0.10		0.2
0.0	clay	0.262	sand	0.8	clay	4.8	loam	238	clay	0.3	sand	0.5
0.0		2.62		7.6		21		1064		0.4		0.7

	Imazapic				Animopyralid			
Soil Type	Low WCR	Soil Type	High WCR	Soil Type	Low WCR	Soil Type	High WCR	Soil Type
sand	0.00	oam and sanc	0.0	clay	0.00	loam	0.0	sand
	0.00		0.0		0.00		0.0	
loam	0.0	loam	0.0	clay	0.0	clay	0.0	sand
	0.0		0.0		0.0		0.0	
loam	0.0	loam	0.0	clay	0.0	clay	0.0	sand
	0.0		0.0		0.0		0.0	
sand	0.000	oam and sanc	0.00	clay	0.000	loam	0.00	sand
	0.000		0.00		0.000		0.00	
loam	0.00	loam	0.0	clay	0.00	clay	0.0	sand
	0.00		0.0		0.00		0.0	
loam	0.0	loam	0.0	clay	0.0	clay	0.0	sand
	0.0		0.0		0.0		0.0	
sand	0.000	oam and sanc	0.00	clay	0.000	loam	0.00	sand
	0.000		0.00		0.000		0.00	
loam	0.00	loam	0.0	clay	0.00	clay	0.0	sand
	0.00		0.0		0.00		0.0	
loam	0.0	loam	0.0	clay	0.0	clay	0.0	sand
	0.0		0.0		0.0		0.0	
sand	0.000	oam and sanc	0.00	clay	0.000	loam	0.00	sand
	0.000		0.01		0.000		0.00	
loam	0.00	loam	0.1	clay	0.00	clay	0.0	sand
	0.00		0.1		0.00		0.0	
loam	0.0	loam	0.1	clay	0.0	clay	0.0	sand
	0.0		0.2		0.0		0.0	

WORKSHEETS FOR THREATENED OR ENDANGERED FISH
Invasive Plant EIS Biological Assessment

Hazard Quotients for Herbicides in the Proposed Action
Invasive Plant EIS, USDA Forest Service
Region 6, Portland OR

29-Mar-05

These worksheets use either 1/20th of the acute LC50,
following protocol of EPA (2004),
or a lower chronic NOEC, for the acute toxicity index.
These values were reviewed and agreed to by Shawna Bautista, USDA Forest Service
and Rick Golden, NOAA Fisheries, for use in assessing risks to **threatened and**
endangered fish, while attempting to account for uncertainty regarding sublethal effects.

This version contains correct values used for invertebrates and aquatic plants,
used to assess indirect effects to listed fish and the Bliss Rapids snail.

For assessing chronic risk to listed fish and Bliss Rapids snail, water
concentrations were estimated for a 90-day interval using flowing streams
(the types of habitats in which our listed aquatic species occur).
Exposures of concern are not plausible, so chronic exposures are not
evaluated further. The chronic exposures in these worksheets retain the calculations
from the SERA risk assessments, and are not applied to our analysis.

Summary of Risk Quotient Exceedences by Herbicide and Aquatic Group

			Typical application rate		High application rate		
			HQ	exposure level	HQ	exposure level	Comments
Chlorsulfuron							
	Fish	None					
	Invertebrates	None					
	Algae	Acute, senstive	1.1	upper	5	upper	
					2.5	mid	
	Macrophytes	Acute	234	upper	1064	upper	
			119	mid	532	mid	
			11.9	lower	53.2	lower	
Clopyralid							
	Fish	None					
	Invertebrates	None					
	Algae	None					
	Macrophytes	None					
Glyphosate							
	Fish	Acute, sensitive	1.6	upper	5.6	upper	Rodeo
		Acute, sensitive	12	upper	43	upper	Roundup
		Acute, sensitive			2.2	mid	Roundup
	Invertebrates	Acute, sensitive			2.5	upper	Roundup
	Algae	Acute, sensitive			3.1	upper	Roundup
	Macrophytes	None					
Imazapic							
	Fish	None					
	Invertebrates	None					
	Algae	None					
	Macrophytes	Acute, sensitive & tolerant			1.4	upper	

Imazapyr						
	Fish					
	Invertebrates					
	Algae	Acute, sensitive	1.8	upper	5.0	upper
	Macrophytes	Acute, sensitive & tolerant	2.8	upper	7.7	upper
Metsulfuron						
	Fish	None				
	Invertebrates	None				
	Algae	None				
	Macrophytes	Acute, sensitive & tolerant	1.9	upper	9.4	upper
					1.9	mid
Picloram						
	Fish	Acute, sensitive	1.8	upper	5.0	upper
					1.3	mid
	Invertebrates	None				
	Algae	None				
	Macrophytes	Acute, sensitive			2.0	upper
Sethoxydim						
	Fish	Acute, sensitive	2.5	upper	3.1	upper
		Acute, sensitive			1.3	mid
	Invertebrates	None				
	Algae	None				
	Macrophytes	None				
Sulfometuron						
	Fish	None				
	Invertebrates	None				
	Algae	Acute, sensitive			3.0	upper
	Macrophytes	Acute, tolerant & sensitive	4.3	upper	36	upper
					1.8	mid

Triclopyr TEA						
	Fish	Acute, sensitive	1.5	upper	15	upper
					3.5	mid
	Invertebrates					
	Algae	Acute, one value used for algae & macros			9.5	upper
	Macrophytes				2.1	mid
Triclopyr BEE						
	Fish	Acute, sensitive	13	upper	125	upper
			1.2	mid	12	mid
	Invertebrates	Acute, sensitive			1.8	upper
	Algae	Acute, one value used for algae & macros	2.0	upper	214	upper
	Macrophytes					

APPENDIX F. Listed Species Eliminated from the CREP Consultation

Appendix F. Listed Species Eliminated from the CREP Consultation

The following species have been eliminated from the CREP consultation for the reasons discussed in the species summaries below. If a CREP project arises on lands that may support any of these species or their designated critical habitats, individual consultation(s) will be initiated as needed.

1. **Hutton Tui Chub (*Gila bicolor*)**
2. **Borax Lake Chub (*Gila boraxobius*)**
3. **Foskett Speckled Dace (*Rhinichthys osculus* ssp)**
4. **Marbled Murrelet (*Brachyramphus marmoratus*)**
5. **Western Snowy Plover (*Charadrius alexandrinus nivosus*)**
6. **Northern Spotted Owl (*Strix occidentalis caurina*)**
7. **Gray Wolf (*Canis lupus*)**
8. **Canada lynx (*Felis lynx canadensis*)**
9. **Oregon silverspot butterfly (*Speyeria zerene hippolyta*)**
10. **Malheur wire-lettuce (*Stephanomeria malheurensis*)**
11. **McDonald's Rock-Cress (*Arabis macdonaldiana*)**

1. Hutton Tui Chub (*Gila bicolor*)

The Hutton tui chub is listed as threatened without critical habitat (50 FR 12302). The Hutton tui chub occurs in Lake County, Oregon. It is known to occur in Hutton Spring in habitat that is in good condition primarily due to conscientious long-term land stewardship by the private landowner. One other spring nearby, known as 3/8 Mile Spring, supports the only other known population of Hutton tui chub which was rediscovered in 2007 (Oregon Department of Fish and Wildlife 2007).

Because of the limited, small and isolated nature of Hutton tui chub habitats (i.e., two spring locations known at this time), it is unlikely that CREP project opportunities will arise that would affect this species. If project opportunities arise at the known locations, or if new populations are discovered on potential CREP project sites, individual consultations will be initiated if needed. **Therefore, the Hutton tui chub is not considered in the CREP programmatic Biological Assessment.**

2. Borax Lake Chub (*Gila boraxobius*)

The Borax Lake chub is listed as endangered with critical habitat (47 FR 43957). The Borax Lake chub is endemic to Borax Lake and adjacent wetlands in the Alvord Basin, Harney County, Oregon. Borax Lake is small and shallow, about 4.1 ha (10 acres) in size. Water flows from Borax Lake into surrounding marshes, small pools, and Lower Borax Lake.

Designated critical habitat totals 640 acres that encompasses Borax Lake, marsh areas to the south and southwest of the lake, Lower Borax Lake and the hot springs north of Borax Lake.

Half of the Critical Habitat is privately owned, and the other half is federally owned by the Bureau of Land Management. In 1993, The Nature Conservancy purchased 160 acres of the private portion that includes Borax Lake. Therefore, 320 acres are federal, a 160-acre parcel is owned by The Nature Conservancy, and the remaining 160 acres is a parcel of private land (U.S. Fish and Wildlife Service 1987). Much of the area is fenced to exclude livestock.

Due to the land ownership and small geographical area in which this species is known to occur, it would be rare for CREP projects to take place on sites that support the Borax chub. **Therefore, Borax chub and its critical habitat are not considered in the CREP programmatic Biological Assessment.** In the event that a project arises on the private parcel known to support this species or on lands that may influence Borax chub habitat, an individual consultation will be initiated if needed.

3. Foskett Speckled Dace (*Rhinichthys osculus* ssp)

The Foskett speckled dace was listed as a threatened species in 1985 (50 FR 12302). Critical habitat has not been designated. Foskett speckled dace were probably distributed throughout prehistoric Coleman Lake of the Warner Basin during times that it held substantial amounts of water. There is currently only one known population of Foskett speckled dace which is found in Foskett Spring in the Coleman subbasin on land managed by the Bureau of Land Management. Fish at Foskett Spring live in the main spring pool, outflow channel and tiny outflow rivulets that are at times only a few inches wide and deep. The fish find cover under overhanging bank edges, grass, exposed grass roots, and filamentous algae.

Dace Spring, a short distance away, was occupied by Foskett speckled dace in the recent past, but none are known to occur there at this time. Both Foskett and Dace springs are extremely small and shallow with limited habitat for fish. Foskett Spring originates in a pool about 5 m across, then flows toward Coleman Lake in a narrow, shallow channel. The source pool has a loose, sandy bottom and is thick with aquatic plants. The spring outflow channel eventually turns into a marsh and finally dries up before reaching the dry lake bed of Coleman Lake. Dace Spring is about one km south of Foskett Spring and is smaller and more choked with plants. The spring outflow terminates in a cattle trough.

The disappearance of dace from Dace Spring was likely due to the limited habitat and the shrinking of this habitat over time as sediment and vegetation filled in the excavated area near the spring outflow. Also, the outflow from Dace Spring terminates in a cattle trough in which a number of Foskett speckled dace lived following the 1979 and 1980 transplant. The dace were probably caught in the flow to the trough, but were unable to return to the spring. The overflow water from the trough spills on the ground and any dace flushed out would perish.

Known populations of the dace occur exclusively on federal land, which is not eligible for CREP. Therefore, it is unlikely that CREP project opportunities will arise that would affect this species. If new populations are discovered on potential CREP project sites, individual consultations will be initiated if needed. **Therefore, the Foskett speckled dace is not considered in the CREP programmatic Biological Assessment.**

4. Marbled Murrelet (*Brachyramphus marmoratus*)

The Washington, Oregon, and California populations were listed as threatened in 1992 (57 FR 45328). Critical habitat was designated for the species in 1996 (61 FR 26255). The marbled murrelet is a small robin-sized diving seabird that feeds primarily on fish and invertebrates in near-shore marine waters. It spends the majority of its time on the ocean, roosting and feeding, but comes inland up to 80 kilometers (50 miles) to nest in forest stands with old-growth forest characteristics. These dense shady forests are generally characterized by large trees with large branches or deformities for use as nest platforms. The listed population nests in stands varying in size from several acres to thousands of acres. However, larger, unfragmented stands of old growth appear to be the highest quality habitat for marbled murrelet nesting. Nesting stands are dominated by Douglas fir in Oregon and Washington and by old-growth redwoods in California.

CREP activities will not occur in habitats that support the marbled murrelet. Therefore, this species and its critical habitat are not considered in the CREP programmatic Biological Assessment.

5. Western Snowy Plover (*Charadrius alexandrinus nivosus*)

The Western Snowy Plover was listed as a threatened species in 1993 (58 FR 12864). Critical habitat was designated in 1999 (64 FR 68507) at 28 areas along the coasts of California, Oregon, and Washington. The Pacific coast population of western snowy plovers breeds on coastal beaches. They nest in open, flat, sparsely vegetated beaches and sand spits above the high tide.

CREP projects will not occur on coastal beaches or sand spits where they could affect snowy plover, and will not occur in critical habitat designated for this species. Therefore, this species will not be affected by CREP activities and is not considered in the CREP programmatic Biological Assessment.

6. Northern Spotted Owl (*Strix occidentalis caurina*)

The Northern Spotted Owl was listed as a threatened species in 1990 (55 FR 26115). In 1992, areas of critical habitat were designated to further protect this subspecies on Federal lands (57 FR 1796). Northern spotted owls live in forests characterized by dense canopy closure of mature and old-growth trees, abundant logs, standing snags, and live trees with broken tops. Although they are known to nest, roost, and feed in a variety of habitat types, the owls prefer older forest stands with variety, including multi-layered canopies of several tree species of varying size and age, both standing and fallen dead trees, and open space among the lower branches to allow flight under the canopy. Typically, forests do not attain these characteristics until they are at least 150 to 200 years old.

CREP activities will not take place in spotted owl habitat. Therefore, this species and its critical habitat are not considered in the CREP programmatic Biological Assessment.

7. Gray Wolf (*Canis lupus*)

The gray wolf was listed as endangered in 1974 throughout the conterminous U.S., except Minnesota, where it was listed as threatened (39 FR 1171). No critical habitat has been designated. On February 27, 2008, the Service published a final rule that delisted the gray wolf in the northern Rocky Mountains. However, an injunction issued on July 18, 2008 reinstated all previous ESA protections in the entire northern Rocky Mountain area. The injunction will remain in place until a case before the U.S. Federal District Court regarding the delisting decision is resolved. If the final rule stands, any wolves found beyond the delisted area in Oregon (west of the centerline of Highway 395 and Highway 78 north of Burns Junction and west of the centerline of Highway 95 south of Burns Junction) will still be listed as endangered [see 73 FR 10514] (U.S. Fish and Wildlife Service 2008b).

Wolves were historically widespread in Oregon. However, there have been no known wolf packs in the State for many years, until recently. As of December 2006, the activity centers of two documented wolf packs in western Idaho were less than 15 miles from the Oregon border and at least six more Idaho packs were within 50 miles of the border, well within the average wolf dispersal range. A wolf pack was confirmed in Union County, Oregon in July 2008 (Gary Miller, pers. comm.) Wolves may continue to become reestablished in Oregon over time.

Because only one wolf pack has been very recently documented in Oregon in the area that may be delisted (if the delisting rule is upheld), **the gray wolf is not considered in the CREP programmatic Biological Assessment.** Consultations will be initiated as needed if any wolves are found in Oregon in areas where they are still listed and may be affected by CREP activities.

8. Canada lynx (*Felis lynx canadensis*)

The Canada lynx was listed as a threatened species in 2000 (65 FR 16051). Canada lynx inhabit montane coniferous forests. They are specialized predators that are highly dependent on the snowshoe hare (*Lepus americanus*) for food, but also eat alternate prey such as squirrels and grouse. Snowshoe hare prefer diverse, early successional forests with dense stands of conifers and shrubby understories that provide food, cover to escape from predators, and protection during extreme weather.

Lynx concentrate their winter foraging activities in areas where hare activity is high and den in forests with large woody debris, such as downed logs and windfalls. Based on information from the western United States, sites selected for denning also must provide for minimal disturbance by humans and proximity to foraging habitat (early successional forests) with denning stands at least one hectare (2.5 acres) in size. Intermediate-age forests allow for lynx access between den sites and foraging areas, movement within home ranges, and random foraging opportunities.

CREP projects are not expected to occur in Canada lynx habitat. Therefore, the Canada lynx is not considered in the CREP programmatic Biological Assessment.

9. Oregon silverspot butterfly (*Speyeria zerene hippolyta*)

The Oregon silverspot butterfly was listed as a threatened species in 1980 (45 FR 44935). Critical habitat has been designated for this species in Lane County, Oregon. At the time of the listing, the only viable population known was on the Siuslaw National Forest in Tillamook County, Oregon. Additional populations have since been discovered at Cascade Head, Bray Point, and Clatsop Plains in Oregon and at sites in Washington and California.

The Oregon silverspot occupies three types of grassland habitat. One type consists of marine terrace and coastal headland salt-spray meadows (e.g., Cascade Head, Bray Point, Rock Creek-Big Creek and portions of Del Norte sites). The second consists of stabilized dunes as found at the Long Beach Peninsula, Clatsop Plains, and the remainder of Del Norte. Both of these habitats are strongly influenced by proximity to the ocean, mild temperatures, high rainfall, and persistent fog. The third habitat type consists of montane grasslands found on Mount Hebo and Fairview Mountains. Conditions at these sites include colder temperatures, significant snow accumulations, less coastal fog, and no salt spray.

CREP activities will not take place in Oregon silverspot butterfly habitats. Therefore, this species is not considered in the CREP programmatic Biological Assessment.

10. Malheur wire-lettuce (*Stephanomeria malheurensis*)

Malheur wirelettuce was federally listed as endangered with critical habitat in 1982 (U.S. Fish and Wildlife Service 1982). It occurs in the high desert of the northern portion of the Great Basin in an area south of Burns, Oregon. Critical habitat has been designated on Bureau of Land Management lands, and has been set aside to allow for natural expansion of the population and to provide a buffer against potential adverse impacts from activities on adjacent lands. The 160-acre area has been fenced since 1974 to prevent grazing by livestock.

Malheur wirelettuce is only known to occur at one location on public lands managed by the Bureau of Land Management. Therefore, CREP activities will not affect this species or its critical habitat, and it is not considered in the CREP programmatic Biological Assessment.

11. McDonald's Rock-Cress (*Arabis macdonaldiana*)

MacDonald's rock-cress was federally listed as endangered without critical habitat in 1978 (43 FR 44810). It is one of several closely related endemic species (species restricted to a well-defined geographic area) which have evolved in the Siskiyou Mountains region of southwest Oregon and northwest California. MacDonald's rock-cress occurs on serpentine soils (high in magnesium, iron, and certain toxic metals) in habitat that is often very steep and unstable, with an open tree canopy of generally less than 5 percent cover. Elevation ranges up to about 4,900 feet on the slopes of Preston Peak and Sanger Peak in the Siskiyou Mountains. This species is thought to be restricted to the southern extent of Curry and Josephine Counties in southwest Oregon and on sites in Mendocino, Del Norte and Siskiyou Counties in California.

A review of previous CREP project locations in relation to known occurrences of the MacDonald's rock-cress found no overlap. **Because it is unlikely that CREP activities will occur in areas and habitats that support this plant, this species is not considered in the CREP programmatic Biological Assessment.** In the event that a project arises on a site where this species occurs, an individual consultation will be initiated if needed.

APPENDIX G. Oregon Department of Forestry Herbicide Application Diagram

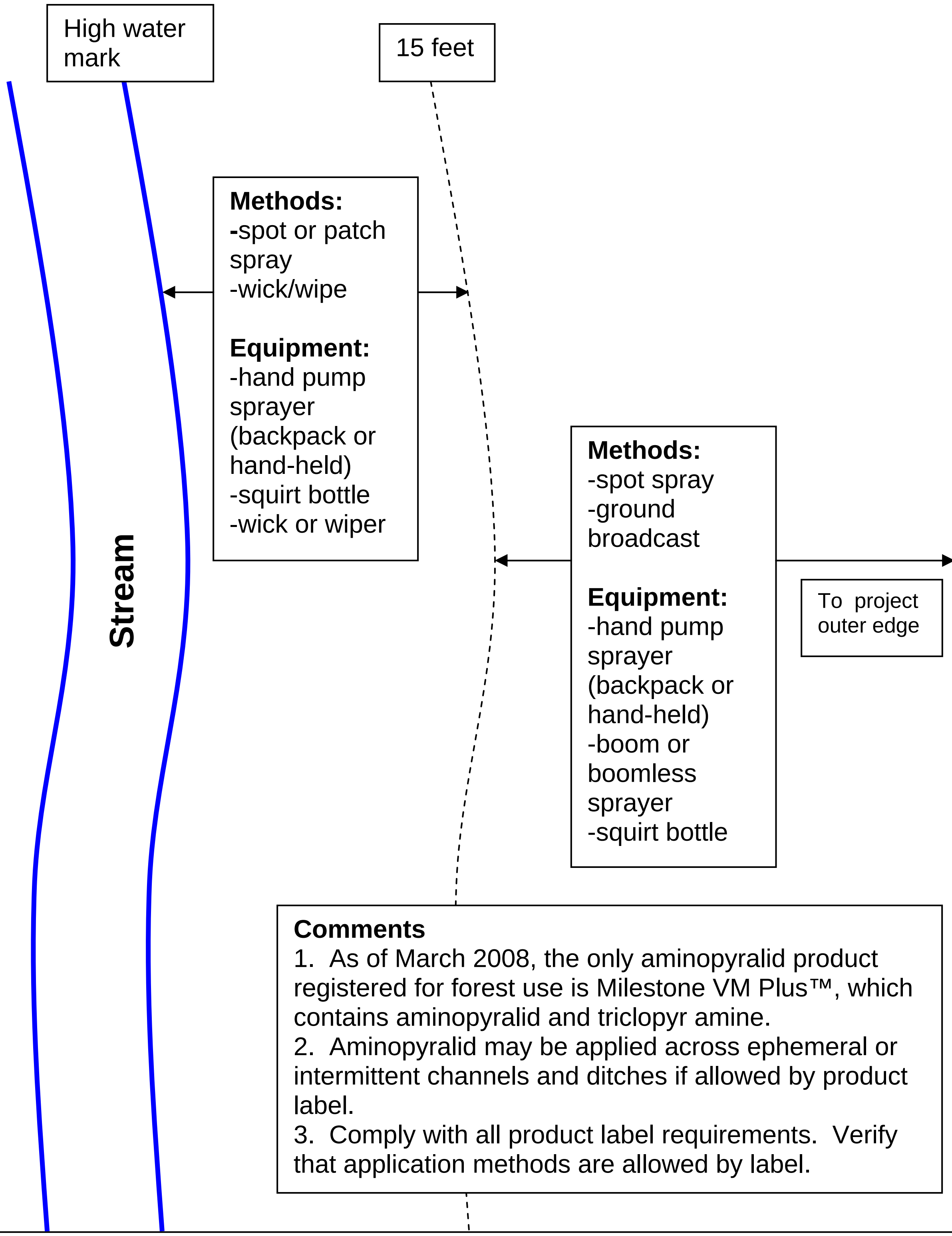
Appendix G

Summary of Methods and Equipment for Herbicide Use on CREP Projects

Oregon Department of Forestry

March 2008

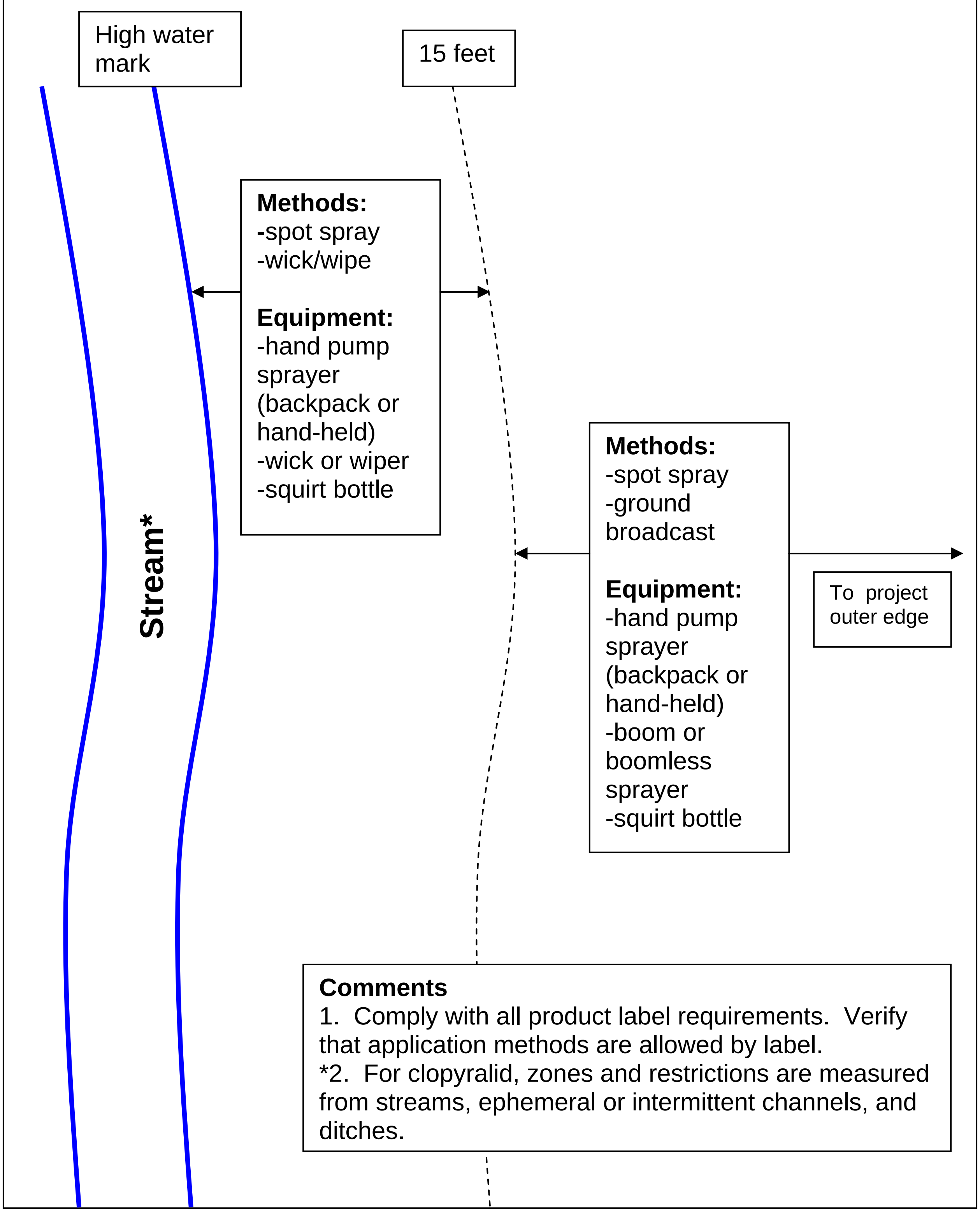
Aminopyralid: Methods and Equipment



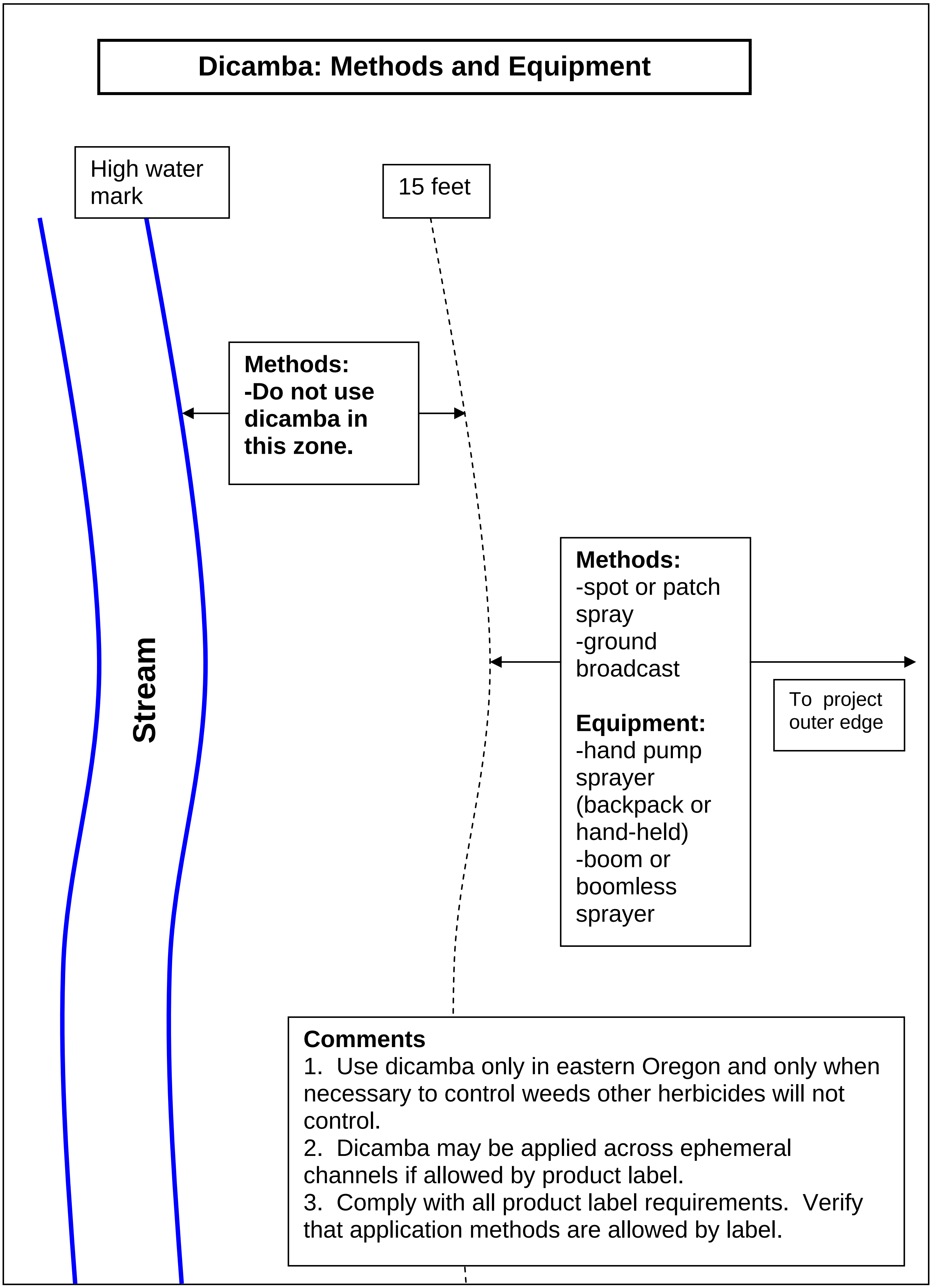
Comments

1. As of March 2008, the only aminopyralid product registered for forest use is Milestone VM Plus™, which contains aminopyralid and triclopyr amine.
2. Aminopyralid may be applied across ephemeral or intermittent channels and ditches if allowed by product label.
3. Comply with all product label requirements. Verify that application methods are allowed by label.

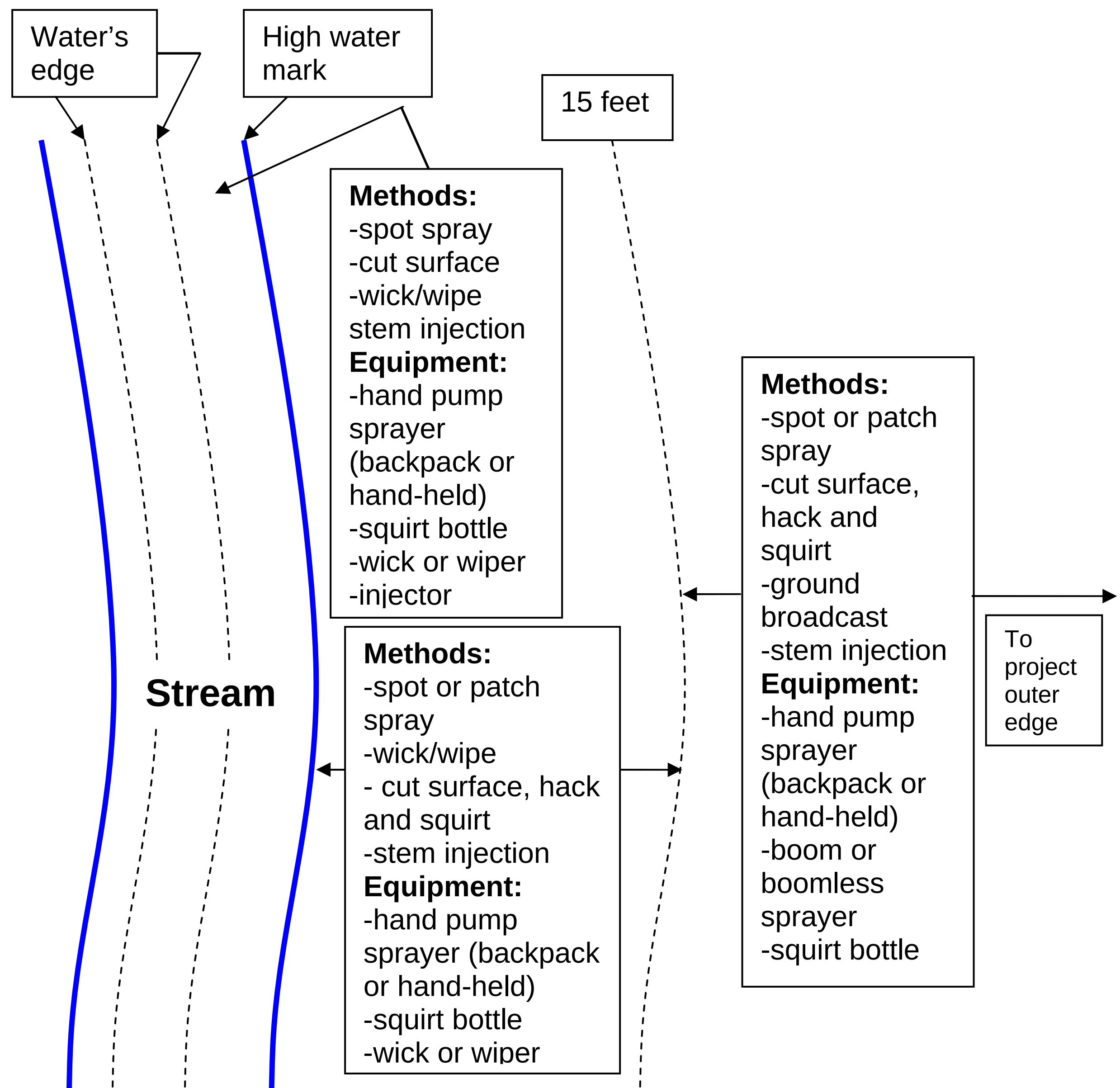
Clopyralid: Methods and Equipment



Comments
1. Comply with all product label requirements. Verify that application methods are allowed by label.
*2. For clopyralid, zones and restrictions are measured from streams, ephemeral or intermittent channels, and ditches.

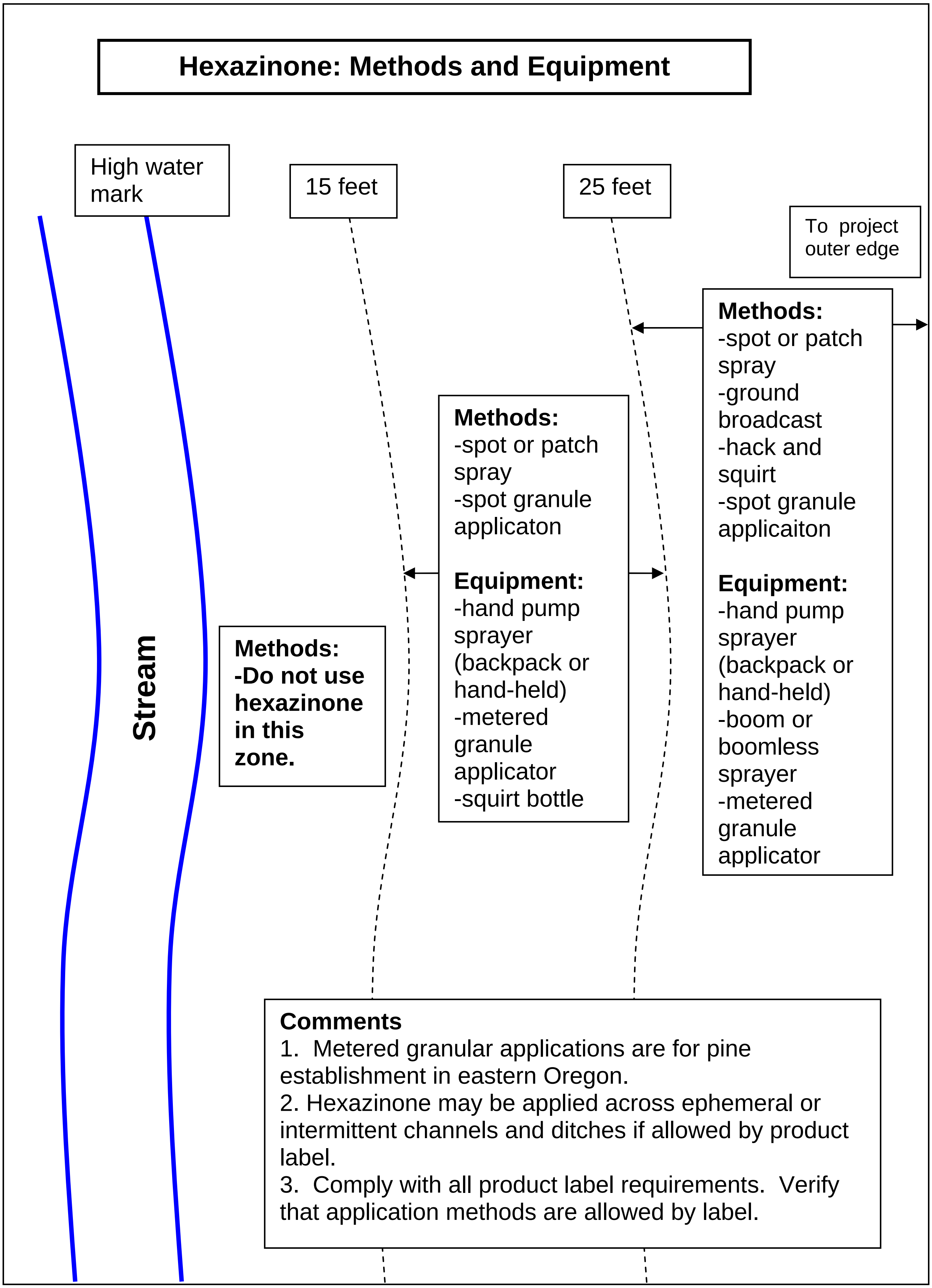

Dicamba: Methods and Equipment
High water mark
15 feet
Methods:
-Do not use dicamba in this zone.
Stream
Methods:
-spot or patch spray
-ground broadcast
Equipment:
-hand pump sprayer (backpack or hand-held)
-boom or boomless sprayer
To project outer edge
Comments
1. Use dicamba only in eastern Oregon and only when necessary to control weeds other herbicides will not control.
2. Dicamba may be applied across ephemeral channels if allowed by product label.
3. Comply with all product label requirements. Verify that application methods are allowed by label.

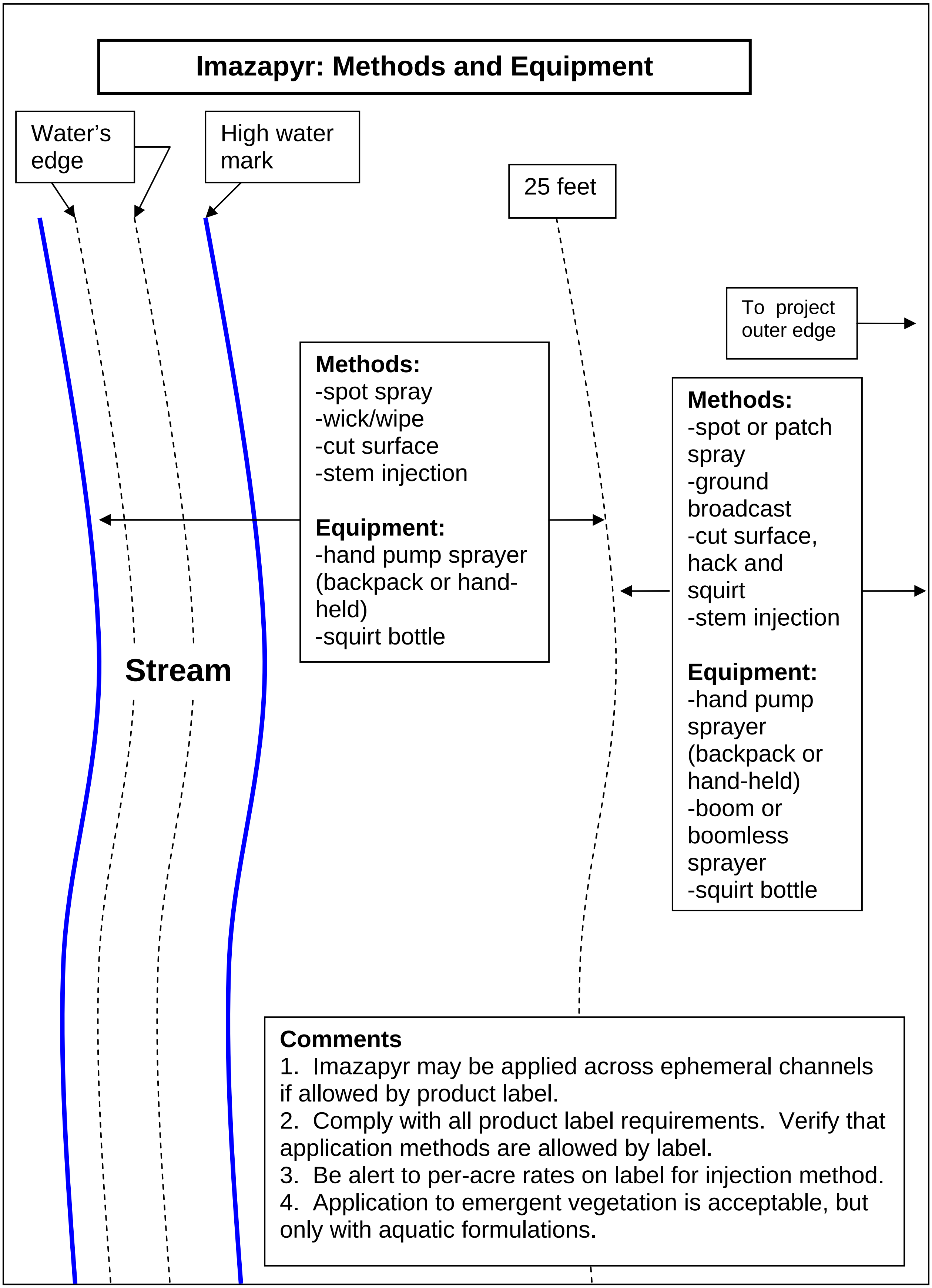
Glyphosate: Methods and Equipment



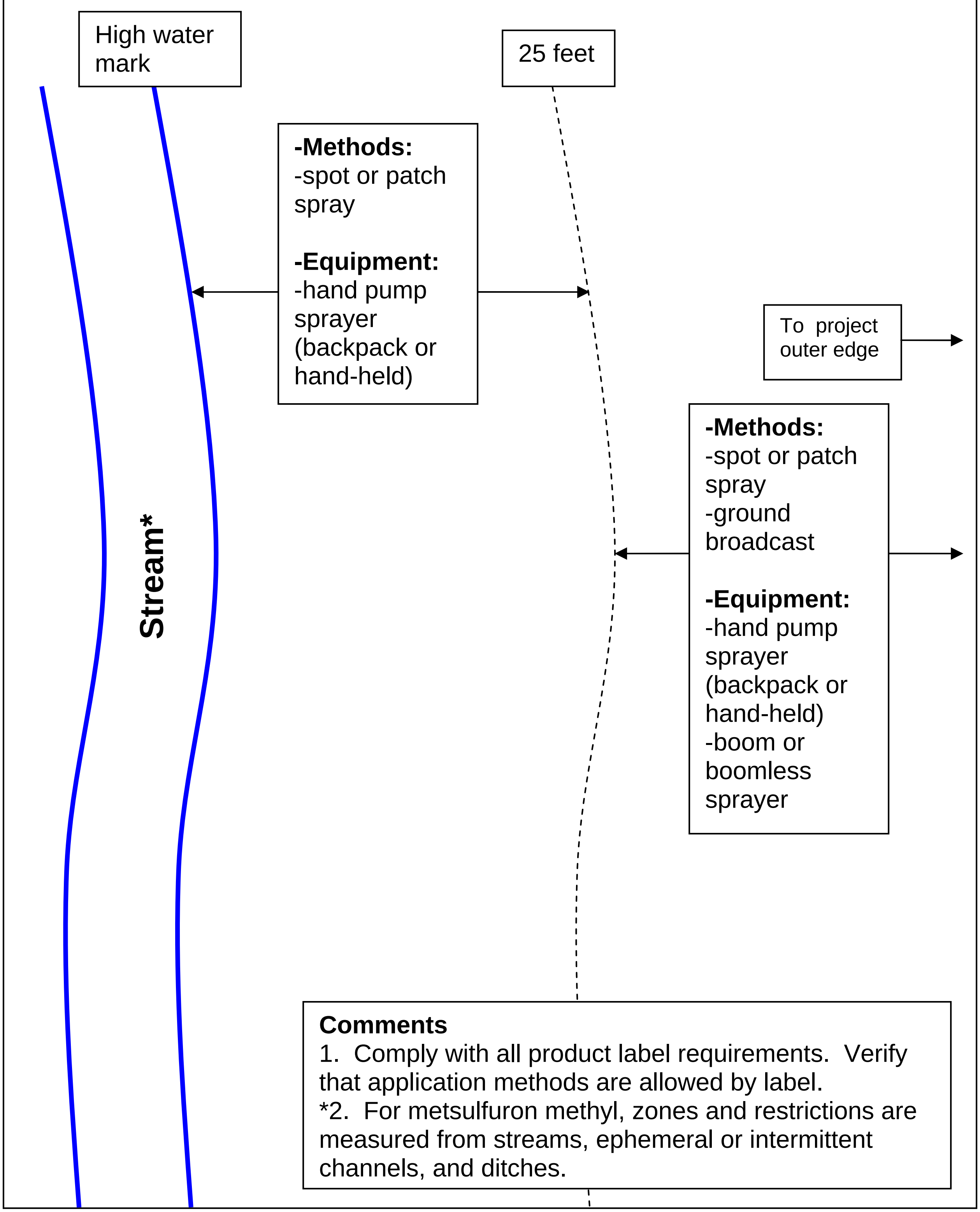
Comments

1. Glyphosate is the preferred herbicide within 15 feet of streams.
2. Glyphosate may be applied across ephemeral or intermittent channels and ditches if allowed by product label.
3. Comply with all product label requirements. Verify that application methods are allowed by label.
4. Be alert to per-acre rates on label for injection method.


Hexazinone: Methods and Equipment
High water mark
15 feet
25 feet
To project outer edge
Stream
Methods:
-Do not use hexazinone in this zone.
Methods:
-spot or patch spray
-spot granule applicaton
Equipment:
-hand pump sprayer (backpack or hand-held)
-metered granule applicator
-squirt bottle
Methods:
-spot or patch spray
-ground broadcast
-hack and squirt
-spot granule applicaiton
Equipment:
-hand pump sprayer (backpack or hand-held)
-boom or boomless sprayer
-metered granule applicator
Comments
1. Metered granular applications are for pine establishment in eastern Oregon.
2. Hexazinone may be applied across ephemeral or intermittent channels and ditches if allowed by product label.
3. Comply with all product label requirements. Verify that application methods are allowed by label.


Imazapyr: Methods and Equipment
Water's edge
High water mark
25 feet
To project outer edge
Methods:
-spot spray
-wick/wipe
-cut surface
-stem injection
Equipment:
-hand pump sprayer (backpack or hand-held)
-squirt bottle
Methods:
-spot or patch spray
-ground broadcast
-cut surface, hack and squirt
-stem injection
Equipment:
-hand pump sprayer (backpack or hand-held)
-boom or boomless sprayer
-squirt bottle
Stream
Comments
1. Imazapyr may be applied across ephemeral channels if allowed by product label.
2. Comply with all product label requirements. Verify that application methods are allowed by label.
3. Be alert to per-acre rates on label for injection method.
4. Application to emergent vegetation is acceptable, but only with aquatic formulations.

Metsulfuron methyl: Methods and Equipment

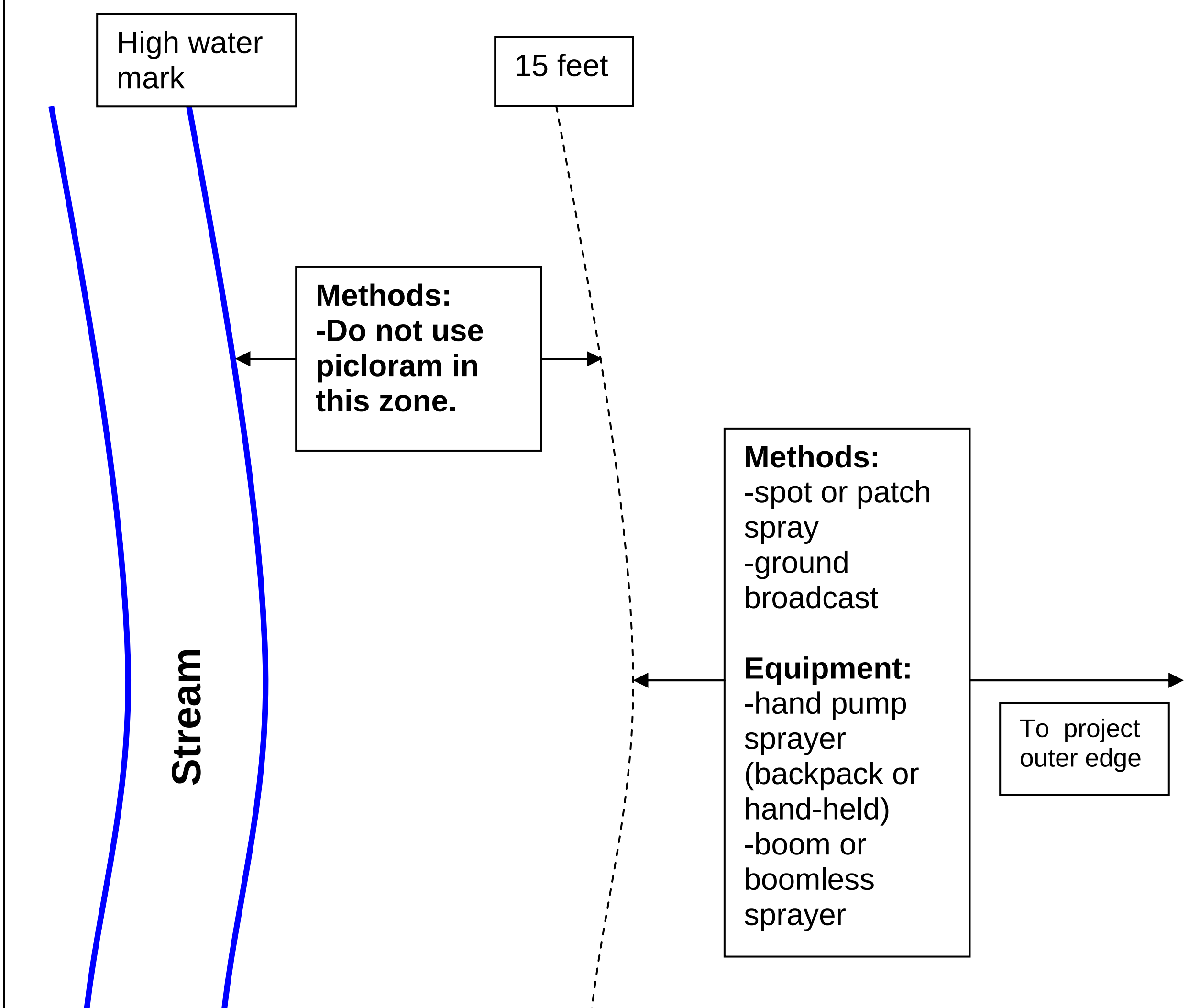


Comments

1. Comply with all product label requirements. Verify that application methods are allowed by label.

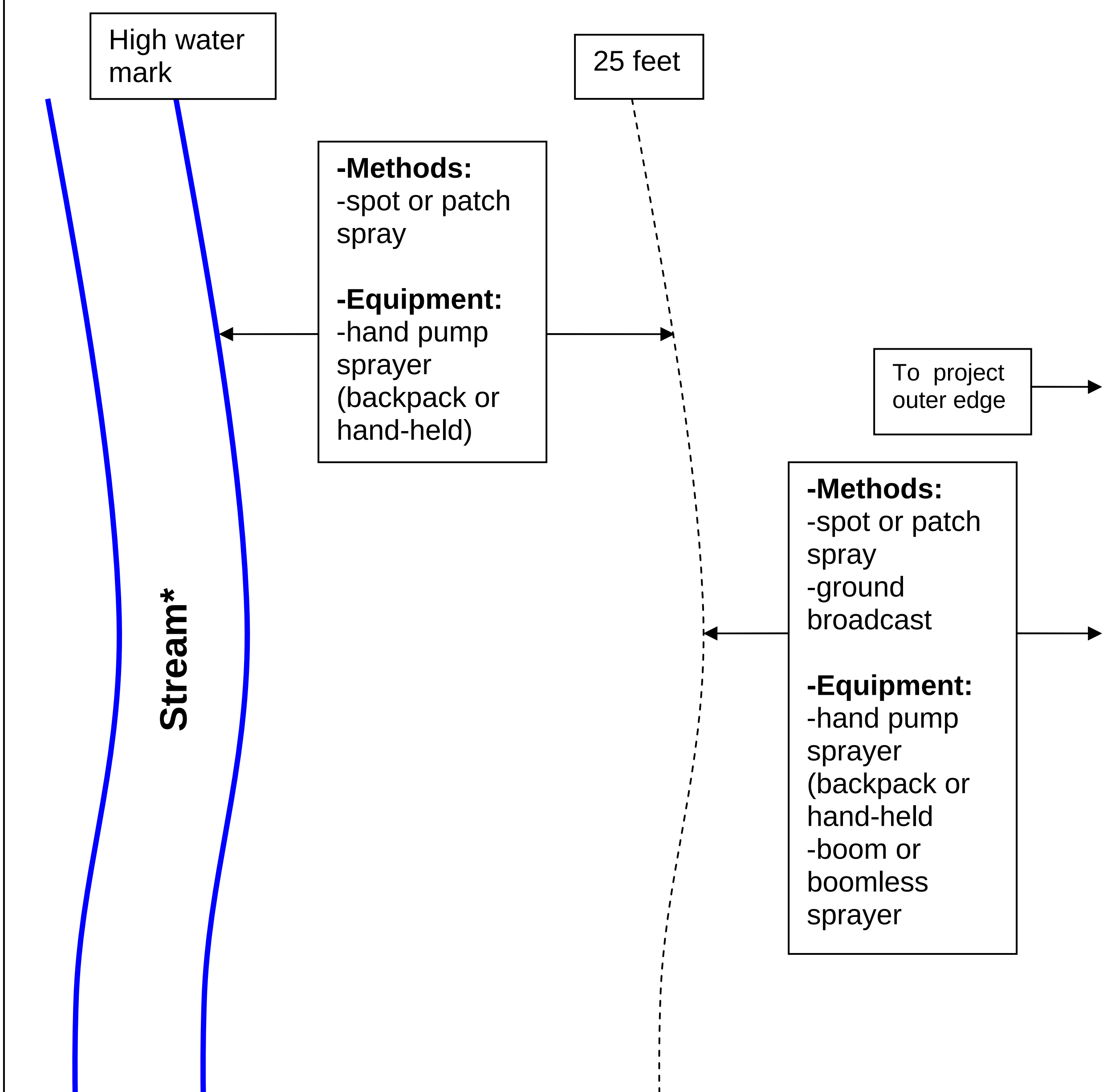
*2. For metsulfuron methyl, zones and restrictions are measured from streams, ephemeral or intermittent channels, and ditches.

Picloram: Methods and Equipment



Comments
1. Use picloram only in eastern Oregon and only when necessary to control weeds other herbicides will not control.
2. In ephemeral channels, picloram may be applied by cut stump, hack and squirt, or injection, if allowed by product label.
3. Comply with all product label requirements. Verify that application methods are allowed by label.
4. Some picloram products are ***restricted use pesticides***.

Sulfometuron methyl: Methods and Equipment

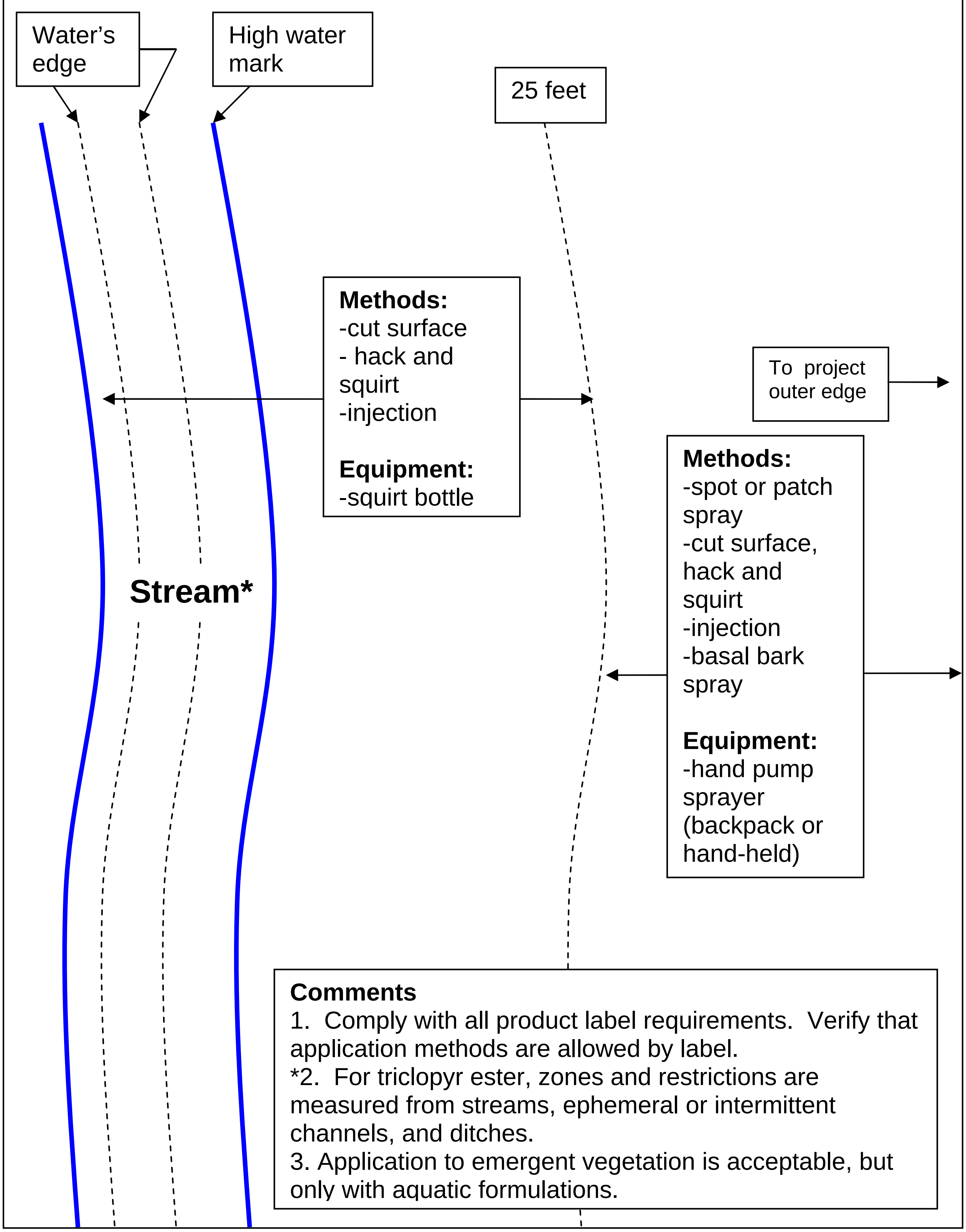


Comments

1. Comply with all product label requirements. Verify that application methods are allowed by label.

*2. . For sulfometuron methyl, zones and restrictions are measured from streams, ephemeral or intermittent channels, and ditches.

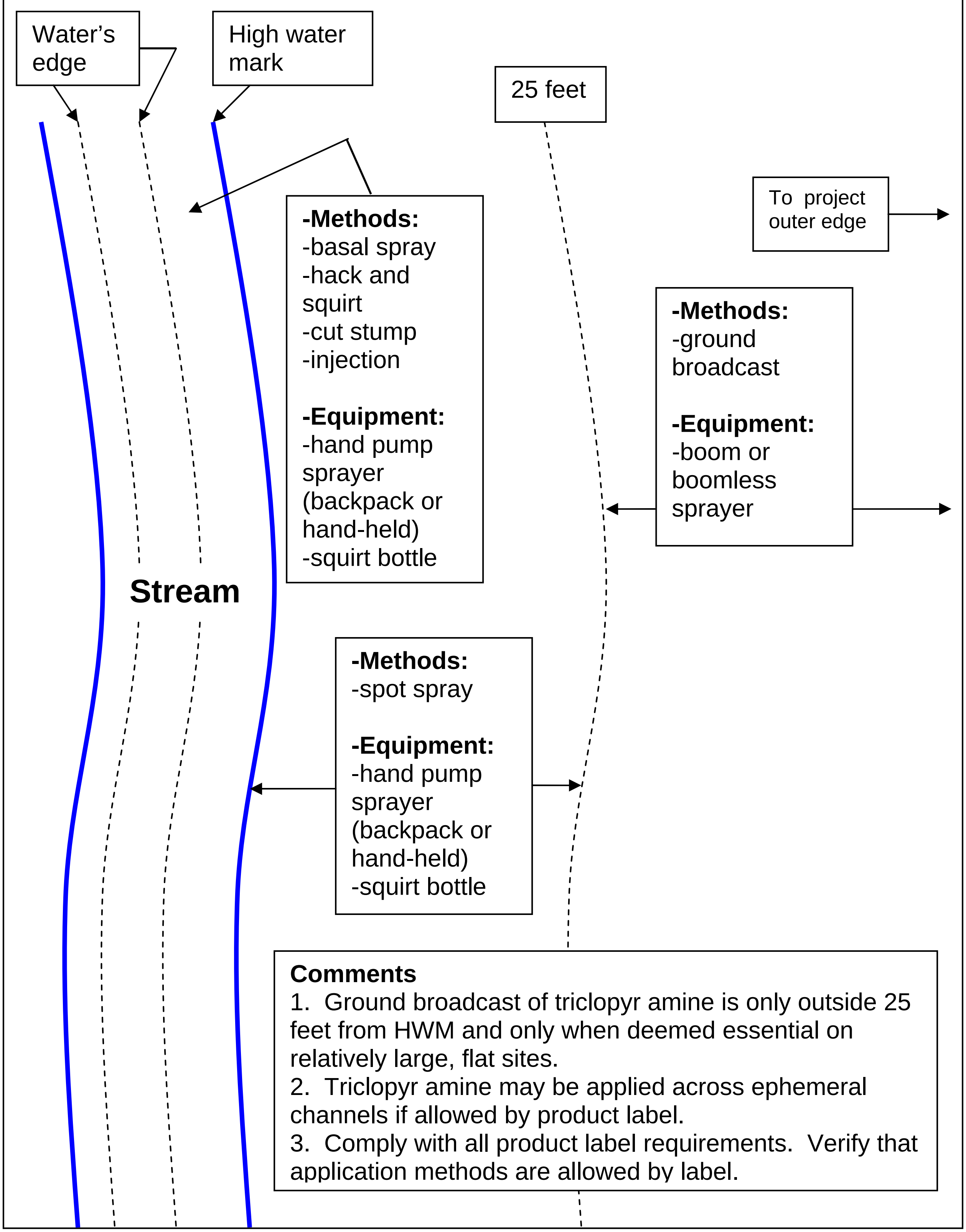
Triclopyr (ester): Methods and Equipment



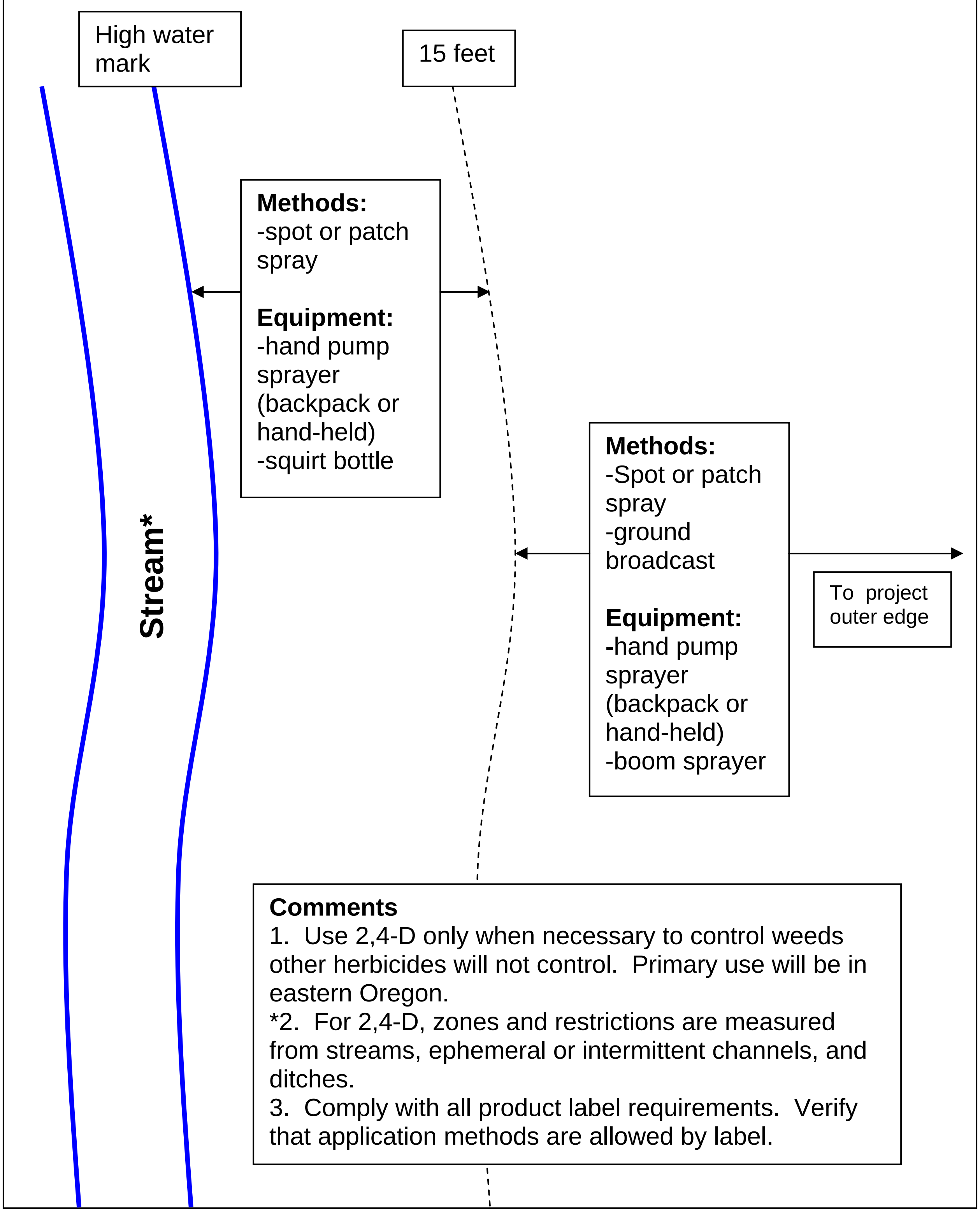
Comments
1. Comply with all product label requirements. Verify that application methods are allowed by label.
*2. For triclopyr ester, zones and restrictions are measured from streams, ephemeral or intermittent channels, and ditches.
3. Application to emergent vegetation is acceptable, but only with aquatic formulations.

-

Triclopyr (amine): Methods and Equipment



2,4-D: Methods and Equipment



Comments

1. Use 2,4-D only when necessary to control weeds other herbicides will not control. Primary use will be in eastern Oregon.

*2. For 2,4-D, zones and restrictions are measured from streams, ephemeral or intermittent channels, and ditches.

3. Comply with all product label requirements. Verify that application methods are allowed by label.

APPENDIX G
U.S. FISH AND WILDLIFE SERVICE BIOLOGICAL OPINION

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Oregon Fish and Wildlife Office
2600 SE 98th Avenue, Suite 100
Portland, Oregon 97266
Phone: (503) 231-6179 FAX: (503) 231-6195

Reply To: 8330.F0047(09)
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Doc Type: Final

Don Howard, Acting State Executive Director
U.S. Department of Agriculture
Farm Service Agency, Oregon State Office
7620 SW Mohawk St.
Tualatin, OR 97062-8121

Dear Mr. Howard,

This letter transmits the U.S. Fish and Wildlife Service's (Service) Biological and Conference Opinion (BO) and includes our written concurrence based on our review of the proposed Oregon Conservation Reserve Enhancement Program (CREP) to be administered by the Farm Service Agency (FSA) throughout the State of Oregon, and its effects on Federally-listed species in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). Your November 24, 2008 request for informal and formal consultation with the Service, and associated Program Biological Assessment for the Oregon Conservation Reserve Enhancement Program (BA), were received on November 24, 2008. We received your letter providing a 90-day extension on March 26, 2009 based on the scope and complexity of the program and the related species that are covered, which we appreciated. This Concurrence and BO covers a period of approximately 10 years, from the date of issuance through December 31, 2019. The BA also includes species that fall within the jurisdiction of the National Oceanic and Atmospheric Administration's Fisheries Service (NOAA Fisheries Service). FSA is consulting separately with the NOAA Fisheries Service concerning listed anadromous fish species and their designated critical habitats.

FSA has requested informal consultation with the Service on Columbian white-tailed deer (*Odocoileus virginianus leucurus*), Applegate's milk-vetch (*Astragalus applegatei*), Gentner mission-bells (*Fritillaria gentneri*), Howellia *(Howellia aquatilis*), Western lily (*Lilium occidentale*), Large-flowered wooly meadowfoam (*Limnanthes floccosa* ssp. *grandiflora*), Cook's lomatium (*Lomatium cookie*), MacFarlane's four o'clock (*Mirabilis macfarlanei*), Rough popcorn flower (*Plagiobothrys hirtus*), Spalding's campion (*Silene spaldingii*), Howell's spectacular thelypody (*Thelypodium howellii* ssp. *spectabilis*) and vernal pool fairy shrimp (*Branchinecta lynchi*) and its designated critical habitat. Formal consultation with the Service has been requested on Fender's blue butterfly (*Icaricia icarioides fenderi*), Golden Indian paintbrush (*Castilleja levisecta*), Bradshaw's lomatium (*Lomatium bradshawii*), Nelson's checker-mallow (*Sidalcea nelsoniana*), Willamette daisy (*Erigeron decumbens* var. *decumbens*), Kincaid's lupine (*Lupinus sulphureus* var. *kincaidii*), Warner sucker (*Catostomus warnerensis*), bull trout, Columbia River and Klamath River Basins (*Salvelinus confluentus*), Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*), Oregon chub (*Oregonichthys crameri*), shortnose sucker (*Chasmistes brevirostris*), Lost River sucker (*Deltistes luxatus*), Modoc sucker (*Catostomus microps*) and designated critical habitat for the Fender's blue butterfly, Willamette daisy, Kincaid's lupine, Warner sucker and bull trout. Conferencing has been requested for proposed critical habitat for the shortnose and Lost River suckers, and is included for Oregon chub proposed critical habitat which became available in March 2009.

Our concurrence and BO are based on (1) information provided in the BA; (2) technical assistance and informational meetings between the Service, FSA, Oregon Department of Agriculture, Natural Resource Conservation Service and NOAA Fisheries Service regarding the CREP program and consultation issues; (3) Federal Register notices of proposed and final listing rules for species covered in this opinion and relevant approved recovery plans; (4) recent consultations completed by the Service that address similar actions and one or more of the same species (*e.g.,* Invasive Plant Project with Umatilla and Wallowa-Whitman National Forests, 2009; Fender's Blue Butterfly Programmatic Safe Harbor Agreement, 2009; Western Oregon Prairie Restoration Activities, 2008; Continued Operation and Maintenance of the Willamette River Basin Project, 2008; Programmatic Aquatic Habitat Restoration Activities in Oregon and Washington, 2007; Caspian Tern Management to Reduce Predation of Juvenile Salmonids in the Columbia River Estuary, 2005; Warner Basin Environmental Quality Incentives and Conservation Security programs for irrigation system projects, 2007; (5) file materials and other sources of information. A complete administrative record of this consultation is on file at the Oregon Fish and Wildlife Office.

CONSULTATION HISTORY

On December 22, 1998, FSA submitted a Biological Assessment to initiate a programmatic-level consultation with the Service and the NOAA Fisheries Service on the Oregon CREP program. The initial Biological Assessment submitted by FSA was modified by a letter dated March 25, 1999. A BO was jointly issued by the Service and NOAA Fisheries Service on June 2, 1999 (references: NMFS Log #6112, USFWS Log #1-7-99-F-117). The Service determined that the implementation of the Oregon CREP was not likely to jeopardize any of the species nor adversely modify designated critical habitats addressed within the Service's jurisdiction in the 1999 opinion, which are shown in Table 1.

Provisions of the Oregon CREP are set forth by an agreement between the Governor of Oregon and the Secretary of Agriculture. The previous agreement, which was signed in 1998, was modified in November 2004 to expand the CREP program service area to virtually include the entire state of Oregon and to add two new practices to the program. Consequently, since the 1999 BO was issued, the programmatic changes within the CREP program, geographical program boundary changes, new species listings, species delistings, and additional critical habitat designations prompted FSA to reinitate consultation.

Table 1. Species addressed by the Service in the 1999 CREP consultation.

GROUP	SPECIES	STATUS
Fishes	Bull trout (*Salvelinus confluentus*)	T
	Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*)	T
	Oregon chub (*Oregonichthys crameri*)	E
	Lost River sucker (*Deltistes luxatus*)	E, PCH
	Shortnose sucker (*Chasmistes brevirostris*)	E, PCH
Birds	Aleutian Canada goose (*Branta canadensis leucopareia*)	T
	Bald eagle (*Haliaeetus leucocephalus*)	T
Mammals	Columbian white-tailed deer (*Odocoileus virginianus leucurus*)	E
Plants	Nelson's checkermallow (*Sidalcea nelsoniana*)	T
	Bradshaw's lomatium (*Lomatium bradshawi*)	E
	Howell's spectacular thelopody (*Thelypodium howellii* ssp. *spectabilis*)	PT
	Rough popcornflower (*Plagiobothrys hirtus*)	PE
	Willamette daisy (*Erigeron decumbens* var. *decumbens*)	PE

E = Endangered, T = Threatened, PE = Proposed Endangered, PT = Proposed Threatened, PCH = Proposed Critical Habitat

FSA began discussions with the Service and NOAA Fisheries Service about the changes to the CREP program and their consultation reinitiation needs in 2004. The Service participated in on-going discussions with FSA and the other involved agencies, and both the Service and NOAA Fisheries Service assisted with the development of the current BA until it was submitted in November 2008. Activity-based and listed species-specific best management practices (BMPs) designed to reduce and minimize the potential for adverse affects on listed species and habitats were jointly developed and are included as part of the proposed action. The Service greatly appreciates the work of FSA and its partnering agencies to carry out actions that will benefit listed species, and to incorporate BMPs that will avoid or reduce unintended impacts.

CONCURRENCE

The primary purpose of the Oregon CREP is to restore agriculture lands that contain streams to improve fish and wildlife habitat and water quality. Restoration activities designed to achieve desired habitat conditions can involve unintended and sometimes unavoidable adverse effects, especially over the short-term as project activities are taking place and after construction as sites are stabilizing. Activity-based and listed species-specific BMPs have been developed as part of the action to avoid and greatly reduce the potential for adverse affects on listed species and their habitats.

Based on the proposed action and with consideration of the BMPs, as described in the BA, the Service concurs with your determination that the proposed action may affect, but is not likely to adversely affect, the following listed species and designated critical habitat: Columbian white-tailed deer (*Odocoileus virginianus leucurus*), Applegate's milk-vetch (*Astragalus applegatei*), Gentner mission-bells (*Fritillaria gentneri*), Howellia *(Howellia aquatilis*), Western lily (*Lilium occidentale*), Large-flowered wooly meadowfoam (*Limnanthes floccosa* ssp. *grandiflora*), Cook's lomatium (*Lomatium cookie*), MacFarlane's four o'clock (*Mirabilis macfarlanei*), Rough popcorn flower (*Plagiobothrys hirtus*), Spalding's campion (*Silene spaldingii*), Howell's spectacular thelypody (*Thelypodium howellii* ssp. *spectabilis*) and vernal pool fairy shrimp (*Branchinecta lynchi*) and its designated critical habitat.

Our concurrence is based upon: (1) the processes, guidance and specifications used in administering the Oregon CREP program to ensure that activities are carried out in accordance with program directives, including environmental considerations and determining if listed species may be present on CREP project sites (see sections 2.1 and 2.2 of the BA), (2) the limited scope of the proposed action, which involves the implementation of five CREP practices (*i.e.,* filter strip, riparian forest buffer, wetland restoration, marginal pastureland wildlife habitat buffer, and marginal pastureland wetland buffer) that are specifically designed to improve fish and wildlife habitat and water quality on agricultural lands that have been impacted by past land uses, and (3) the activity-based and species-specific BMPs included in the proposed action, described in more detail below for the species addressed in this section, that are specifically designed to avoid and minimize potential adverse affects to listed species and habitats.

Columbian white-tailed deer
It is unlikely that CREP project activities will exceed current noise and activity levels on CREP project areas that may support Columbian white-tailed deer, and a BMP is in place to ensure that noise and activity levels do not rise above ambient conditions in fawning areas from June 1 to July 15. Project personnel will be instructed to reduce vehicle speed around project sites where deer occur, especially during times of limited visibility (*e.g.,* sunset to sunrise) to avoid vehicle-deer collisions. They will also be instructed not to approach adults or fawns at any time in order to avoid disturbance to the deer.

Vegetation that could be used for cover and forage by deer may be temporarily reduced as invasive species are removed, but less desirable species that are removed will be replaced by native grasses, forbs, shrubs and trees, which are expected to provide more valuable habitat for the deer. Any fencing that is installed in Columbian white-tailed deer habitat will meet a height restriction so deer will be able to move throughout the area. The use of manual and mechanical methods to control competitive vegetation around newly planted trees is encouraged to reduce the need for herbicides. Any herbicide that is used in deer habitat is restricted to certain herbicides and application rates that were found in the herbicide analyses to be below both the acute and chronic “No Observable Adverse Effect Levels” for large herbivorous mammals (see section 4.3.1.1 in the BA for a full discussion of the effects of herbicide applications to terrestrial wildlife).

We concur that CREP activities that occur in Columbian white-tailed deer habitat are likely to benefit the deer over time by restoring native vegetation and increasing the quality and quantity of available forage and cover.

Listed plants
BMPs have been developed to avoid and minimize the risk of disturbing areas where listed plants may occur. Disking, tillage, fence building, and construction of livestock watering facilities, will not take place in locations that could cause physical harm to listed plants. In addition, areas with the listed plant species included in this section will not be mowed, and vehicles and machinery will not be driven on areas where the plants occur. To avoid shading out shade-intolerant listed species, technical staff will recommend species for planting that will maintain or restore habitat conditions needed to support listed plants that occur on the project sites. Plants used in revegetation efforts will be selected based on soil type and plant community type and will not grow tall enough to shade out listed shade-intolerant species that occur on site. Therefore, shading is not likely to adversely affect listed plants.

BMPs have been developed that avoid and minimize the risks to listed plants that are associated with herbicide use. The BMPs specify and limit the types of herbicides that can be used, application methods, weather conditions required when spraying occurs, and distances that must be maintained between herbicide use and listed plants. Limitations on the herbicide use areas and application methods were developed with consideration of the potential for herbicide movement, mode of uptake by plants, herbicide half-lives, and the types of plants affected by each herbicide to prevent listed plants from being exposed to herbicides that would put them at risk. In addition, the BMPs require that listed plants be physically shielded or that application buffers be maintained between sprayed areas and listed plants to greatly minimize the potential for listed plants to come into contact with herbicides that could harm them. See the "Herbicide-related BMPs for Listed Plants" in section 2.5.6 of the BA for a complete listing of relevant BMPs.

All applicable project BMPs listed in section 2.4 of the BA will be followed, as well as those listed in section 2.5.6 of the BA that are specifically related to plants. Some CREP projects may be specifically designed to benefit threatened and endangered plants over the long-term.

Vernal pool fairy shrimp
Several BMPs have been developed to prevent or minimize potential impacts to the vernal pool fairy shrimp and its critical habitat, and most potentially disturbing activities will be avoided altogether. CREP actions will not occur directly within the vernal pool habitats themselves where vernal pool fairy shrimp may occur. Herbicides will not be applied on project areas that may support the vernal pool fairy shrimp. Activities that could cause the excess movement of soils that could be deposited into vernal pools, disturbances from vehicular or foot traffic or disruption of the impermeable subsurface soil layer needed to maintain vernal pool habitats that support the fairy shrimp are not allowed per the BMPs.

The BMPs listed in section 2.4 of the BA will be followed, as well as those listed in section 2.5.4 that are specifically related to vernal pool fairy shrimp. CREP projects may benefit the shrimp in the long-term. For instance, installing fencing to eliminate livestock traffic in vernal pools could improve water quality in vernal pools, potentially benefiting the shrimp and its critical habitat. In addition, vernal pools created through wetland restoration projects may create additional habitat for the fairy shrimp, thus benefiting the species.

CONCLUSION

In closing, we again want to express our appreciation for the efforts of FSA and its CREP partners to improve fish and wildlife habitat and support recovery actions for listed and at-risk species throughout the State of Oregon. Please do not hesitate to contact Jennifer Thompson of my staff at (503) 231-6179 if you have any questions or concerns about this consultation.

Sincerely,

Donald R. Progulske

for Paul Henson, Ph.D.
State Supervisor

Enclosure

PROGRAMMATIC
BIOLOGICAL AND CONFERENCE OPINIONS
on the
OREGON CONSERVATION RESERVE ENHANCEMENT PROGRAM

U.S. Department of Agriculture
Farm Service Agency
Oregon State Office

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Prepared by:
U.S. Fish and Wildlife Service
Oregon Fish and Wildlife Office
Portland, Oregon

Approved by: Donald R. Gogulsh
for Paul Henson, Ph.D.
State Supervisor

Date: July 24, 2009

BIOLOGICAL AND CONFERENCE OPINIONS

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1. DESCRIPTION OF THE PROPOSED ACTION

1.1. Action Area

CREP projects may take place on up to 100,000 acres of private agricultural lands (*i.e.,* pastureland and cropland) throughout Oregon during the life of the agreement between the State of Oregon and U.S. Department of Agriculture, which does not have a specified duration. To date, approximately 35,000 acres have been enrolled, leaving 65,000 acres that can be enrolled over time before the CREP cap of 100,000 acres is reached (L. Loop, pers. comm. 2009). This BO covers a period of approximately 10 years, from the date of issuance through December 31, 2019.

CREP projects will primarily occur in riparian areas, along with some wetlands and upland habitats. Wetlands and uplands enrolled in CREP will generally be associated with streams and rivers. Some supporting actions, such as spring developments, may take place in upland areas or springs. In general, habitats eligible to be enrolled in CREP have been significantly modified so they are no longer providing all of the functions that benefit fish and wildlife and water quality. Eligible lands are as follows:

- Land must have been cropped two of the last five years or be pasture that can be planted to a riparian buffer.
- Land must be along a stream where threatened or endangered salmonids, sucker, chub, or dace are present or were historically present (excludes lands above permanent barriers to fish passage); be along a stream within an area with an Agricultural Water Quality Management Area Plans; or be along a stream on reservation or tribal trust land (combined, these criteria virtually account for all of Oregon).
- The riparian area must be in poor condition. For example, the riparian area could be cropped to the water's edge, or could have small patches of vegetation interspersed with bare, heavily grazed ground.
- To receive the irrigated rental rate, land must have been irrigated for two of the last five years, and landowners must lease their water right to the Oregon Water Resources Department for the length of their CREP contract (generally 10 to 15 years).

On grazed lands, impacts from livestock use are often concentrated in riparian areas, since animals are drawn to these areas for forage and water. Concentrated livestock use of riparian areas, if improperly managed, eliminates riparian vegetation, prevents vegetation from reestablishing, and causes streambank erosion. Bank trampling and livestock activity in streams have increased sediment and manure runoff to streams, impacting aquatic life. On cropland, removal of riparian vegetation and cropping in the riparian area has reduced shade, prevented streamside vegetation from reestablishing, and caused streambank erosion. In addition, cleaning out or straightening streams along cropland or pastureland has reduced the amount and quality of instream and riparian habitat available for fish and wildlife.

The average size of a riparian buffer contract in Oregon is 28 acres. Assuming that the average width of these buffers is 100 feet, each contract provides stream buffering along 2.31 stream miles. The Oregon CREP includes incentives that encourage more projects to be concentrated together, rather than having scattered participation by individual landowners, in order to increase program effectiveness in achieving the desired water quality and habitat benefits. This is done by offering cumulative impact incentive payments to landowners in any case where a total of at least 50% of the streambank within a 5-mile stream segment is enrolled.

Listed species that occur within the action area and that are included in this programmatic consultation are shown in Table 1.

Table 1. **Species addressed by the Service in the current programmatic CREP consultation.**

GROUP	SPECIES	STATUS
Inland Fish	Bull trout (*Salvelinus confluentus*)	T, CH
	Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*)	T
	Lost River sucker (*Deltistes luxatus*)	E, PCH
	Modoc sucker (*Catostomus microps*)	E, CH
	Oregon chub (*Oregonichthys crameri*)	E, PCH
	Shortnose sucker (*Chasmistes brevirostris*)	E, PCH
	Warner sucker (*Catostomus warnerensis*)	T, CH
Plants	Bradshaw's lomatium (*Lomatium bradshawi*)	E
	Golden Indian paintbrush (*Castilleja levisecta*)	T
	Kincaid's lupine (*Lupinus sulphureus* var. *kincaidii*)	T, CH
	Nelson's checkermallow (*Sidalcea nelsoniana*)	T
	Willamette daisy (*Erigeron decumbens* var. *decumbens*)	E, CH
Invertebrates	Fender's blue butterfly (*Icaricia icarioides fenderi*)	E, CH

E = Endangered, T = Threatened, CH = Critical Habitat, PCH = Proposed Critical Habitat

The following are the annual enrollment targets for the various geographic regions within Oregon:

Coastal Basins
- 1,250 acres of riparian forest buffer
- 1,000 acres of restored wetland
- 2,250 total acres (180 total stream miles) of riparian forest, wetland, and wildlife buffers.

Columbia Basin
- 8,000 acres of riparian forest buffer and filter strips
- 1,000 acres of restored wetland
- 9,000 total acres (700 stream miles) of riparian forest, wetland, and wildlife buffers.

Interior Drainages
- 3,500 acres of riparian forest buffer and filter strips
- 1,000 acres of restored wetland
- 4,500 total acres (375 stream miles) of riparian forest, wetland, and wildlife buffers

The above figures are CREP program goals set by FSA and the Oregon Watershed Enhancement Board rather than mandated minimums, maximums, or relative proportions of projects by geographic region (L. Loop, pers. comm. 2009). From the time the CREP program became available in 1999 through January 2008, 32,650 acres have been enrolled in Oregon. CREP plantings have restored riparian vegetation along over 1,150 miles of stream. Based on the average enrollment during the first 9 years of CREP, FSA anticipates 704 more projects covering 18,000 additional acres throughout Oregon during the next five years (FSA 2008). Recent enrollments have averaged approximately 3,600 acres a year, ranging from around 3,000 to 5,000 acres per year (L. Loop, pers. comm. 2009). The actual number will depend on landowner interest and the availability of funding and technical staff to work with landowners to enroll in the project and complete practices. Landowner interest and enrollment in Oregon continues to increase (FSA 2008).

1.2. Oregon CREP Conservation Practices

The purpose of the Oregon CREP is to enroll and restore agricultural lands along streams, rivers and other waterbodies to improve fish and wildlife habitat and water quality. Participants may enroll land to be restored under one of the following Conservation Practices (CPs) eligible through the Oregon CREP: filter strips (CP21), riparian forest buffer (CP22), wetland restoration (CP23), marginal pastureland wildlife habitat buffer (CP29), and marginal pastureland wetland buffer (CP30). To complete any of the CPs, a landowner and his or her contractor(s) must complete practice **components**, which involve one or more of the following: tree and shrub planting, invasive species removal (including manual, mechanical or chemical treatments), seeding, fence installation, the installation of livestock and wildlife watering facilities, wetland restoration, livestock crossings and upland wildlife habitat management. More detailed descriptions are provided below. Some additional activities were mentioned in Appendix A of the BA (*e.g.,* breaching dikes/levies, dike setbacks, animal trapping and animal removal of invasive species), but are not typically funded through the CREP and are not included according to the BA. Therefore, unless activities were specifically discussed in the main body of the BA as part of the action, they have not been included in this BO and will need to be addressed through separate consultations as appropriate if activities arise that have not been covered.

1.2.1. Tree and Shrub Planting

Both the riparian forest buffer and wetland restoration practice may involve tree and shrub establishment. The Natural Resource Conservation Service (NRCS) Field Office Technical Guide (FOTG) has three sets of standards and specifications that apply to this component (Practice code 391A, Riparian Forest Buffer; Practice code 612; Tree and Shrub Establishment; Practice code 490, Forest Site Preparation). The ODF either prepares or reviews site preparation and tree planting plans. NRCS and SWCD technical staff recommend shrub, grass and forb species.

The landowner or contractor may complete several site preparation activities prior to planting, depending on the condition of the site. These activities include the following.

- Disking – using a tractor and disk attachment to eliminate competing vegetation in the planting area.

- Ripping – using a tractor and attachment with 3 to 4-foot deep shanks to break up compacted soil layers, increase infiltration of water, and allow tree roots to grow deeper into the soil.
- Herbicide application – applying herbicide to reduce competition with new plantings (this activity is described in more detail in section 1.2.2).
- Mechanical and manual clearing – using equipment or hand tools to clear a field of heavy weeds or to clear circles around spots where trees will be planted. Depending on the site conditions, heavy equipment, small mechanical equipment, or hand tools may be used.

Once the site is prepared for planting, the landowner or contractor will either hand-plant or machine-plant trees and shrubs. For a bare-root seedling, the tree planter or planting machine create a hole for the plant, spread out the roots and fill in the hole. Stakes are usually pounded or shoved into the ground without digging. However, if the planting occurs in a very rocky site, the tree planter may use other equipment to dig holes for bareroot seedlings or stakes.

After the planting, the landowner or contractor may reduce competing vegetation to increase planting survival by manually, mechanically or chemically treating vegetation around the plantings. This activity may be done anytime during the life of the CREP contract. Landowners may also irrigate the plantings for the first three years of establishment if they have valid water rights. Pipelines may be installed using mechanical equipment or manual methods (*i.e.,* a shovel or pick) to dig trenches for the placement of pipes. Water may be delivered from a bucket, hose, water truck, handlines, pipes, sprinkler heads, spray guns or microsprinklers. The water source may be a stream, well, or water truck.

Moisture conservation measures, such as placing geo-textile fabric or mulch around plants, may be used to help ensure survival of plantings. Temporary animal control measures are sometimes used to protect the plants in areas where they may be damaged due to browsing or grazing. Tree protection may involve putting cages, netting or tubes around the plants. Repellents such as bloodmeal and human hair may also be used to keep target animals away from plants while they are becoming established.

Oregon Department of Forestry or other technical staff conduct annual site reviews, and certify the tree and shrub establishment as complete when the plants are in a “free to grow” condition. In other words, they are no longer in danger of dying because of competing vegetation.

1.2.2. Herbicide Applications

Herbicides may be used for site preparation, short-term management during the period when revegetated areas are becoming established, and site maintenance as needed during the life of the CREP contract to control invasive plants. A variety of chemicals, application equipment and application methods are proposed for addressing CREP program needs to control various invasive species of concern, with consideration of site-specific situations and factors. Herbicides proposed for use in CREP activities covered under this programmatic consultation are limited to aminopyralid, chlorsulfuron, clopyralid, dicamba, glyphosate, hexazinone, imazapic, imazapyr, metsulfuron methyl, picloram, sethoxydim, sulfometuron methyl, triclopyr and 2,4-D. Application equipment to be used includes hand pump sprayers, hand pump backpack sprayers, boom or boomless sprayers, and wick or wipe equipment for applications that will include basal bark treatment, patch spray, spot spray, cut surface treatment, hack and squirt, herbicide injection, ground broadcast spray, spot application with dry granule, and wick or wipe applications.

Section 2.3.2.1of the BA (incorporated by reference) includes general descriptions of each herbicide that may be used, the formulations to be used on CREP projects, and the proposed application methods and equipment. Application methods and equipment are described for use within various zones along streams, lakes and ponds. Additional BMPs and application zones that will be used to further minimize effects to listed species and their critical habitats are discussed in sections 1.3.3 and 1.4 below (based on sections 2.4.3 and 2.5 of the BA).

1.2.3. Seeding

Seeding may occur on any of the CREP conservation practices to establish wildlife habitat and provide for filtration of pollutants from runoff. Two NRCS practice codes may apply (Filter Strip; Riparian Herbaceous Cover). NRCS or SWCD staff will prepare seeding recommendations for landowners to implement this component. Seeding activities may include plowing or disking the riparian area, rolling or packing the soil, and mechanically seeding the area or hand-broadcasting seed. A no-till drill may also be used to plant the seed and lessen soil disturbance. Plugs may also be planted. Competing vegetation, including weeds, may be chemically treated before or after the seeding. The landowner must continue to control weeds on the seeding throughout the life of the CREP contract.

1.2.4. Fence Installation

Fencing may be built on any CREP practice except for wetland restoration. NRCS practice code 382 (Fence) applies to this activity. CREP participants may build either a 4-strand barbed wire or smooth-wire fence. If they wish to construct a woven-wire or other fence, they may receive cost-share only up to the cost of the 4-strand wire fence. To install the fence, participants must either hand-dig post holes or use equipment such as an auger, then string the wire. The fence must be maintained to exclude livestock from the CREP area for the life of the contract.

1.2.5 Livestock and Wildlife Watering Facilities

Livestock watering facilities may be built on any CREP practice except for wetland restoration. Wildlife watering facilities may be built on any CREP practice. Several NRCS practice codes may apply to the livestock and wildlife watering facility components (Practice Code 574, Spring Development; Practice Code 614, Trough or Tank; Practice Code 614, Watering Facility; Practice Code 648, Wildlife Watering Facility; Practice Code 441, Pipeline; Practice Code 776, Aluminum Pipe).

To construct a spring development, the landowner or contractor would manually or mechanically excavate into the spring, level the area, install a spring box, and install a pipe that feeds from the spring box to the livestock trough or tank. Vegetation may need to be cleared from around the spring. A trench is dug from the spring box to the trough and a pipe is installed in the trench to feed the trough. A fence is also constructed around the spring development to protect it from livestock trampling. Alternatively, the trough or tank may be fed from a stream or river. The landowner installs a pump with a fish screen into the stream, withdrawing water to feed the trough or tank. In some cases, machinery is used to shape a section of the bank (*i.e.,* less than 30 linear feet) as needed to install the pump and piping.

Livestock troughs are usually installed above-ground and are equipped with a float valve. Manual labor or a tractor is used to excavate and level the site. A concrete pad is then poured into a form created on-site, and the trough or tank and pump are bolted onto the concrete pad. Facilities include escape ramps to prevent wildlife from being trapped in the troughs. To prevent mud from accumulating around the trough, it is surrounded with a concrete pad, gravel, and/or geotextile fabric. No portion of these watering facilities will be constructed within any portion of the active stream channel, with the exception of pumps and pipes that may be installed to withdraw water to feed the trough or tank, as discussed above (L. Loop, pers. comm. 2009).

1.2.6. Wetland Restoration

A wetland restoration component is only conducted on the wetland restoration practice (CP 23). NRCS practice code 657 (Wetland Development or Restoration) applies to this component. The only wetland restoration projects included in this programmatic consultation are those that involve breaking drain tiles, excavating to create new shallow vernal pools, and reestablishing native wetland vegetation. To break drainage tile, small holes will be dug along drain tile pathways to break the tile, and holes will then be filled in with soil. New vernal pools may be constructed, typically in disturbed areas dominated by non-native species. To construct vernal pools, the existing vegetation would be scraped away and shallow, small pools will be constructed no more than a few inches deep. Generally, natural topography will be restored. Native vegetation would be established through tree and shrub planting or seeding.

1.2.7. Livestock Crossings

Livestock crossings may be installed on all CREP practices except wetland restorations. The NRCS practice standard for Animal Trails and Walkways (575) applies to this component. Some livestock crossings involve minimal bank shaping (*i.e.,* less than 30 linear feet), vegetation clearing, and installing rock and/or geotextile on the bank and in the stream channel to minimize erosion at the crossing site. Fencing is installed, and may be placed across the creek to keep livestock within the crossing area. These livestock crossings are included as part of the action in this consultation.

Crossings that involve culvert installation within habitat for fish species under NOAA Fisheries Service jurisdiction and that meet the NOAA Fisheries Service criteria outlined in the Standard Localized Operating Procedures for Endangered Species (SLOPES) BiOp are also included in the CREP BA. However, crossings that involve culvert or bridge installation that are outside the terms and conditions of the SLOPES BiOp, or that may affect the fish species included in this BO (*i.e.,* that fall within the Service's jurisdiction) are not included as part of the action and will require individual consultations.

1.2.8. Upland Wildlife Habitat Management

Revegetation of native plant communities may occur to enhance upland wildlife habitat. In addition, structures such as nesting platforms, snags and bird and bat boxes may be installed to benefit local wildlife. Mechanical augers may be used to dig holes to install structures, and blasting charges or chain saws may be used to create snags. In some cases, hand tools may be used to prune trees. Meadows may be maintained, created or improved by clearing or thinning trees or other vegetation using hand saws, chain saws or machetes. Light disking may be used as a strategy to promote plant species desirable to upland wildlife or promote plant species of concern. Projects involving disking in areas where listed plants or their designated critical habitats occur are not included in this consultation, and will be addressed as needed through separate consultations.

1.3. Activity-Based Best Management Practices

Activity-based and listed species-specific BMPs are included as part of the action, as described in the BA (see sections 2.4 and 2.5). The activity-based BMPs are listed below, organized by type of action. They are designed to help avoid adverse impacts to multiple taxa. Additional BMPs for specific listed species that may occur within the vicinity of CREP projects are discussed in section 1.4. In areas where BMPs may conflict, the more restrictive BMP applies.

1.3.1. General BMPs

- Technical staff will determine which listed species may occur in the area prior to completing the CREP conservation plan for a site. Surveys for listed species that may occur within the area to be affected will be conducted whenever possible; if information is not available about potential location(s) of listed species and surveys cannot be conducted for species that may occur, it will be assumed that species that may occur are present.
- Technical staff will work with landowners to plan construction and other activities to minimize or eliminate adverse effects to listed species and to follow all applicable BMPs.
- Exploring opportunities to benefit listed species and support their recovery is encouraged on CREP project sites that may provide potentially suitable habitat.
- Sediments will be removed from behind work isolation structures or stabilized before structures or erosion controls are removed.
- Existing roads or travel paths will be used to access project sites whenever possible; vehicular access ways to project sites will be planned ahead of time and will provide for minimizing impacts on riparian corridors and areas where listed species or their critical habitats may occur.
- Vehicle use and human activities, including walking in areas occupied by listed species, will be minimized to reduce damage or mortality to listed species.
- Vehicles will not enter or cross streams except in cases where no alternative exists. Where stream crossings are required, the number of crossings will be minimized. Vehicles and machinery will cross streams at right angles to the main channel whenever possible. The use of equipment in or adjacent to a stream channel will be minimized to reduce sedimentation rates and channel instability.
- Removal of native vegetation will be limited to the amount that is absolutely necessary to complete a construction activity.
- Slash materials will be gathered by hand or with light machinery to reduce soil disturbance and compaction. Avoid accumulating or spreading slash in upland draws, streams, and springs. Slash control and disposal activities must be conducted in a manner that reduces the occurrence of debris in aquatic habitats.
- Disturbed areas will be reseeded or planted with apropriate vegetation.

1.3.2. BMPs for Planting

- Vegetative planting techniques must not cause major disturbances to soils or slopes.
- Hand planting is the preferred technique for all plantings, except for filter strips.
- Planting will occur during the appropriate seasonal period for the respective plant species involved.
- Only native species will be used for CREP projects whenever feasible. Where use of native vegetation is not feasible, similar species which are functional equivalents and are known not to be aggressive colonizers may be substituted.
- All materials must be from an appropriate seed zone and certified as disease-free.
- Seeding to establish riparian buffers will use seed that is certified weed-free.

1.3.3. BMPs for Herbicide Applications

The following BMPs are in addition to the measures discussed under "Use Zones, Application Equipment, and Application Methods" for each specific herbicide in section 2.3.2. of the BA, which is hereby incorporated by reference Additional BMPs may be required where certain listed species occur, as discussed in section 1.4. In areas where BMPs may conflict, the more restrictive BMP applies.

BMPs for all herbicide applications

- All herbicide label requirements will be followed.
- Herbicides will not be applied if precipitation is likely within 24 hours unless using soil-activated herbicides, which can be applied as long as label is followed.
- When consistent with label instructions, water will be used when diluting herbicides prior to application. When oil carriers are needed, only crop oils will be used. Use of diesel oil is prohibited.
- A spill cleanup kit will be available whenever herbicides are used, transported, or stored. The cleanup kit will include, at a minimum, the herbicide Material Safety Data Sheet, the herbicide label, emergency phone numbers, and absorbent material such as cat litter to contain the spill.
- Anyone that applies herbicides on a CREP project is required to provide FSA with a written herbicide application summary. The summary will indicate who applied the herbicide, what was applied, how it was applied, when it was applied, the location of the application on the project map, and the rate of application.
- All herbicide applications will be reported to the Oregon Department of Agriculture (PURS) as required by state law.
- When adjuvants are added to a herbicide formulation, Agri-dex and LI-700 will be the only adjuvants used within 200 feet of the high-water mark.

BMPs for herbicide applications along streams, lakes, and ponds

BMPs for Basal Bark herbicide applications from HWM to outer edge of project

- Dilute herbicide with a crop oil (vegetable oil). (Use of diesel oil is prohibited).
- Avoid unnecessary run off when applying herbicide to stems of undesirable vegetation.
- Apply using lowest nozzle pressure that will allow adequate stem coverage.

- Apply spray from the stream bank into the project area (applicator should have back to the stream).
- Do not apply during periods of rain, snow, or melting snow.

BMPs for spot spraying or patch spraying herbicide within 15 feet of HWM:

- If possible, spraying is to take place only during calm periods (no breeze), except when a temperature inversion exists. Temperature inversions may increase the likelihood of off-target drift. Read and follow all product label requirements related to temperature inversions.
- Spraying may take place IF there is a breeze of 6 mph or less AND the direction of the breeze is away from the creek or other sensitive resources.
- Allow post-application rain free period according to herbicide label requirements.
- Herbicide will be applied such that the spray is directed towards the project area away from the creek [person applying the spray will generally have their back to the creek or other sensitive resource.]
- Nozzles will be adjusted [to minimize fine particle size] such that spray does not drift off of the project site or away from the target vegetation.
- The spray nozzle will be kept within four feet of the ground when herbicide is being applied.
- To the extent possible, the spray will be directed away from all desirable vegetation.

BMPs for spot spraying or patch spraying herbicide from 15 feet to outer edge of project:

Same as requirements as "within 15 feet of HWM" except that herbicide can be applied with nozzle that is held up to six feet above the ground if needed to treat taller clumps of competing vegetation.

BMPs for ground broadcast spraying herbicide from 15 feet out from HWM to outer limit of project boundary.

- If possible, spraying is to take place only during calm periods (no breeze).
- Spraying may take place IF there is a breeze of 6 mph or less AND the breeze is blowing away from the creek or other sensitive resource.
- Allow post-application rain free period according to herbicide label requirements
- Spray will be applied in swaths parallel to the creek.
- Spray boom will be mounted such that nozzles are no more than four feet above the ground.
- Nozzles will be adjusted to minimize fine particle size such that spray does not drift off of project site.
- Nozzle pressure will be the adjusted to the lowest practical level (psi) while still providing for reasonable spray converge.
- Drift control agents will be used if necessary to prevent any spray from drifting off of the project site.

BMPs for Cut Surface application from HWM to outer edge of project boundary.

- Applications will be made in a manner that prevents herbicide runoff onto the ground.
- Do not apply herbicide during periods of rain, snow, or melting snow.

BMPs for Hack & Squirt / Injection application from HWM to outer edge of project boundary.

- Applications will be made in a manner that prevents herbicide runoff onto the ground.
- Do not apply herbicide during periods of heavy rainfall.

<u>BMPs for spot application of dry granule [Pronone].</u>
Same as <u>"BMPs for spot or patch spraying herbicide from 15 feet to outer edge of project"</u> with the following exception:

- Applications can be accomplished during a breeze of up to 10 mph <u>IF</u> the direction of the breeze is away from the creek or other sensitive resources.

1.3.4. BMPs for Chemical Effects

Please refer to section 1.3.3. for BMPs specifically related to herbicide use. Other chemicals that may be used on CREP projects are associated with mechanical equipment, vehicle or pump use. These chemicals include fuels and other fluids normally needed to operate farm equipment or other vehicles. To minimize potential impacts from these pollutants, the following BMPs will be used:

- Appropriate materials and supplies (*e.g.,* shovels, disposal containers, absorbent materials, first aid supplies, and clean water) will be available on-site to cleanup any small accidental spills in accordance with product Material Safety Data Sheets and labels. Significant hazardous spills will be reported to the Oregon Emergency Response System at 1-800-452-0311 (system available 24 hours a day). (Also see ODEQ emergency response web site at http://www.deq.state.or.us/wmc/cleanup/spl0.htm for more information.) The Oregon Poison Control Center will be contacted at 1-800-222-1222 (24 hours) for assistance in responding to emergency exposures. Project managers will ensure that each applicator is familiar with spill response procedures before commencing herbicide application operations.
- Locate staging and refueling areas at least 150 feet from any stream or other waterbody.
- Limit the size of staging and refueling areas and only store enough supplies, materials, and equipment onsite to complete the project.
- All equipment must be cleaned to remove external oil, grease, dirt, and mud before beginning operations below the high water mark of a stream.
- All equipment operated within 150 feet of an aquatic habitat must be inspected daily for fuel leaks before leaving the equipment staging area. All detected leaks must be repaired in the staging area before the equipment resumes operation.
- All stationary power equipment (*e.g.,* generators) operated within 150 feet of any aquatic habitat must be diapered to prevent leaks and/or enclosed in a containment device (*e.g.,* non permeable drip plan) of adequate capacity to retain equipment fluids (*e.g.,* gasoline, diesel fuel, and oil) if a leak occurs.

<u>1.3.5. BMPs for Fence Installation</u>

- Where wildlife movement is a concern, maximum fence height is 42 inches.

<u>1.3.6. BMPs for Riparian, Instream and Streambank Work</u>

To prevent disturbances to fish and wildlife and their habitats from riparian, instream and streambank work, the following BMPs will be used:

- Whenever possible, livestock will be excluded from streams and riparian areas altogether.

- There will be no instream work except for installation of livestock crossings and the installation of pumps and pipes for off-stream livestock watering facilities.[1]
- Oregon guidelines for the timing of in-water work will be followed for each affected stream reach, unless the Oregon Department of Fish and Wildlife (ODFW) approves an extension based on current year site-specific conditions. In reaches where the current ODFW timing restrictions for instream construction activities conflicts with the needs for resident listed fish, ODFW should be contacted for a waiver to the timing restrictions to avoid impacts to listed fish.
- Streambank shaping may be implemented where streambank stability is extremely poor or where necessary to restore riparian functions. Streambank modification for planting purposes will be thoroughly documented.
- On each CREP contract where more than 30 linear feet of streambank is shaped by mechanical equipment, USDA will consult with the Services (this consultation only covers projects that involve shaping of up to 30 linear feet of streambank).
- Bank shaping will be done from the top of bank.
- Design of all streambank modification projects will recognize the important wildlife values provided along naturally eroding outside meander curves.
- Any soil control structures will be bio-engineered to the extent possible.
- No riprap will be used under this program for streambank stabilization.
- No streambank stabilization activity will reduce natural stream functions or floodplain connection.
- Sedimentation and erosion controls will be implemented on all project sites where the implementation of restoration activities has the potential to deposit sediment into a stream or waterbody. Structures/techniques must be placed and/or anchored appropriately to prevent adverse impacts to down slope habitats. Control structures/techniques may include, but are not limited to, silt fences, straw bale structures, seeding by hand and hydro-seeding, jutte mats, and coconut logs. Grading and shaping will generally restore natural topography and hydrology.

1.3.7. BMPs for Mechanical Activities

To minimize potential impacts of mechanical activities on sensitive species and habitats, the BMPs below will be followed.

- The project boundary must be flagged to prevent soil disturbance to areas outside the site.
- Construction impacts will be confined to the minimum area necessary to complete the project.
- Filter strips will be left between disturbed areas and streams.
- To prevent the spread of noxious weeds and non-native plants, all vehicles and heavy construction equipment will be cleaned to remove mud, debris, and vegetation prior to entering the project area; all equipment must be cleaned to remove external oil, grease, dirt, and mud before beginning operations below the high water mark elevation of a stream.
- All equipment operated within 150 feet of an aquatic habitat must be inspected daily for fuel leaks before leaving the equipment staging area. All detected leaks must be repaired in the staging area before the equipment resumes operation.

[1] The BMP in the BA reads, "There will be no instream work except for installation of livestock crossings and installation of offstream livestock watering facilities." This BMP was rewritten to clarify that the only instream work associated with watering facilities involves the installation of pumps and pipes.

(See BMPs for Chemical Effects in section 1.3.4 for additional measures that apply to mechanical activities.)

1.3.8. BMPs for Livestock Watering Facilities and Spring Developments

- Whenever possible, livestock will be excluded from streams and riparian areas altogether.
- Springs will always be fenced when spring developments are constructed to provide off-stream watering for livestock.
- Watering facilities will be equipped with float valves, and protection will be used around troughs and other watering sources as needed to prevent mud and sediment delivery to streams.
- Pumps must be screened to meet NOAA Fisheries' fish screen criteria, be self-cleaning or regularly maintained (by removing debris buildup), and a responsible party must be designated to ensure proper operation (*i.e.,* regular inspection and as-needed maintenance to ensure pumps and screens are properly functioning). On CREP projects where listed suckers or Oregon chub may be affected, pumps may be installed under this BA if water delivery is under 0.5 cfs (minor volume diversions).
- All pumps must be sized to only use water amounts that fall within the allowances of the landowner's documented or estimated historic water use and legal water right(s).
- Water withdrawals for watering facilities or irrigation must not dewater habitats, or cause or exacerbate low stream flow conditions that could impact listed fish.
- Escape ramps will be installed on all livestock and wildlife watering facilities.
- Off-channel livestock watering facilities will not be located in areas where compaction and/or damage could occur to sensitive soils, slopes, or vegetation due to congregating livestock.
- Livestock stream crossings will only be constructed on the smallest streams, generally 10 feet or less in width at mean high water level. Crossings will not be placed on the mid- to downstream end of gravel point bars. Crossings will generally be 30 feet or less in width.
- Livestock stream crossings will be appropriately rocked to stabilize soils/slopes and prevent erosion. Fords will be placed on bedrock or stable substrates whenever possible.
- Crossings that involve culvert or bridge installation within habitat for listed fish under NOAA Fisheries' jurisdiction must meet the criteria outlined in the SLOPES BiOp. Crossings that involve culvert or bridge installation that are outside the terms and conditions of the SLOPES BiOp, or that are within habitat for fish species under the jurisdiction of the U.S. Fish and Wildlife Service require individual consultations.

1.4. Listed Species-Specific Best Management Practices

Activity-based and listed species-specific BMPs are included as part of the action, as described in the BA. The species-specific BMPs for the species covered in this consultation are listed below. For projects that involve sites where listed species may be affected by CREP activities, the pertinent species-specific BMPs will be followed in addition to all other BMPs that may apply to the project activities or area. In areas where BMPs may conflict, the more restrictive BMP applies. Some of the BMPs below are repeated because they apply to more than one listed species category.

1.4.1. BMPs for Listed Inland Fish

The BMPs below will be followed to avoid or minimize effects on listed inland fish (see list of inland fish species in Table 1).

General BMPs for Listed Inland Fish

- Oregon guidelines for the timing of in-water work will be followed for each affected stream reach, unless the Oregon Department of Fish and Wildlife approves an extension based on current year site-specific conditions. In reaches where the ODFW in-water work period conflicts with the needs for resident listed fish, ODFW should be contacted for a waiver to the timing restrictions.
- Stream crossings involving culverts or bridges within habitat for listed fish under the jurisdiction of the U.S. Fish and Wildlife Service require individual section 7 consultations.
- Potential spawning habitat will be surveyed for listed species within 300 feet downstream of a proposed stream crossing. Stream crossing will not be constructed at known or suspected spawning areas, or within 300 feet upstream of such areas if spawning areas may be affected.
- Spring development projects will not occur from springs where listed species occur, and water will not be redirected from habitat where listed species occur.
- On CREP projects where listed anadromous species, bull trout or Lahontan cutthroat trout may be affected, pumps must be screened to meet NOAA Fisheries' fish screen criteria, be self-cleaning or regularly maintained (by removing debris buildup), and a responsible party must be designated to ensure proper operation (*i.e.,* regular inspection and as-needed maintenance to ensure pumps and screens are properly functioning).
- On CREP projects where listed suckers or Oregon chub may be affected, pumps may be installed under this BA if water delivery is under 0.5 cfs (minor volume diversions). Pumps must be screened to meet NOAA Fisheries' fish screen criteria, be self-cleaning or regularly maintained (by removing debris buildup), and a responsible party must be designated to ensure proper operation (*i.e.,* regular inspection and as-needed maintenance to ensure pumps and screens are properly functioning).
- Water withdrawals for watering facilities or irrigation must not dewater habitats, or cause or exacerbate low stream flow conditions that could impact listed fish.
- CREP project sites with spring habitats that may support the Hutton tui chub or Foskett speckled dace within Lake County, Oregon will be surveyed for these species if the springs may be affected. An individual ESA section 7 consultation should be initiated if needed *(these species are not included in this programmatic consultation)*. If springs will not be affected but there is potential for either of these species to occur on CREP project sites, the Oregon Department of Fish and Wildlife and/or U.S. Fish and Wildlife Service may be contacted to investigate the possibility that unknown populations exist if landowners are agreeable.

Herbicide BMP for Bull trout

- The herbicide-related BMPs listed in section 1.3.3 and the measures discussed under "Use Zones, Application Equipment, and Application Methods" for each specific herbicide in section 2.3.2 of the BA (incorporated by reference) will be followed on CREP project sites with bull trout.

Herbicide BMPs for listed suckers, Oregon chub and Lahontan cutthroat trout

Shortnose, Lost River, Warner and Modoc suckers, Oregon chub and Lahontan cutthroat trout all have relatively limited distributions in Oregon compared with anadromous salmonids and bull trout, and all but the Warner sucker and Lahontan cutthroat trout are listed as endangered. To reduce the risk of potential adverse affects to these species and their proposed and designated critical habitats, the added precautions below will be taken when applying herbicides on or near habitats where they may occur. The allowable herbicide use covers a wide range of noxious weed treatment needs that may be encountered, while reducing risks to listed species and their critical habitats.

- Herbicides used along streams and ponds is limited to the following chemicals, as proposed in the BA with the restrictions in parenthesis:
    - Aminopyralid
    - Clopyralid
    - Dicamba (beyond 25' of the HWM only at no more than the typical rate of 0.3 lbs/acre)
    - Glyphosate (at no more than the typical application rate of 2 lbs/acre)
    - Imazapic (beyond 50' of the HWM only)
    - Imazapyr (beyond 25' of the HWM only at no more than the typical rate of 0.45 lbs/acre)
    - Picloram (at no more than the typical application rate of 0.35 lbs/acre in areas with annual rainfall levels below 50" only)
- Only aminopyralid may be used in ditches and intermittent channels, and only in segments of ditches and channels where listed species do not occur.
- Only glyphosate may be used in perennial channel instream areas (*i.e.,* dry areas within channel and emergent knotweed) using spray, wick or wipe application methods at a rate of no more than 0.5 lbs/acre or using the injection method in accordance with label requirements.
- Applicable application methods, use zones and BMPs described in sections 1.2.2 and 1.3.3 above, and in sections 2.3.2 and 2.4.3 of the BA (incorporated by reference), shall be followed. In the event that measures conflict, the more restrictive measure shall be followed.

These BMPs were developed based on the combined results of all of the related analyses for the various scenarios discussed in section 4.3.1 and Appendix E of the BA (incorporated by reference). The specific herbicides, application rates, rainfall levels and distances from aquatic resources described in the BMPs are below threshold risk levels (*i.e.,* HQ values and NOEC levels) found in the analyses for fish as well as aquatic invertebrates, algae, and aquatic macrophytes, which are related to the PCEs for designated and proposed critical habitats and food and cover resources for listed fish.

1.4.2. BMPs for Fender's blue butterfly

The BMPs below will be used to avoid or minimize effects on Fender's blue butterfly.

General BMPs for Fender's blue butterfly

- If possible, CREP sites with potential Fender's blue butterfly habitat will be surveyed for Fender's blue butterfly host plants (*i.e., Lupinus sulphureus* spp. *kincaidii, L. arbustus, L. albicaulis)* during the optimal survey period (May and June, or otherwise when in bloom between late April and July). If suitable lupine habitat is present, Fender's blue butterfly surveys will be conducted during the mid-May to early July flight period. Surveys will be conducted by a qualified biologist or individual trained to conduct surveys for this species, and may include observations for presence of the species and non-destructive egg or larvae counts. If it is not possible to conduct surveys or otherwise document that Fender's blue butterfly is absent from the site, it will be assumed that the site is occupied.

- Soil disturbing activities, such as disking, tillage and fence building, will not take place in locations that could cause physical harm to the Fender's blue butterfly or listed plants.
- With the exception of mowers used for mowing in accordance with the BMPs below, vehicles and machinery will not be driven where Fender's blue butterfly or listed plants could be impacted.
- Invasive plants may be removed using a variety of manual methods and hand tools, including hoeing, grubbing, pulling, clipping, digging or cutting. Tools that may be used include shovels, hoes, weed wrenches, lopping shears, trowels, machetes, weed wackers, hand saws and chain saws. Removal using these methods may occur year-round, as long as precautions are taken to prevent negative effects to listed species.
- Trees and shrubs will only be planted outside of habitats where the Fender's blue butterfly or listed prairie plants may occur, and outside of their critical habitats.
- CREP projects may include actions designed to benefit the butterfly, such as planting native nectar and host plants on sites that may support Fender's blue butterfly if food sources or host species are lacking and could be added to enhance habitat.
- If there are opportunities to support Fender's blue butterfly recovery efforts on CREP project sites where landowners may be interested, partners such as the U.S. Fish and Wildlife Service may be invited to provide additional technical and possible financial assistance.

Mowing BMPs for Fender's Blue Butterfly Habitats

- Mowing may be conducted throughout sites with Fender's blue butterflies when lupine and nectar plants have completed seed production, lupine have not yet re-emerged and the butterflies are in diapause (i.e. generally August 15 to February 28).
- Mowing at any time of year, including early spring mowing (i.e. March 1 to May 15), may be used for management purposes in unoccupied Fender's blue butterfly habitat; note that BMPs in section 1.4.3 for sites with Kincaid's lupine or other listed plants may be applicable.
- After the butterfly flight season but before lupine senescence (generally June 30 through August 15), tractor mowing may occur no closer than 2 meters (m) (6 feet) from the nearest lupine host plants.
- Mowing with hand-held mowers may be implemented during the Fender's blue butterfly flight season (generally May 1 to June 30), as long as a buffer of at least 8 m (25 feet) is maintained between the mower and any individual of a lupine host plant. Spring tractor mowing will not occur at sites with Fender's blue butterflies.
- Rubber-tracked mowers vs. wheeled mowers will be encouraged whenever possible/practical and the mowing deck should be set sufficiently high to avoid soil gouging and impacting listed plants and butterfly larvae, but low enough to remove weed flowers (generally at least 15 centimeters [cm]) (6 inches).[2]

Herbicide-related BMPs for Fender's Blue Butterfly

[2] This BMP was changed from "Mowers will be rubber-tracked and the mowing deck will be set sufficiently high to avoid soil gouging (generally at least 15 centimeters) (6 inches) to reduce potential impacts to butterfly larvae and low-stature native plants," as written in the BA, for consistency with related BMPs and to allow for greater flexibility.

- Only the following herbicides may be applied on sites with Fender's blue butterfly: glyphosate, imazapyr, clopyralid, triclopyr BEE, and triclopypr TEA; no more than one type of herbicide will be used at a time (*i.e.,* herbicides will not be mixed).
- On sites where Fender's blue butterfly may occur, herbicide spraying will only occur while larvae are in diapause (*i.e.,* generally August 15 through February 28).
- Host plants (*i.e.,* Kincaid's, sickle-keeled, and spur lupine) will be covered during spraying, even if they have senesced, to protect butterfly larvae that may be on the plant or on the ground in the immediate vicinity; plants will be uncovered immediately after spraying has been completed.

<u>1.4.3. BMPs for Listed Plants</u>

The BMPs below will be used to avoid or minimize effects on listed plants.

General BMPs for Listed Plants

- All CREP sites will be surveyed for any listed plants that may occur in the project area; surveys will be conducted by a botanist or otherwise qualified individual following a standardized or otherwise appropriate protocol during the known flowering period for the specific plant.
- Soil disturbing activities, such as disking, tillage and fence building, will not take place in locations that could cause physical harm to the Fender's blue butterfly or listed plants.
- With the exception of mowers used for mowing in accordance with the BMPs below, vehicles and machinery will not be driven where Fender's blue butterfly or listed plants could be impacted.
- Trees and shrubs will only be planted outside of habitats where the Fender's blue butterfly or listed prairie plants may occur, and outside of their critical habitats.

Mowing BMPs for Listed Plants

Project sites occupied by listed native prairie plants species in the Willamette Valley may be mowed to control or remove woody vegetation or invasive non-native vegetation, as follows:

- Mowing may occur when listed plants are dormant and seeds have been dispersed (generally August 15 through February 28).
- Spring mowing with tractor or hand-held mowers may occur where necessary to control overwhelming weed infestations, except at sites with Fender's blue butterflies. Spring mowing at sites with listed plants will maintain a buffer of 2 m (6 feet) from nearest listed plants. However, if needed to control serious infestations of weeds that mainly reproduce by seed (*e.g.,* meadow knapweed [*Centaurea x pratensis*]), up to one half of the listed plant population at a site may be mowed in an effort to reduce seed set by non-native weeds.
- Rubber-tracked mowers vs. wheeled mowers will be encouraged whenever possible/practical and the mowing deck should be set sufficiently high to avoid soil gouging and impacting listed plants and butterfly larvae, but low enough to remove weed flowers (generally at least 15 centimeters [cm]) (6 inches).
- All mowing equipment will be cleaned of invasive and non-native plant materials before entering an occupied site to prevent the dispersal of unwanted seeds or other reproductive plant parts.

Herbicide-related BMPs for Listed Plants

Only the following herbicides will be applied on listed plant sites: glyphosate, imazapyr, clopyralid, triclopyr BEE, triclopypr TEA, Pronone (granular form of hexazinone), sethoxydim and 2,4-D. FSA selected this subset of herbicides will provide effective control of weeds while minimizing impacts to sensitive plants. Application will occur in accordance with the BMPs below.

BMPs for Wick/Wipe herbicide applications from edge of listed plant site to outer edge of project

- Glyphosate and clopyralid may be hand-applied up to or within the plant patch to control competing vegetation.
- A 10-foot buffer will be maintained between the plant patch and the hand-application area for imazapyr, 2,4-D, and the triclopyrs to reduce the risk of herbicide movement through the soil and uptake by the roots of listed plants.

BMPs for Basal Bark herbicide applications from edge of listed plant site to outer edge of project

- Dilute herbicide with a crop oil (vegetable oil). (Use of diesel oil is prohibited).
- Avoid unnecessary run off when applying herbicide to stems of undesirable vegetation.
- Apply using lowest nozzle pressure that will allow adequate stem coverage.
- Applicator should apply facing away from plant site.
- Do not apply during periods of rain, snow, or melting snow.
- A 10-foot buffer will be maintained between the plant patch and the hand-application area for imazapyr, 2,4-D, and the triclopyrs to reduce the risk of herbicide movement through the soil and uptake by the roots of listed plants.
- Listed plants will be physically shielded (*e.g.,* covered with buckets or some other barrier that will not harm the plants) as needed to protect them from drift, unless they are dormant; plants will be uncovered immediately after spraying has been completed.

BMPs for spot spraying or patch spraying herbicide from edge of listed plant site out 50 feet

- If possible, spraying is to take place only during calm periods (no breeze).
- Spraying may take place IF there is a breeze of 3 mph or less AND the direction of the breeze is away from the sensitive resource.
- Allow post-application rain free period according to herbicide label requirements.
- Herbicide will be applied such that the spray is directed towards the project area away from the sensitive resource [person applying the spray will generally have their back to the plant site or other sensitive resource.]
- Nozzles will be adjusted to minimize fine particle size such that spray does not drift off of the project site or away from the target vegetation.
- The spray nozzle will be kept within four feet of the ground when herbicide is being applied within 50 feet of listed plants; beyond 50 feet, the nozzle may be held up to six feet above ground if needed to treat taller clumps of competing vegetation.
- To the extent possible, the spray will be directed away from all desirable vegetation.
- A 10-foot buffer will be maintained between the plant patch and the spray application area for imazapyr, 2,4-D and the triclopyrs to reduce the risk of herbicide movement through the soil and uptake by the roots of listed plants.

- Listed plants will be physically shielded (*e.g.,* covered with buckets or some other barrier that will not harm the plants) as needed to protect them from spray or drift, unless they are dormant; plants will be uncovered immediately after spraying has been completed.

BMPs for ground broadcast spraying herbicide

- Broadcast sprays will only occur at a distance from listed plants where the hazard quotient identified from SERA risk assessment worksheets is below 1 (*i.e.,* adverse effects are not likely to occur according to the analyses). Specific application buffers are as follows: 900 feet for clopyralid and imazapyr; 300 feet for triclopyr acid (TEA) and BEE, and 50 feet for glyphosate.
- If possible, spraying is to take place only during calm periods (no breeze).
- Spraying may take place IF there is a breeze of 3 mph or less AND the breeze is blowing away from the sensitive resource.
- Allow post-application rain free period according to herbicide label requirements
- Spray boom will be mounted such that nozzles are no more than four feet above the ground.
- Nozzles will be adjusted to minimize fine particle size such that spray does not drift off of project site.
- Nozzle pressure will be the adjusted to the lowest practical level (psi) while still providing for reasonable spray converge.
- Drift control agents will be used if necessary to prevent any spray from drifting off of the project site.

BMPs for Cut Surface application from edge of listed plant site to outer edge of project

- Applications will be made in a manner that prevents herbicide runoff onto the ground.
- Do not apply herbicide during periods of rain, snow, or melting snow.

BMPs for Hack & Squirt / Injection application from edge of listed plant site to outer edge of project

- Applications will be made in a manner that prevents herbicide runoff onto the ground.
- Do not apply during herbicide during periods of heavy rainfall.

BMPs for spot application of dry granule [Pronone]

- A 10-foot buffer will be maintained between the plant patch and the application area to prevent exposure by listed plants.
- If possible, application is to take place only during calm periods (no breeze).
- Applications may take place IF there is a breeze of 10 mph or less AND the direction of the breeze is away from the sensitive resource.

2. ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

2.1 Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this BO relies on four components: (1) the *Status of the Species*, which evaluates the range-wide condition, the factors responsible for that condition, and the survival and recovery needs for the species covered in the

BO; (2) the *Environmental Baseline*, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species covered in the BO; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species covered in the BO; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the species covered in the BO.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the current status of each species addressed in the BO, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of any of the covered species in the wild.

The jeopardy analysis in this BO places an emphasis on consideration of the range-wide survival and recovery needs of the species addressed in this BO and the role of the action area in the survival and recovery of the species as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

2.2 Adverse Modification Determination

This BO does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this BO relies on four components: (1) the *Status of Critical Habitat*, which evaluates the range-wide condition of designated critical habitats for the species addressed in this BO in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat overall; (2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on designated critical habitats for species addressed in this BO are evaluated in the context of the range-wide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat range-wide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the species.

The analysis in this BO places an emphasis on using the intended range-wide recovery function of critical habitats for the species addressed in this BO and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

3. STATUS OF THE SPECIES AND DESIGNATED CRITICAL HABITAT

3.1. Bull trout, *Salvelinus confluentus*

Listing Status

The coterminous United States population of the bull trout (*Salvelinus confluentus*) was listed as threatened on November 1, 1999 (USFWS 1999a,b). A 5-year review was conducted in 2008 and reaffirmed the species status as threatened (USFWS 2008a). The threatened bull trout generally occurs in the Klamath River Basin of south-central Oregon; the Jarbidge River in Nevada; the Willamette River Basin in Oregon; Pacific Coast drainages of Washington, including Puget Sound; major rivers in Idaho, Oregon, Washington, and Montana, within the Columbia River Basin; and the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Cavender 1978, Bond 1992, Brewin *et al.* 1997, Leary and Allendorf 1997).

The bull trout was initially listed as three separate Distinct Population Segments (DPSs) (USFWS 1998a and 1999a). The Columbia and Klamath DPSs were consolidated into one listed taxon (USFWS 1999a). Based on conformance with the DPS policy for purposes of consultation under section 7 of the Act, we retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process (USFWS 2005b).

At the time of publication of the Draft Bull Trout Recovery Plan (USFWS 2002b), there were 27 recovery units described. Almost immediately upon publication, the FWS recognized that these units may not meet the FWS standard for "recovery units" and decided to call them "management units." In addition, the DPSs described in the June 10, 1998 listing of bull trout (USFWS 1998a) were subsequently recognized as "interim recovery units" in the November 1, 1999, final listing rule for bull trout (USFWS 1999a). In summary, until the Draft Bull Trout Recovery Plan is finalized, the FWS has adopted the use of local population, core area, management unit, and interim recovery unit for purposes of consultation and recovery.

Critical Habitat

The Service published a final critical habitat designation for the coterminous United States population of the bull trout on September 26, 2005 (USFWS 2005b); the rule became effective on October 26, 2005. Approximately 3,828 miles of streams and 143,218 acres of lakes and reservoirs in Oregon, Washington, Idaho and Montana were designated. The scope of the designation involves the Klamath River, Columbia River, Coastal-Puget Sound, and St. Mary-Belly River DPSs. No critical habitat was designated for the Jarbidge River population of bull trout in Nevada and southern Idaho. The conservation role of bull trout critical habitat is to support viable core area populations (USFWS 2005a). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses.

Critical habitat units generally encompass one or more core areas and may include foraging, migration and overwintering areas outside of core areas that are important to the survival and recovery of bull trout. Because there are numerous exclusions that reflect land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments. These individual critical habitat segments are expected to contribute to the ability of the stream to support bull trout within local populations and core areas in each critical habitat unit.

The primary function of individual critical habitat units is to maintain and support core areas which (1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993); (2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (Rieman and McIntyre 1993, MBTSG 1998); (3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Rieman and McIntyre 1993, Hard 1995, Healey and Prince 1995, MBTSG 1998); and (4) are distributed throughout the historical range of the species to preserve both genetic and phenotypic adaptations (Rieman and McIntyre 1993, Hard 1995, MBTSG 1998, Rieman and Allendorf 2001).

Within the designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, and sheltering. The PCEs are as follows:

1. Water temperatures that support bull trout use. Bull trout have been documented in streams with temperatures from 0 to 22 ºC (32 to 72 ºF) but are found more frequently in temperatures ranging from 2 to 15 ºC (36 to 59 ºF). These temperature ranges may vary depending on bull trout life-history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence. Stream reaches with temperatures that preclude bull trout use are specifically excluded from designation;

2. Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures;

3. Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. This should include a minimal amount of fine substrate less than 0.63 centimeters (0.25 inches) in diameter;

4. A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, currently operate under a BO that addresses bull trout, or a hydrograph that demonstrates the ability to support bull trout populations by minimizing daily and day-to-day fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variation. This rule finds that reservoirs currently operating under a BO that addresses bull trout provides management for PCEs as currently operated;

5. Springs, seeps, groundwater sources, and subsurface water to contribute to water quality and quantity as a cold water source;

6. Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows;

7. An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish; and

8. Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.

Critical habitat includes the stream channels within the designated stream reaches, the shoreline of designated lakes, and the inshore extent of marine nearshore areas, including tidally influenced freshwater heads of estuaries.

Current Status and Conservation Needs

In recognition of available scientific information relating to their uniqueness and significance, five interim recovery units of the coterminous United States population of the bull trout are considered essential to the survival and recovery of the species: Jarbidge River, Klamath River, Columbia River, Coastal-Puget Sound, and St. Mary-Belly River. Each of these interim recovery units is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions.

Jarbidge River

This interim recovery unit currently contains a single core area with six local populations. Less than 500 resident and migratory adult bull trout, representing about 50 to 125 spawners, are estimated to occur within the core area. The current condition of the bull trout in this interim recovery unit is attributed to the effects of livestock grazing, roads, angler harvest, timber harvest, and the introduction of non-native fishes (USFWS 2004c). The draft bull trout recovery plan (USFWS 2004c) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout within the core area; maintain stable or increasing trends in abundance of both resident and migratory bull trout in the core area; restore and maintain suitable habitat conditions for all life history stages and forms; and conserve genetic diversity and increase natural opportunities for genetic exchange between resident and migratory forms of the bull trout. An estimated 270 to 1,000 spawning fish per year are needed to provide for the persistence and viability of the core area and to support both resident and migratory adult bull trout (USFWS 2004c).

Klamath River

This interim recovery unit currently contains three core areas and 12 local populations. The current abundance, distribution, and range of the bull trout in the Klamath River Basin are greatly reduced from historical levels due to habitat loss and degradation caused by reduced water quality, timber harvest, livestock grazing, water diversions, roads, and the introduction of non-native fishes (USFWS 2002b). Bull trout populations in this unit face a high risk of extirpation (USFWS 2002b). The draft bull trout recovery plan (USFWS 2002b) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout and restore distribution in previously occupied areas; maintain stable or increasing trends in bull trout abundance; restore and maintain suitable habitat conditions for all life history stages and strategies; conserve genetic diversity and provide the opportunity for genetic exchange among appropriate core area populations. Eight to fifteen new local populations and an increase in population size from about 3,250 adults currently to 8,250 adults are needed to provide for the persistence and viability of the three core areas (USFWS 2002b).

Columbia River

This interim recovery unit currently contains about 90 core areas and 500 local populations. About 62 percent of these core areas and local populations occur in central Idaho and northwestern Montana. The condition of the bull trout within these core areas varies from poor to good but generally all have been subject to the combined effects of habitat degradation, fragmentation, fisheries management, and alterations associated with one or more of the following activities: dewatering; road construction and maintenance; mining, and grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; poaching and incidental mortality from other targeted fisheries; entrainment into diversion channels; and introduced non-native species. The draft bull trout recovery plan (USFWS 2002b) identifies the following conservation needs for this unit: maintain or expand the current distribution of the bull trout within core areas; maintain stable or increasing trends in bull trout abundance; maintain/restore suitable habitat conditions for all bull trout life history stages and strategies; and conserve genetic diversity and provide opportunities for genetic exchange.

Coastal-Puget Sound

Bull trout in the Coastal-Puget Sound interim recovery unit exhibit anadromous, adfluvial, fluvial, and resident life history patterns. The anadromous life history form is unique to this unit. This interim recovery unit currently contains fourteen core areas and 67 local populations (USFWS 2004a,b). Bull trout are distributed throughout most of the large rivers and associated tributary systems within this unit. With only a few exceptions, bull trout continue to be present in nearly all major watersheds where they likely occurred historically within this unit. Generally, bull trout distribution has contracted and abundance has declined especially in the southeastern part of the unit. The current condition of the bull trout in this interim recovery unit is attributed to the adverse effects of dams, forest management practices (*e.g.,* timber harvest and associated road building activities), agricultural practices (*e.g.,* diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation), livestock grazing, roads, mining, urbanization, poaching and incidental mortality from other targeted fisheries, and the introduction of non-native species. The draft bull trout recovery plan (USFWS 2004a,b) identifies the following conservation needs for this unit: maintain or expand the current distribution of bull trout within existing core areas; increase bull trout abundance to about 16,500 adults across all core areas; and maintain or increase connectivity between local populations within each core area.

St. Mary-Belly River

This interim recovery unit currently contains six core areas and nine local populations (USFWS 2002b). Currently, the bull trout is widely distributed in the St. Mary River drainage and occurs in nearly all of the waters that it inhabited historically. Bull trout are found only in a 1.2-mile reach of the North Fork Belly River within the United States. Redd count surveys of the North Fork Belly River documented an increase from 27 redds in 1995 to 119 redds in 1999. This increase was attributed primarily to protection from angler harvest (USFWS 2002b). The current condition of the bull trout in this interim recovery unit is primarily attributed to the effects of dams, water diversions, roads, mining, and the introduction of non-native fishes (USFWS 2002b). The draft bull trout recovery plan (USFWS 2002b) identifies the following conservation needs for this unit: maintain the current distribution of the bull trout and restore distribution in previously occupied areas; maintain stable or increasing trends in bull trout abundance; restore and maintain suitable habitat conditions for all life history stages and forms; conserve genetic diversity and provide the opportunity for genetic exchange; and establish good working relations with Canadian interests because local bull trout populations in this unit are comprised mostly of migratory fish, whose habitat is mostly in Canada.

Species Description

Bull trout, a char in the salmonid family, were commonly known as Dolly Varden until recognized as a separate species by the American Fisheries Society in 1980. Char are distinguished from trout and salmon by the absence of teeth in the roof of the mouth, presence of light colored spots, small scales, and differences in the structure of their skeleton. Their spotting pattern is easily recognizable, showing pale yellow spots on the back, and pale yellow and orange or red spots on the sides. Bull trout fins are tinged with yellow or orange, while the pelvic, pectoral, and anal fins have white margins. Bull trout have no black or dark markings on the fins. They have an elongated body covered with cycloid scales, somewhat rounded and slightly compressed laterally. Unlike Dolly Varden, the head of a bull trout is more broad and flat on top, and hard to the touch. The bull trout was first described by Girard in 1856 from a specimen collected in the lower Columbia River.

Life History

Bull trout exhibit resident and migratory life-history strategies through much of the current range (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. Migratory bull trout spawn in tributary streams where juvenile fish rear from one to four years before migrating to either a lake (adfluvial), a river (fluvial), or in certain coastal areas to salt water (anadromous) where they grow to maturity (Fraley and Shepard 1989, Goetz 1989). Growth of resident fish is generally slower than migratory fish; resident fish tend to be smaller at maturity and less fecund (Fraley and Shepard 1989, Goetz 1989). The size and age of maturity for bull trout is variable depending upon life-history strategy, but they typically reach sexual maturity in 4 to 7 years. Bull trout can live as long as 12 years.

Preferred bull trout spawning habitat consists of low gradient streams with loose, clean gravel (Fraley and Shepard 1989) and water temperatures 5 to 9 ^{o}C (41 to 48 ^{o}F) (Goetz 1989). Spawning occurs late summer to early fall in the upper reaches of clear streams in areas of flat gradient, uniform flow, and uniform gravel or small cobble. Bull trout typically spawn from August to November during periods of decreasing water temperatures. However, migratory bull trout frequently begin spawning migrations as early as April, and move upstream as far as 250 kilometers (km) (155 miles (mi)) to spawning grounds (Fraley and Shepard 1989). Temperatures during spawning generally range from 4 to 10 ^{o}C (39 to 51 ^{o}F), with redds often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989, Pratt 1992, Rieman and McIntyre 1996). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992), and juveniles remain in the substrate after hatching. Time from egg deposition to emergence may surpass 200 days. Fry normally emerge from early April through May depending upon water temperatures and increasing stream flows (Howell and Buchanan 1992, Pratt 1992, Ratliff and Howell 1992). Fry and juvenile fish are strongly associated with the stream bottom and are often found at or near it.

Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macro-zooplankton, amphipods, mysids, crayfish, and small fish (Wyman 1975, Rieman and Lukens 1979, Boag 1987, Goetz 1989, Donald and Alger 1992). Adult migratory bull trout are an apex predator that is primarily piscivorous, known to feed on various trout (*Salmo* spp.) and salmon (*Onchorynchus* spp.), whitefish (*Prosopium* spp.), yellow perch (*Perca flavescens*), and sculpin (*Cottus* spp.) (Fraley and Shepard 1989, Donald and Alger 1992). Growth varies depending upon life-history strategy. Resident adults range from 150 to 300 millimeters (mm) or (6 to 12 inches (in.)) total length, and migratory adults commonly reach 600 mm (24 in) or more (Pratt 1985, Goetz 1989).

Older individuals are found in deeper and faster water compared to juveniles. Adults are often found in pools sheltered by large, organic debris or “clean” cobble substrate (McPahil and Murray 1979). Migratory bull trout may use a wide range of habitats ranging from first-to-sixth order streams and varying by season and life stage. In intermountain areas, lower-elevation lakes and rivers constitute important habitats for maturing and overwintering fluvial and adfluvial bull trout. Resident populations are generally found in small headwater streams where they spend their entire lives. Stream resident bull trout occupy small, high-elevation streams.

Where suitable migratory corridors exist, extensive migrations are characteristic of this species. Retention and recovery of migratory life history forms and maintenance or re-establishment of stream migration corridors is considered crucial to the persistence of bull trout throughout their geographic range. Migratory bull trout facilitate the interchange of genetic material between local subpopulations and are necessary for recolonizing habitat where subpopulations are or become extirpated by natural or human-caused events.

Habitat Needs

Bull trout have habitat requirements that are more specific than those for many other salmonids (Rieman and McIntyre 1993). Four elements relate to suitable bull trout habitat, known as the “Four C’s”: (1) CLEAN substrate composition that includes free interstitial spaces, (2) COMPLEX cover including large woody debris, undercut banks, boulders, shade, pools or deep water, (3) COLD water temperatures, and (4) CONNECTED habitats through migratory corridors. Stream temperatures and substrate types are especially important to bull trout, with water temperature representing a critical habitat characteristic for bull trout. Temperatures above 15 ^{o}C (59 ^{o}F) are thought to limit bull trout distribution (Rieman and McIntyre 1993). Spawning bull trout require hiding cover such as logs and undercut banks. Strict habitat requirements make spawning and incubation habitat for bull trout limited and valuable (Fraley and Shepard 1989).

Strong populations require high stream channel complexity, and are likely to be found in areas with low road densities, on forested lands, and in mid-size streams at relatively high elevations (> 5000 feet) (Quigley and Arbelbide 1997). However, because bull trout exhibit a patchy distribution, even in undisturbed habitats (Rieman and McIntyre 1993), fish are not likely to simultaneously occupy all available habitats (Rieman *et al.* 1997).

Reasons for Listing and Threats

Bull trout are vulnerable to many of the same threats that have reduced salmon populations in the Columbia River Basin. They are more sensitive to increased water temperatures, poor water quality, and low flow conditions than many other salmonids. Past and continuing land management activities such as timber harvest, livestock grazing, road construction, and mining have degraded stream habitat, especially those along larger river systems and stream areas located in valley bottoms, to the point where bull trout can no longer survive or successfully reproduce. Cumulative impacts of these activities are increased stream temperatures, more fine sediment in spawning gravels, loss of stream channel stability, and the creation of migration barriers. Road construction and maintenance account for a majority of man-induced sediment loads to streams in forested areas (Shepard *et al.* 1984b; Cederholm and Reid 1987; Furniss *et al.* 1991). Sedimentation affects streams by reducing pool depth, altering substrate composition, reducing interstitial space, and causing braiding of channels (Rieman and McIntyre 1993), which reduce carrying capacity. Sedimentation negatively affects bull trout embryo survival and juvenile bull trout rearing densities (Shepard *et al.* 1984b; Pratt 1992).

Large dams built for flood control and power production have eliminated riverine habitat and restricted bull trout movement. Culverts installed at road crossings may also act as barriers to bull trout movement. Additionally, irrigation withdrawls including diversions can dewater spawning and rearing streams, impede fish passage and migration, and cause entrainment. Discharging pollutants such as nutrients, agricultural chemicals, animal waste, and sediment into spawning and rearing waters is also detrimental. The loss and degradation of habitat has isolated many populations, increasing the risk of extinction due to demographic, genetic, and environmental stochasticity, and other natural catastrophic events. In many watersheds, remaining bull trout are small, resident fish isolated in headwater streams.

Historically, both intentional reductions and liberal harvest regulations posed a threat to some bull trout populations. Bull trout can no longer be legally harvested in Idaho, but misidentification of bull trout as brook trout or lake trout is resulting in some fish being killed accidentally. Illegal poaching of spawning adults is a problem in some areas.

Hybridization, competition, and predation from non-native species has also been detrimental to bull trout. Brook trout readily spawn with bull trout creating a hybrid that is often sterile. Lake trout have out-competed and replaced adfluvial populations of bull trout in some lakes. Overall, interspecific interactions, including predation, with non-native species may exacerbate stresses on bull trout from habitat degradation, fragmentation, isolation, and species interactions (Rieman and McIntyre 1993).

Warmer temperature regimes associated with global climate change represent another risk factor for bull trout. Increased stream temperature is a recognized effect of a warming climate (ISAB 2007). Species at the southern margin of their range that are associated with colder water temperatures, such as the bull trout, are likely to become restricted to smaller more disjunct habitat patches or become extirpated as the climate warms (Rieman *et al.* 2007). Climate warming is projected to result in the loss of 22 to 92 percent of suitable bull trout habitat in the Columbia River basin (ISAB 2007). Habitat conservation and restoration will be needed to mitigate these habitat losses.

3.2. Lahontan cutthroat trout, *Oncorhynchus clarki henshawi*

Listing Status

Lahontan cutthroat trout is an inland subspecies of cutthroat trout endemic to the physiographic Lahontan basin of northern Nevada, eastern California, and southern Oregon (USFWS 1995). It was initially listed as endangered under the Endangered Species Conservation Act of 1969 based on evidence of destruction and drastic modification of their habitat and hybridization with introduced species (USFWS 1970). The species was reclassified as threatened in 1975 to facilitate management and allow regulated angling (USFWS 1975). Critical habitat has not been designated for Lahontan cutthroat trout. A final recovery plan for Lahontan cutthroat trout was published by the Service in January 1995 (USFWS 1995). The species has been introduced into habitat outside of its native range, primarily for recreational fishing purposes.

Species Description

The Lahontan cutthroat trout is an inland subspecies of cutthroat trout belonging to the Salmonidae family. This trout is one of 14 recognized subspecies of cutthroat trout in the western United States. Stream-dwellers generally live less than 5 years, and lake-dwellers live between 5 and 9 years. Lahontan cutthroat trout range between 10 and 15 inches in length, and feed on terrestrial and aquatic insects.

Cutthroat trout have the most extensive range of any inland trout species of western North America, and occur in anadromous, non-anadromous, fluvial, and lacustrine populations (Behnke 1979). Many of the basins in which cutthroat trout occur contain remnants of much more extensive bodies of water which were present during the wetter period of the late Pleistocene epoch (Smith 1978).

Differentiation of the species into 14 recognized subspecies occurred during subsequent general desiccation of the Great Basin and Inter-mountain Region since the end of the Pleistocene, and indicates presence of cutthroat trout in most of their historic range prior to the last major Pleistocene glacial advance (Behnke 1981, Loudenslager and Gall 1980). Ancestral Lahontan cutthroat trout probably invaded the pluvial Lake Lahontan system over 35,000 years ago (Gerstung 1986, Coffin 1982), although the precise events of entry and origin of original stock are unclear (Behnke 1979, Loudenslager and Gall 1980).

Life History and Habitat Needs

Lahontan cutthroat trout evolved in a range of habitat types, from cold-water, high elevation streams to warmer, more alkaline lake environments. It is likely that localized, natural events historically caused the local extirpation of small populations of Lahontan cutthroat trout. Those events included landslides and rock fall, fires, drought, and debris flows that restricted movement. Lahontan cutthroat trout population persistence is associated with the ability to maintain connectivity among populations, (*i.e.,* networked populations). A networked system is defined as an interconnected, stream and/or stream lake system in which individuals can migrate from or disperse into areas from which fish have been extirpated. This ability to disperse and repopulate habitats allows populations to persist (Neville-Arsenault 2003, Rieman and Dunham 2000, Dunham *et al.* 1997). Periodic repopulation by upstream or downstream sources enabled Lahontan cutthroat trout to survive extreme circumstances and provided for genetic exchange (Neville-Arsenault 2003).

Lahontan cutthroat trout historically occurred in most cold waters of the Lahontan Basin of Nevada and California, including the Humboldt, Truckee, Carson, Walker, and Summit Lake/Quinn River drainages. Large alkaline lakes, small mountain streams and lakes, small tributary streams, and major rivers were inhabited, resulting in the present highly variable subspecies. The fish occurred in Tahoe, Pyramid, Winnemucca, Summit, Donner, Walker, and Independence Lakes, but disappeared from the type locality, Lake Tahoe, about 1940 due primarily to blockage of spawning tributaries, and subsequently from Pyramid and Walker Lakes (Behnke 1979). The subspecies has been extirpated from most of the western portion of its range in the Truckee, Carson and Walker River Basins, and from much of its historic range in the Humboldt Basin. Only remnant populations remain in a few streams in the Truckee, Carson, and Walker Basins out of an estimated 1,020 miles of historic habitat (Gerstung 1986). Coffin (1988) estimated that only 85 stream populations existed in the Humboldt Basin in a total of 270 miles of habitat compared with an estimated historic occurrence in 2,210 stream miles.

Lahontan cutthroat trout, like other trout species, are found in a wide variety of cold-water habitats including large terminal alkaline lakes (*e.g.,* Pyramid and Walker lakes); oligotrophic alpine lakes (*e.g.,* Lake Tahoe and Independence Lake); slow meandering low-gradient river (*e.g.,* Humboldt River); moderate gradient montane rivers (*e.g.,* Carson, Truckee, Walker, and Marys Rivers); and small headwater tributary stream (*e.g.,* Donner and Prosser Creeks). Generally, Lahontan cutthroat trout occur in cool flowing water with available cover, velocity breaks, well-vegetated and stable stream banks, and relatively silt free, rocky substrate in riffle-run areas.

Lacustrine Lahontan cutthroat trout populations have adapted to a wide variety of lake habitats from small alpine lakes to large desert waters. Unlike most freshwater fish species, some Lahontan cutthroat trout tolerate alkalinity and total dissolved solid levels as high as 3,000 mg/L and 10,000 mg/L, respectively (Koch *et al.* 1979). Galat *et al.* (1983) indicated that Lahontan cutthroat trout will develop slight to moderate hyaline degeneration in kidney tubules in lakes where total dissolved solids and sulfates equal or exceed 5,000mg/L and 2,000 mg/L, respectively. This ability to tolerate high alkalinity prompted introductions of Lahontan cutthroat trout into saline-alkaline lakes in Nevada, Oregon, and Washington for recreational purposes (Trotter 1987). Walker Lake, Nevada is the most saline-alkaline water maintaining a Lahontan cutthroat trout sport fishery. In Walker Lake, total alkalinity exceeded 2,800 mg/L HCO 3 in 1975 and total dissolved solids exceeded 11,000 mg/L in 1982 (Sevon 1988).

Like other cutthroat trout subspecies, Lahontan cutthroat trout is an obligatory stream spawner that spawns between April and July. Spawning depends upon stream flow, elevation, and water temperature. Female sexual maturity is reached between the ages of 3 and 4, while males mature at 2 to 3 years of age. Over 60 percent of male and female Lahontan cutthroat die after their first time spawning, and those that remain usually spawn again two or more years later. Consecutive repeat spawning is very rare.

Reasons for Listing and Threats

The severe decline in range and numbers of Lahontan cutthroat trout is attributed to a number of factors, including hybridization and competition with introduced trout species; loss of spawning habitat due to pollution from logging, mining, and urbanization; blockage of streams by dams; channelization; de-watering from irrigation and urban water withdrawal; and watershed degradation due to overgrazing of domestic livestock (Gerstung 1986, Coffin 1988, Wydoski 1978). Minshall *et al.* (1989) state that the major human impacts on Great Basin streams are due to irrigated farming and livestock grazing. In the Humboldt Basin in Nevada, Coffin (1981, 1982, 1988) and Behnke (1979) attribute the poor condition of most stream habitats primarily to effects of extensive long-term livestock grazing. However, in the Truckee, Carson, and Walker Basins, Gerstung (1986) does not include effects of livestock grazing as a factor in the decline of Lahontan cutthroat trout, but includes pollution, over fishing, construction of dams and diversions, and competition and hybridization with non-native trout species.

3.3. Warner sucker, *Catostomus warnerensis*

Listing Status and Critical Habitat

The Service listed the Warner sucker as a threatened species and designated critical habitat on September 27, 1985 (USFWS 1985b). A final recovery plan for the Warner sucker was published in the Federal Register on April, 27, 1998 (USFWS 1998c).

Warner sucker critical habitat includes the following streams in Lake County, Oregon and 50 feet on either side of the stream banks: Twelvemile Creek from the confluence of Twelvemile and Twentymile Creeks upstream for about six stream kilometers (four stream miles); Twentymile Creek starting about 14 kilometers (nine miles) upstream of the junction of Twelvemile and Twentymile Creeks and extending downstream for about 14 kilometers (nine miles); Spillway Canal north of Hart Lake and continuing about three kilometers (two miles) downstream; Snyder Creek, from the confluence of Snyder and Honey Creeks upstream for about five kilometers (three miles); Honey Creek from the confluence of Hart Lake upstream for about 25 kilometers (16 miles). Constituent elements of the critical habitat include streams 15 feet to 60 feet wide with gravel-bottom shoal and riffle areas with intervening pools. Streams should have clean, unpolluted flowing water and a stable riparian zone. The streams should support a variety of aquatic insects, crustaceans, and other small invertebrates for food (USFWS 1985b).

Species Description

The Warner sucker is a member of the Catostomidea family. It is a slender-bodied species that attains a maximum recorded fork length (the measurement on a fish from the tip of the nose to the middle of the tail where a V is formed) of 456 millimeters (17.9 inches). Pigmentation of sexually mature adults can be striking. The dorsal two-thirds of the head and body are blanketed with dark pigment, which borders creamy white lower sides and belly. During the spawning season, males have a brilliant red (or, rarely, bronze) lateral band along the midline of the body, female coloration is lighter. Breeding tubercles (small bumps usually found on the anal, caudal and pelvic fins during spawning season) are present along the anal and caudal fins of mature males and smaller tubercles occasionally occur on females (Coombs *et al.* 1979).

Sexes can be distinguished by fin shape, particularly the anal fin, among sexually mature adults (Coombs *et al.* 1979). The anal fin of males is broad and rounded distally, whereas the female anal fin is narrower in appearance and nearly pointed or angular. Bond and Coombs (1985) listed the following characteristics of the Warner sucker that differentiate it from other western species of Catostomus: dorsal fin base short, its length typically less than, or equal to, the depth of the head; dorsal fin and pelvic fins with 9 to 11 rays; lateral line (microscopic canal along the body, located roughly at midside) with 73-83 scales, and greater than 25 scales around the caudal peduncle (rear, usually slender part of the body between the base of the last anal fin ray and the caudal fin base); eye small, 0.035 millimeter (0.0013 inch) Standard Length (straight-line distance from the tip of the snout to the rear end of the vertebral column) or less in adults; dark pigmentation absent from lower 1/3 of body; in adults, pigmented area extends around snout above upper lip; the membrane-covered opening between bones of the skull (fontanelle) is unusually large, its width more than one half the eye diameter in adults.

Life History and Habitat Needs

Much of the information on the life history of Warner sucker is taken from the species' recovery plan (USFWS 1998c). Information from research and observations since completion of the recovery plan has been added.

The probable historic range of the Warner sucker includes the main Warner Lakes (Pelican, Crump, and Hart), and other accessible standing or flowing water in the Warner Valley, as well as the low to moderate gradient reaches of the tributaries which drain into the Warner Valley. Warner sucker historic distribution in tributaries includes Deep Creek (up to the falls west of Adel), the Honey Creek drainage, and the Twentymile Creek drainage. In Twelvemile Creek, a tributary to Twentymile Creek, the historic range of Warner sucker extended through Nevada and back into Oregon.

Early collection records document the occurrence of Warner sucker from Deep Creek up to the falls about 5 kilometers (3.1 miles) west of Adel, the sloughs south of Deep Creek, and Honey Creek (Snyder 1908). Andreasen (1975) reported that long-time residents of the Warner Valley described large runs of suckers in the Honey Creek drainage, even far up into the canyon area.

Between 1977 and 1991, eight studies examined the range and distribution of the Warner sucker throughout the Warner Valley (Kobetich 1977, Swenson 1978, Coombs *et al.* 1979, Coombs and Bond 1980, Hayes 1980, White *et al.* 1990, Williams *et al.* 1990, White *et al.* 1991). These surveys have shown that when adequate water is present, Warner sucker may inhabit all the lakes, sloughs, and potholes in the Warner Valley. The documented range of the sucker extended as far north into the ephemeral lakes as Flagstaff Lake during high water in the early 1980's, and again in the 1990's (Allen *et al.* 1996). The Warner sucker population of Hart Lake was intensively sampled to salvage individuals before the lake went dry in 1992.

Stream resident populations of Warner sucker are found in Honey Creek, Snyder Creek, Twentymile Creek and Twelvemile Creek. Intermittent streams in the drainages may support small numbers of migratory suckers in high water years. No stream resident Warner sucker have been found in Deep Creek since 1983 (Smith *et al.* 1984, Allen *et al.* 1994), although a lake resident female apparently trying to migrate to stream spawning habitat was captured and released in 1990 (White *et al.* 1990). The known upstream limit of the Warner sucker in Twelvemile Creek is through the Nevada reach and back into Oregon (Allen *et al.* 1994). However, the distribution appears to be discontinuous and centered around low gradient areas that form deep pools with protective cover. In the lower Twentymile Slough area on the east side of the Warner Valley, White *et al.* (1990) collected adult and young suckers throughout the slough and Greaser Reservoir. This area dried up in 1991, but because of its marshy character, may be important sucker habitat during high flows. Larval, young-of-year, juvenile and adult Warner sucker captured immediately below Greaser Dam suggest either a slough resident population, or lake resident suckers migrating up the Twentymile Slough channel from Crump Lake to spawn (White *et al.* 1990, Allen *et al.* 1996).

While investigating the distribution of Cowhead Lake tui chub, Scoppettone and Rissler (2001) discovered a single juvenile Warner sucker in West Barrel Creek. West Barrel Creek is a tributary to Cow Head Slough that eventually enters Twelvemile Creek at the known upper extension of suckers in the Twelvemile drainage. This discovery of a Warner sucker in the Cowhead Lake drainage is a significant range extension for Warner sucker.

Kennedy and Vinyard (1997) made observations of the success of survivorship of sucker larvae during 1992 and 1993. In 1992, all lakes were dry by July and refilled in 1993 due to higher spring run-off. Estimated survivorship of sucker larvae were not significantly different and showed low recruitment to the juvenile size class both years (<10% in 1992 and <3% in 1993). Evidence of similar survivorship despite lake level, may indicate that the sucker's survivorship is independent of its ability to occupy and use lake type habitat.

The distribution of Warner sucker is well known, but limited information is available on stream habitat requirements and spawning habits. Relatively little is known about feeding, fecundity, recruitment, age at sexual maturity, natural mortality, and interactions with introduced game fishes. In this account, "larvae" refers to the young from the time of hatching to transformation into juvenile (several weeks or months), and "juvenile" refers to young that are similar in appearance to adults. Young of year refers to members of age-group 0, including transformation into juvenile until January 1 of the following year.

A common phenomenon among fishes is phenotypic plasticity (the ability of different individuals of the same species to have different appearances despite identical genotypes) induced by changes in environmental factors (Wooton 1990, Barlow 1995). This is most easily seen by a difference in the size of the same species living in different but contiguous, and at times sympatric (occurring in the same area) habitats for a portion of their lives (Healey and Prince 1995, Wood 1995). The Warner Basin provides two generally continuous aquatic habitat types; a temporally more stable stream environment and a temporally less stable lake environment (*e.g.,* lakes dried in 1992 and in the early 1930's).

Observations indicate that Warner sucker grow larger in the lakes than they do in streams (White *et al.* 1990). The smaller stream morph (development form) and the larger lake morph are examples of phenotypic plasticity within metapopulations of the Warner sucker. Expressions of these two morphs in Warner sucker might be as simple as the species being opportunistic. When lake habitat is available, the stream morph migrates downstream and grows to become a lake morph. These lake morphs can migrate upstream to spawn or become resident populations while the lake habitat is available. Presumably, when the lake habitat dries up the lake morph is lost but the stream morph persists. When the lakes refill, the stream morph can reinvade the lakes to again become lake morphs. The lake habitat represents a less stable but more productive environment than the metapopulations of Warner sucker use on an opportunistic basis. The exact nature of the relationship between lake and stream morphs remains poorly understood and not well studied.

The lake and stream morphs of the Warner sucker probably evolved with frequent migration and gene exchange between them. The larger, presumably longer-lived, lake morphs are capable of surviving through several continuous years of isolation (*e.g.,* drought or other factors) from stream spawning habitats. Similarly, stream morphs probably serve as sources for recolonization of lake habitats in wet years following droughts, such as the refilling of the Warner Lakes in 1993 following their desiccation in 1992. The loss of either lake or stream morphs to drought, winter kill, excessive flows and a flushing of the fish in a stream, in conjunction with the lack of safe migration routes and the presence of predaceous exotic fishes, may strain the ability of the species to rebound (White *et al.* 1990, Berg 1991).

Lake morph Warner sucker occupy the lakes and, possibly, deep areas in the low elevation creeks, reservoirs, sloughs and canals. Recently, only stream morph suckers have exhibited frequent recruitment, indicated by a high percentage of young of year and juveniles in Twelvemile and Honey Creeks (Tait and Mulkey 1993a,b). Lake morph suckers, on the other hand, were skewed towards larger, older adults (8-12 years old) with no juveniles and few younger adult fish (White *et al.* 1991) before the lakes dried up in 1992. Since the lakes refilled, the larger lake morph suckers have reappeared. Captured lake suckers averaged 267 millimeters (10.5 inches) SL in 1996 (Allen 1996), 244 millimeters (9.6 inches) SL in 1995 (Allen *et al.* 1995a) and 198 millimeters (7.8 inches) SL in 1994 (Allen *et al.* 1995b). Stream caught fish averaged 138 millimeters (5.4 inches) SL in 1993 (Tait and Mulkey 1993b).

Warner sucker recovered from an ice induced kill in Crump Lake were aged to 17 years old and had a maximum fork length of 456 millimeters (17.9 inches) (White *et al.* 1991). Lake resident suckers are generally much larger than stream residents, but growth rates for adults are not known for either form. Sexual maturity occurs at an age of three to four years (Coombs *et al.* 1979), although in 1993, captive fish at Summer Lake Wildlife Management Area, Oregon, successfully spawned at the age of two years (White *et al.* 1991).

Coombs *et al.* (1979) measured Warner sucker larval growth and found a growth rate of approximately 10 millimeters (0.39 inch) per month during the summer (*i.e.,* when the larvae were 1-4 months old). Sucker larvae at Summer Lake Wildlife Management Area grew as large as 85 millimeters (3.3 inches) in three months during the summer of 1991, but this was in an artificial environment (earth ponds) and may not reflect natural growth patterns.

The feeding habits of the Warner sucker depend to a large degree on habitat and life history stage, with adult suckers becoming more generalized than juveniles and young of year. Larvae have terminal mouths and short digestive tracts, enabling them to feed selectively in midwater or on the surface. Invertebrates, particularly planktonic (having weak powers of locomotion) crustaceans, make up most of their diet. As the suckers grow, they develop subterminal mouths, longer digestive tracts, and gradually become generalized benthic (living on the bottom) feeders on diatoms (small, usually microscopic, plants), filamentous (having a fine string-like appearance) algae, and detritus (decomposed plant and animal remains). Adult stream morph suckers forage nocturnally over a wide variety of substrates such as boulders, gravel, and silt. Adult lake morph suckers are thought to have a similar diet, though caught over predominantly muddy substrates (Tait and Mulkey 1993a,b).

Spawning usually occurs in April and May in streams, although variations in water temperature and stream flows may result in either earlier or later spawning. Temperature and flow cues appear to trigger spawning, with most spawning taking place at 14-20 degrees Celsius (57-68 degrees Fahrenheit) when stream flows are relatively high. Warner sucker spawn in sand or gravel beds in slow pools (White *et al.* 1990, White *et al.* 1991, Kennedy and North 1993). Allen *et al.* (1996) surmise that spawning aggregations in Hart Lake are triggered more by rising stream temperatures than by peak discharge events in Honey Creek.

Tait and Mulkey (1993b) found young of year were abundant in the upper Honey Creek drainage, suggesting this area may be important spawning habitat and a source of recruitment for lake recolonization. The warm, constant temperatures of Source Springs at the headwaters of Snyder Creek (a tributary of Honey Creek) may provide an especially important rearing or spawning site for Warner sucker (Coombs and Bond 1980).

Warner sucker may attempt to spawn on gravel beds along the lake shorelines during years when access to stream spawning areas is limited by low flow or by physical in-stream blockages (such as beaver dams or irrigation diversion structures). In 1990, Warner sucker were observed digging nests in 40+ centimeters (16+ inches) of water on the east shore of Hart Lake at a time when access to Honey Creek was blocked by extremely low flows (White *et al.* 1990).

Warner sucker larvae are found in shallow backwater pools or on stream margins where there is no current, often among or near macrophytes. Young of year Warner sucker are often found over deep, still water (from midwater to the surface) but also move into faster flowing areas near the heads of pools (Coombs *et al.* 1979).

Warner sucker larvae venture near higher velocities during the daytime to feed on planktonic organisms but avoid the mid-channel water current at night. This aversion to downstream drift may indicate that spawning habitats are also used as rearing grounds during the first few months of life (Kennedy and North 1993). None of the studies conducted thus far have succeeded in capturing Warner sucker younger than two years old in the Warner lakes, and it has been suggested that Warner sucker do not migrate down from the streams for two to three years (Coombs *et al.* 1979). The absence of young Warner sucker in the Warner lakes, even in years following spawning in the lakes, could be due to predation by introduced game fishes (White *et al.* 1991).

Juvenile suckers (one to two years old) are usually found at the bottom of deep pools or in other habitats that are relatively cool and permanent, such as near springs. As with adults, juvenile Warner sucker prefer areas of the streams that are protected from the higher velocities of the main stream flow (Coombs *et al.* 1979). Larval and juvenile mortality over a two month period during the summer has been estimated at 98 percent and 89 percent, respectively, although accurate larval Warner sucker counts were hampered by dense macrophyte cover (Tait and Mulkey 1993b).

White *et al.* (1991) found in qualitative surveys that, in general, adult suckers used stretches of stream where the gradient was sufficiently low to allow the formation of long (50 meters [166.6 feet] or longer pools. These pools tended to have undercut banks, large beds of aquatic macrophytes (usually greater than 70 percent of substrate covered), root wads or boulders, a surface to bottom temperature differential of at least two degrees Celsius (at low flows), a maximum depth greater than 1.5 meters (5 feet), and overhanging vegetation (often *Salix spp*.). About 45 percent of these pools were beaver ponds, although there were many beaver ponds in which Warner sucker were not observed. Warner sucker were also found in smaller or shallower pools or pools without some of the above mentioned features. However, they were only found in such places when a larger pool was within approximately 0.4 kilometer (0.25 mile) upstream or downstream of the site.

Submersed and floating vascular macrophytes are often a major component of Warner sucker-inhabited pools, providing cover and harboring planktonic crustaceans which make up most of the young of year Warner sucker diet. Rock substrates such as large gravel and boulders are important in providing surfaces for epilithic (living on the surface of stones, rocks, or pebbles) organisms upon which adult stream resident Warner sucker feed, and finer gravels or sand are used for spawning. Siltation of Warner sucker stream habitat increases the area of soft stream bed necessary for macrophyte growth, but embeds the rock substrates utilized by adult Warner sucker for foraging and spawning. Embeddedness, or the degree to which hard substrates are covered with silt, has been negatively correlated with total Warner sucker density (Tait and Mulkey 1993a).

Habitat use by lake resident Warner sucker appears to be similar to that of stream resident Warner sucker in that adult Warner sucker are generally found in the deepest available water where food is plentiful. Not surprisingly, this describes much of the habitat available in Hart, Crump, and Pelican Lakes, as well as the ephemeral lakes north of Hart Lake. Most of these lakes are shallow and of uniform depth (the deepest is Hart Lake at 3.4 meters (11.3 feet) maximum depth), and all have mud bottoms that provide the Warner sucker with abundant food in the form of invertebrates, algae, and organic matter.

Population Dynamics

A population estimate of Warner sucker in streams was conducted in 1993 on the Honey Creek and Twentymile Creek drainages (Tait and Mulkey 1993b). Approximately 20 percent of available stream habitat in the Honey Creek drainage was sampled. The population within the area sampled was estimated at 77 adults, 172 juveniles, and 4,616 young of year. Approximately 60 percent of the available stream habitat in the Twentymile Creek drainage was also sampled. The population estimates within this area sampled was 2,563 adults, 2,794 juveniles, and 4,435 young of year.

As of 1996, the Hart Lake Warner sucker population was estimated at 493 spawning individuals (95 percent confidence intervals of 439-563) (Allen *et al.* 1996). Although this is the only quantified population estimate of Warner sucker ever made for Hart Lake, it is likely well below the abundances found in Hart Lake prior to the drought.

In 1997, Bosse *et al.* (1997) documented the continued existence, but reduced numbers, of Warner sucker in the Warner Lakes. The number of Warner sucker, as measured by catch per unit effort, had declined 75 percent over the 1996 results. The reduction in sucker numbers was offset by a sharp increase in the percentage composition of introduced game fish, especially white crappie and brown bullhead.

Hartzell and Popper (2002) indicated a continued reduction of Warner sucker numbers and an increase of introduced fish in Warner Lakes. The greatest number of Warner sucker captured was in Hart Lake (96% of total Warner sucker catch) with only a few Warner sucker captured in the other Warner Lakes, including Crump Lake. Suckers represented a greater percentage of the catch in relation to introduced and other native fish compared to the efforts of 1997, although a smaller total number of sucker were captured than in 1997. This was the first year since 1991 that native fish made up a smaller percentage of the catch than introduced fish.

Reasons for Listing and Threats

Warner suckers were once common throughout the Warner basin but gradually declined from about the 1900 to the early 1970's. Historical accounts tell of impressive runs of fish in the Warner Valley. Long-time residents recall during the 1930's large numbers of spawning Warner suckers ascend Honey Creek into upstream canyon areas. The combination of restricted distribution, semi-permanent nature of the lakes, degradation of existing stream habitat, blockage of migration corridors, introduction of piscivorus exotic fishes into the lakes and water usage have impacted the existing populations of Warner sucker.

Warner sucker were listed due to reductions in the range and numbers, reduced survival due to predation by introduced game fishes in lake habitats, and habitat fragmentation and migration corridor blockage due to stream diversion structures and agricultural practices. Since the time of listing, it has been recognized that habitat modification, due to both stream channel degradation and overall reduced watershed function has worsened and the status and viability of the Warner sucker has declined. Signs of stream channel and watershed degradation are common in the Warner Valley, and include fences hanging in mid-air because stream banks have collapsed beneath them, high cut banks on streams, damaged riparian zones, bare banks, and large sagebrush flats where there were once wet meadows (White *et al.* 1991).

With few exceptions, designated Warner sucker critical habitat is excluded from grazing and other land use authorizations by the BLM. The one exception is on the Deppy Creek/ Honey Creek confluence where a water gap allows stock access. The other exception is in the 0207 allotment on Twentymile Creek. This area is not occupied by Warner sucker and is an intermittent, rock-armored channel.

The first large scale human impact to migration of the Warner sucker within the Warner Basin was the construction of irrigation diversion structures in the late 1930s (Hunt 1964). These structures hamper or block both upstream and downstream migrations of various life stages of Warner sucker. Few irrigation diversions have upstream fish passage. Adult suckers that have spawned and are moving downstream can be diverted from the main channel to become lethally trapped in unscreened irrigation canals. Larval, post larval, young of year, and juvenile suckers are probably also lethally diverted into unscreened irrigation canals.

In high water years, the amount of water diverted from Warner Valley streams may be only a small portion of the total flow, but in drought years, total stream flows often do not meet existing water rights, and so entire streams may be diverted. Over a series of drought years, reduced flows can cause drops in lake levels and sometimes, especially in conjunction with lake pumping for irrigation, cause complete dry-ups, as was the case with Hart Lake in 1992.

Although the native species composition in the Warner basin included some piscivorus fishes like the Warner Valley redband trout (*Oncorhynchus mykiss* sp.), the introduction of exotic game fish disrupted this balance and the native ichthyofauna has suffered. In the early 1970s, ODFW stocked white crappie (*Pomoxis annularis*), black crappie (*P. nigromaculatus*), and largemouth bass (*Micropterus salmoides*), in Crump and Hart Lakes. Prior to this, brown bullhead (*Ameiurus nebulosus*) and non-native rainbow trout were introduced into the Warner Valley. The adults of all five piscivorous fish species feed on Warner sucker to varying degrees.

The presence of the introduced game fishes may also threaten Warner sucker through competitive interactions. Brown bullhead is a bottom oriented omnivore (Moyle 1976) that may compete directly with Warner sucker for the same food sources. Bullhead may also prey on sucker eggs in the lower creek or lake spawning areas, as well as on sucker larvae and juveniles. Young crappies probably eat many of the same zooplankton and other small invertebrates that young suckers depend on. Habitat use by young Warner sucker remains poorly understood, but there may be competition between suckers and other fishes for what scarce cover resources are available.

3.4. Lost River sucker, *Deltistes luxatus* and Shortnose sucker, *Chasmistes brevirostris*

Listing Status and Proposed Critical Habitat

The Lost River and shortnose suckers were listed as endangered in 1988 (USFWS 1988a). A recovery plan for both species was published in April 1993 (USFWS 1993d). Critical habitat for the suckers was proposed in 1994, but has not been finalized (USFWS 1994). The PCEs identified in the critical habitat proposal are: (1) water of sufficient quantity and suitable quality; (2) sufficient physical habitat, including water quality refuge areas, and habitat for spawning, feeding, rearing, and travel corridors; and (3) a sufficient biological environment, including adequate food levels, and patterns of predation, parasitism, and competition that are compatible with recovery. A five-year status review was conducted in 2007. A recommendation was made to down-list the Lost River sucker. No status change was recommended for the shortnose sucker (USFWS 2008c).

Life History

Lost River suckers are large fish (up to 1 meter long and 4.5 kg in weight) that are distinguished by their elongate body and sub-terminal mouth with a deeply notched lower lip. They have dark brown to black backs and brassy sides that fade to yellow or white on the belly (Moyle 2002). Lost River suckers have been recorded to live up to 43 years (Scoppettone 1988).

Shortnose suckers are distinguished by their large heads with oblique, terminal mouths with thin but fleshy lips. The lower lips are deeply notched. Adults are dark on their back and sides and silvery or white on the belly. They can grow to about 50 cm in length, but growth is variable among individuals (Moyle 2002). Shortnose suckers have been recorded to live as long as 33 years (Buettner and Scoppettone 1990).

Lost River and shortnose suckers are native to the Lost River and upper Klamath River systems in Oregon and California where they have adapted to lake living (Moyle 2002). Adult and juvenile Lost River and shortnose suckers feed on benthic and planktonic organisms, primarily midge larvae and *Daphnia*. While adult fish can be found throughout the reservoirs they inhabit at depths of 6 feet or more, larvae prefer shorelines with emergent vegetation that can provide cover from predators and invertebrate food (Moyle 2002); juveniles occur over various substrates. Little is known about sub-adults but it is believed they occupy habitats similar to the adults.

Lost River and shortnose suckers grow rapidly in their first five to six years. Shortnose suckers reach sexual maturity sometime between years four and six, whereas Lost River suckers reach sexual maturity between five and 14 years of age, with most maturing at 9 years (Buettner and Scoppettone 1990). Spawning of Lost River and shortnose suckers occurs from February to May in the larger tributaries of inhabited lakes. River spawning habitat is riffles or runs with gravel or cobble substrate, moderate flows, and depths less than 130 cm. Lost River suckers and a few shortnose suckers spawn in Upper Klamath Lake near springs and seeps occurring along the shorelines (Moyle 2002). Females of both species are highly fecund, producing tens of thousands of eggs during each spawning event and spawn with numerous males (Perkins *et al.* 2000). Adults of both species can spawn multiple times during their life, but it is unknown if an individual fish will spawn every year (NRC 2004).

Sucker eggs incubate in the gravels for approximately two to three weeks, depending on the water temperature. Sucker larvae are small being only 11 mm upon hatching. They emerge sometime in late March to early June and most immediately move downstream to lakes where they rear (Cooperman and Markle 2003); however, some rearing occurs in tributaries especially in years when backwater areas are created by high flows. Larval suckers prefer to rear in shallow, nearshore and vegetated habitat in both lakes and rivers (Cooperman and Markle 2004), but in Gerber Reservoir and Clear Lake rearing of shortnose sucker occurs in shallow, unvegetated areas. Larvae transform into juveniles at about 30 mm total length and move to slightly deeper water. During their first year, suckers are known as age-0 fish.

Distribution

At the time of listing, Lost River and shortnose suckers were reported from Upper Klamath Lake and its tributaries (Klamath Co., Oregon); from the Lost River (Klamath Co., Oregon, and Modoc and Siskiyou Co., California) and Clear Lake (Modoc Co., California); the Klamath River above Keno (Klamath Co., Oregon); and in one or more of the Klamath River reservoirs below Keno (Klamath Co., Oregon, and Siskiyou Co., California) (see Figure 1) (USFWS 1988a).

The known geographic ranges of Lost River and shortnose suckers have not substantially changed since listing and they are still found primarily in Upper Klamath Lake and Clear Lake. One previously-unreported Lost River sucker and two previously-unreported shortnose sucker populations have been found since listing. A population of about a thousand adults of each species occur in the Tule Lake sumps at the terminus of the Lost River (Siskiyou Co., California) (Scoppettone *et al.* 1995). Also, shortnose suckers (or shortnose sucker x Klamath largescale sucker hybrids) are now known to occur in Gerber Reservoir (Klamath Co., Oregon), which was considered in 1994 when the Service proposed critical habitat (USFWS 1994). New genetics information casts some doubt on whether these fish in Gerber Reservoir and Clear Lake are actually shortnose suckers (ISRP 2005, Tranah and May 2006). Until that information can be further evaluated, we will continue to assume that these fish are shortnose suckers.

The total area of occupied lake habitat for Lost River and shortnose suckers is about 80,000 acres, of which about 80% or more is in Upper Klamath Lake (which has about 64,000 surface acres). The remainder of occupied habitat occurs primarily in Clear Lake (which rarely reaches its maximum surface area of about 20,000 acres).

Upper Klamath Lake is a large natural lake located in Klamath County, Oregon. Since 1921, its water levels have been modified by operation of Link River Dam, which is part of the Klamath Project (NRC 2004). The watershed occupies about 3,800 square miles, ranges in elevation from 4,100 to over 9,000 feet, and has an average annual precipitation of 27 inches (ODEQ 2002). The lake surface area averages about 64,000 acres and averages 6-8 feet deep (USBR 2005b). Its three major tributaries are the Sprague, Williamson, and Wood rivers.

Clear Lake is a natural lake located in Modoc County, California. It is in the 700-square-mile Lost River watershed, which ranges in elevation from approximately 4,500 to 6,100 feet (USBR 1970). Annual precipitation equals about 13 inches. Upstream stock ponds and diversions reduce inflows somewhat, and over half of the annual inflow is lost to seepage and evaporation (USBR 1970). The lake has one major tributary, Willow Creek, where suckers spawn (Scoppettone *et al.* 1995). The size of Clear Lake was increased by construction of a dam constructed by Reclamation in 1910. During the 65-year period prior to 1970, annual net inflow has fluctuated from 18,000 to 370,000 acre feet (USBR 1970). The lake has never reached its capacity of 450,000 acre feet.

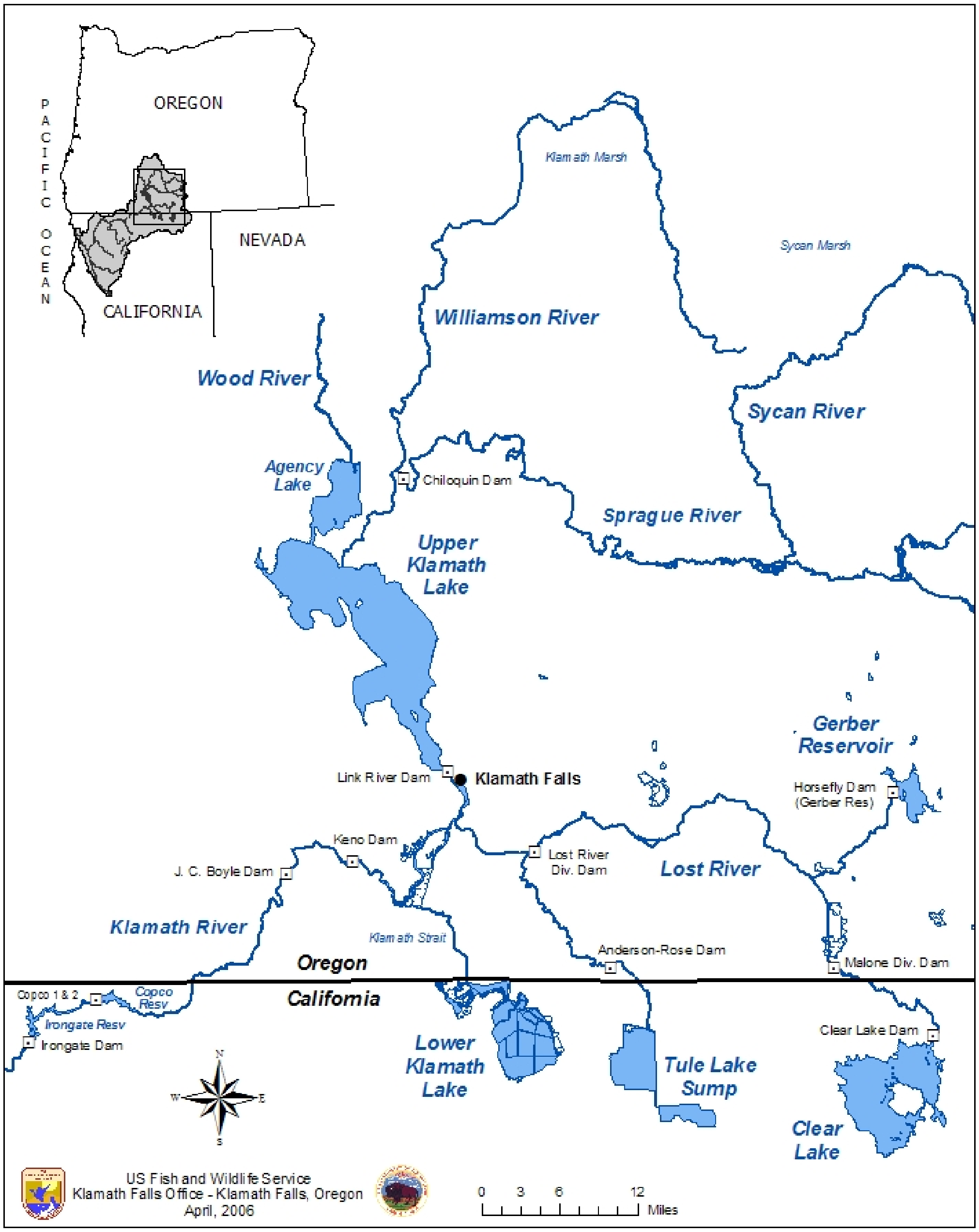

Figure 1. Map of major water bodies in the upper Klamath River Basin.

Population Abundance and Trends

Estimation of fish population size is an inexact science. All estimation methods have limitations caused by environmental conditions or by other factors such as lost tags, timing and geographic range of sampling, unmet statistical assumptions, and broad statistical confidence intervals. Thus, because population size often cannot be precisely estimated, assessment of population trends is used to evaluate the health of fish populations (R. Shively, pers. comm. 2005). The following discussion is based upon an assessment of Lost River and shortnose sucker population trends.

At the time of listing, the Lost River and shortnose sucker population numbers were unknown, but surveys had shown general downward trends. In Upper Klamath Lake, surveys in 1984 resulted in an estimate of 2,650 shortnose suckers and 11,000 to 23,000 Lost River suckers, and subsequent information indicated that population reductions had occurred (USFWS 1988a). Information gathered in recent years indicates that sucker population estimates made at the time of listing were probably inaccurate. Because assumptions necessary for modeling population sizes were likely not met, the actual sizes of the populations at that time are uncertain. Available data on distribution of age classes showed that little recruitment (the addition of fish to the reproducing population) had occurred in nearly 18 years, a major fish die-off in 1986, and substantial harvest by a sport fishery that was open until 1987 (USFWS 1988a, Markle and Cooperman 2002, NRC 2004). Thus, the listing was based on a variety of data, all indicating a downward trend (USFWS 1998c).

On this issue of population trends at the time of listing, the National Research Council (NRC) (NRC 2004) stated: "For purposes of ESA actions, the critical facts, which are known with a high degree of certainty, are that the fish are much less abundant than they originally were and that they are not showing an increase in overall abundance."

Information gathered since listing indicates that there may be several tens of thousands of adult Lost River and shortnose suckers in Upper Klamath Lake (ISRP 2005). Gerber Reservoir and Clear Lake also have shortnose sucker populations numbering in the thousands of adults (ISRP 2005). Clear Lake has a Lost River sucker population that probably numbers in the tens of thousands of adults.

A small population of about one thousand adult Lost River and shortnose suckers occurs in the Tule Lake sumps at the terminus of the Lost River (J. Hodge, pers. comm. 2008). It is isolated from upstream spawning areas by a series of dams. Small populations of adult shortnose suckers (probably in the hundreds of individuals) also occur in the Lost River, Keno Reservoir, J.C. Boyle Reservoir, Copco Reservoir, and Iron Gate Reservoir (Desjardins and Markle 2000, Piaskowski 2003, USGS 2000, USBR 1993, Ziller and Buettner, unpublished data 1987).

Population trends in Upper Klamath Lake have been evaluated by comparing an adult abundance index or cumulative catch-per-unit effort in the Williamson River (R. Shively, pers. comm. 2007). These data indicate that sucker populations in Upper Klamath Lake have varied considerably in size and age structure owing to fluctuating recruitment and periodic die-offs (NRC 2004), and that sharp and substantial population declines can occur in a span of just a few years (Perkins *et al.* 2000).

In 1995, the adult abundance index for Lost River and shortnose suckers populations spawning in the Williamson River system were the highest observed between 1995 and 2005 (ISRP) 2005, USGS 2003). Between 1995 and 1997, die-offs in Upper Klamath Lake reduced the Williamson River abundance index by over 90 percent. In 2000 and 2001, recruitment increased for both species, although it was greater for Lost River sucker than shortnose sucker (Janney and Shively 2007, Janney *et al.* in review). In 2003, another die-off occurred but was much smaller in magnitude than those in 1995-1997. From 2003-2005, the Lost River sucker index increased gradually, but was still only about 40 percent of the 1995 value. The shortnose sucker index has remained low, less than 10 percent of the 1995 level (ISRP 2005, Janney and Shively 2007).

Mark-recapture data from 1995 through 2004 have been analyzed to estimate annual survival rates for Lost River and shortnose sucker in Upper Klamath Lake (Janney and Shively 2007).

Based upon a mean survival rate of 0.76 for the 10 year period, it is estimated that the average life expectancy of shortnose suckers entering the spawning population was only 3.6 years. Mean annual survival rate for Upper Klamath Lake shoreline spawning Lost River suckers from 1995 to 2004 was estimated at ~0.9. Based on this survival probability, average life expectancy of Lost River suckers after recruiting into the spawning population was approximately 7.8 years. These short estimated life expectancies are of concern because the species are believed to be normally long-lived (up to 30-40 years); thus suggesting that adults are dying before reproducing often enough for population replacement (USFWS 2007c,d).

Although Clear Lake Lost River and shortnose suckers populations appear to number in the thousands of individuals, a substantial reduction in mean body size has occurred in the last decade. Between 1996 and 2000 there was a reduction of over 30 percent in mean size of adult Lost River and shortnose suckers (Barry *et al.* 2007). In 2005 and 2006, adult suckers were represented by mostly smaller size classes.

The Gerber Reservoir shortnose sucker population appears to be viable with evidence of frequent recruitment and large numbers of adults (Barry *et al.* 2007, Piaskowski and Buettner 2003).

Population monitoring at Tule Lake, Lost River, and Klamath River reservoirs has not been intensive enough to determine trends. However, the limited survey information collected over the last two decades suggests populations have remained at relatively low levels (hundreds of individuals) (Buettner and Scoppettone 1991, Desjardins and Markle 2000, USFWS 2007c,d).

Habitat Characteristics

Shortnose and Lost River suckers use a variety of specific aquatic habitats at various stages in their lives, from larvae to adults. Adult spawning habitats are gravel substrates in streams and rivers. They are also known to spawn along the lake margins of Upper Klamath Lake, but that currently appears to be a rare occurrence (NRC 2004, R. Shively, pers. comm. 2005). After hatching, most larvae swim up (emerge) from gravel and quickly emigrate downstream to a lake environment where they occupy “shallow, near-shore, and vegetated” habitats (Cooperman and Markle 2004, NRC 2004).

Researchers have found high densities of larvae in the shallow, near-shore areas of Upper Klamath Lake (Buettner and Scoppettone 1990, Klamath Tribes 1996, Markle and Simon 1993, Simon *et al.* 1995, Simon *et al.* 1996, Cooperman and Markle 2004). Although larval densities as high as 120 larvae/square meter have been reported in emergent vegetation along Upper Klamath Lake, only 2 percent of trawls have densities over 10 larvae /square meter (D. Markle, pers. comm. 2007). Sucker larvae generally occur at higher densities in and adjacent to emergent vegetation than in areas devoid of vegetation (Klamath Tribes 1996, Cooperman and Markle 2004). The term "emergent vegetation" refers to plants that are rooted in lake sediment, with tops extending above the water. Cattails and bulrushes are common examples of emergent vegetation. Larvae do not appear to use submerged vegetation as an alternative to emergent vegetation, primarily because submerged vegetation is slow to develop in the spring and therefore is largely not available early in the summer when larvae are present (Cooperman and Markle 2004).

Emergent vegetation along lakeshore areas is believed to be particularly important larval habitat for several reasons. Emergent vegetation provides cover from predators, and also provides habitat for sucker food items such as zooplankton, macroinvertebrates, and periphyton (the community of microscopic organisms that live on submerged surfaces in aquatic environments) (Klamath Tribes 1996, Cooperman and Markle 2004, Markle and Dunsmoor 2007). Emergent wetlands also may provide protection from currents and turbulence; and water temperatures can be higher in emergent vegetation so larvae likely grow faster.

Juveniles suckers use relatively shallow (less than about 1.2 meters), vegetated and un-vegetated shoreline with a variety of substrate types ranging from cobble to mud (Hendrixson *et al.* 2007). Adult suckers use water depths of 1 to 4.5 meters, but prefer depths of 1.5 to 3.4 meters (Reiser *et al.* 2001, NRC 2004), and spawn in streams and rivers or lakes, as described above. Sub-adults are assumed to be similar to non-spawning adults in their requirements and habits (NRC 2004).

Conservation Measures

Since the early 1990's, the Service, Reclamation, State of Oregon, Klamath Tribes, other partners, and private landowners have been working to improve water quality and aquatic habitat conditions in the Upper Klamath Basin and to make progress towards the recovery of the Lost River and shortnose suckers. The Service and its partners have supported approximately 400 habitat restoration projects in the Upper Klamath Basin, including 50 wetland and 150 riparian projects. The cost of these projects has been shared by many entities, including State and Federal programs such as Partners for Fish and Wildlife, Hatfield Restoration, Jobs in the Woods, and Oregon Resources Conservation Act programs as well as private grant programs and contributions from landowners.

Major habitat restoration efforts focusing on endangered suckers have been completed or initiated. These include: (1) restoration of over 25,000 acres of wetlands adjacent to Upper Klamath Lake and in the watershed above the lake; (2) removal of Chiloquin Dam; (3) screening of the outlet of Clear Lake Dam; (4) construction of a new fish ladder at Link River Dam; (5) screening of the main irrigation diversion of the Klamath Project (A-Canal); (6) 13 fish passage improvement projects, including screening and fish ladders; and many other actions.

Wetland Restoration

Restoration of the Williamson River Delta, approximately 6,500 acres of open water, deep water wetland, riparian/wet prairie, and upland plant communities is expected to provide substantial benefits toward the recovery of sucker populations in Upper Klamath Lake (see Figure 1). Based on pilot wetland restoration projects at River Bend and Goose Bay, restoration and reconnection of wetlands at the Williamson River Delta are expected to provide good habitat for larval suckers increasing survivorship and reducing vagrancy and dispersal out of Upper Klamath Lake where survival is currently minimal (Hendrixson 2006 and 2007, Markle *et al.* in review).

Levees surrounding The Nature Conservancy (TNC) property keep lake and river water from flooding former agricultural lands inside the levees. The agricultural lands within the levees have subsided through the years as a result of repeated cultivation of organic soils. TNC has attempted to restore wetland vegetation prior to levee removal by active water management of isolated fields. At present, TNC estimates approximately 1,000 acres of emergent wetlands will remain in 2008 following levee breaches on the Tulana Farm property which was breached in fall 2007 (Elseroad 2004, M. Barry, pers. comm. 2007). Elseroad (2004) estimated the surface area to be colonized by emergent vegetation after several years as 2,640 acres for the entire Lower Williamson River Delta (Tulana and Goose Bay). The estimated 2,640 acres of emergent vegetation yet to establish on the Williamson River Delta is a large increase from previous areas of emergent vegetation there, which was only about 15 acres (Dunsmoor *et al.* 2000). Should only a fraction of this habitat be used by larval and juvenile suckers, the habitat increase could result in increased survivorship and numbers of sucker at the two earliest life history stages. This becomes especially true if habitat has been a limiting factor for sucker survivorship in Upper Klamath Lake.

Agency Lake Ranch and the Barnes properties (9,700 acres) along the northern and northwestern shores of Agency Lake have been acquired by Reclamation and used as water storage areas. The properties will be managed by the Service as an addition to Upper Klamath National Wildlife Refuge. Levees along these properties are likely to be breached within the next 10 years. Emergent wetland plant communities have reestablished over the last several years with seasonal flooding and draining (USBR 2007). However, because of subsidence much of the property will be too deep to maintain emergent wetland vegetation (>5 feet deep) and will become open water habitat. At maximum lake elevation only about 820 acres are likely to be suitable for the development of emergent vegetation, based on depth preferences of local emergent plant species distributed around Upper Klamath Lake (Watershed Sciences 2007, Elesroad 2004). It is not understood how suckers will use these future wetland habitats on the Agency Lake Ranch and Barnes properties.

Chiloquin Dam Removal
In 2008, Reclamation and Bureau of Indian Affairs removed the Chiloquin Dam near the confluence of the Sprague and Williamson Rivers. This will increase fish access to habitats in the Sprague River watershed as far upstream as Beatty (river kilometer [rkm] 120) where sucker spawning and rearing have been recently documented (Tyler *et al.* 2007, Ellsworth *et al.* 2007). Although continued monitoring will determine the impact of dam removal on suckers in the watershed, the anticipated benefits of dam removal are increasing access to spawning areas at least 118 rkm upstream. A redistribution of spawning suckers from the lower 2 km of the Sprague River below Chiloquin Dam to spawning habitats in the Chiloquin Narrows (rkm 2-13), Ninemile Creek area (rkm 30-32), S'Ocholis Canyon (rkm 47-52), and Beatty Gap (rkm 112-120), and possibly the lower Sycan River (rkm 0-15), may increase sucker production if spawning habitat in the lower Williamson and Sprague Rivers below Chiloquin Dam was a limiting factor to survival of fertilized eggs (see Figure 1). Furthermore, redistribution of spawning suckers could reduce hybridization rates and limit risks associated with catastrophic events, such as flood scour, that can adversely impact concentrated spawning.

Sprague River Habitat Restoration
The Service, NRCS, and other state and local entities have focused watershed restoration and land and water conservation activities in the Sprague River watershed since 2002 (D. Ross, pers. comm. 2007; J. Regan-Vienop, pers. comm. 2007). There have been approximately 500 acres of wetland restored, 100 miles of riparian fencing installed, 5 miles of river channel realigned, and four spring complexes reconnected and enhanced. Approximately, 3,000 acres of floodplain habitat has been enrolled in permanent easements under the Wetland Reserve Program and Conservation Reserve Enhancement Program Program. NRCS has restored over 2,000 acres of

wetland habitat and conservation of over several thousand acre-feet of on-farm water. More than 70 percent of the private lands in the Sprague River Valley are partnering with local, state, and Federal agencies on land conservation and natural resource actions (D. Ross, pers. comm. 2007).

Fish Passage Improvements

Reclamation has made significant progress on reducing entrainment and improving fish passage at Federally-owned facilities since the last Klamath Project BO issued in 2002. Reclamation formed the Klamath Fish Passage Technical Committee (KFPTC) in 2002 to help guide efforts to install Federal and State approved fish screens and/or ladders on the Klamath Project and in the Upper Klamath Basin. The KFPTC, composed of biologists, engineers, and water users, have met several times per year to discuss, review, plan, and design fish screen/passage issues and concepts.

A-Canal Fish Screen and Fish Bypass Facility

Reclamation completed construction of a state-of-the-art fish screen at the entrance to the A-Canal in Upper Klamath Lake in March 2003 to reduce the high rates of fish entrainment known to occur at this diversion site. Lost River and shortnose suckers larvae and juvenile life stages were particularly vulnerable to entrainment at A-Canal before the screen was installed (Gutermuth *et al.* 1998, 2000).

3.5. Modoc sucker, *Catostomus microps*

Listing Status and Critical Habitat

The Modoc sucker, *Catostomus microps*, was listed as endangered with critical habitat on June 11, 1985. At the same time, critical habitat was designated for the Modoc Sucker in Modoc County, California to include a total of approximately 26 miles of the streams and a 50-foot riparian zone on either side of the stream channel. There is no critical habitat for the Modoc sucker in Oregon because the species was not known to occur there at the time critical habitat was designated. The constituent elements for critical habitat listed in the final rule include: (1) intermittent and permanent water; and (2) surrounding land areas that provide vegetation for cover and protection from erosion (USFWS 1985a). A recovery plan is not available for the Modoc sucker. However, recovery strategies and actions are outlined in an Action Plan for the Recovery of the Modoc Sucker that was signed in 1984; refer to section 4.5 for a more detailed discussion.

Life History

The Modoc sucker is a relatively small member of the sucker family (*Catostomidae*), generally maturing around 3-4 inches, and usually reaching only 7 inches in total length. Rutter differentiated the Modoc sucker from the sympatric Sacramento Sucker, *C. occidentalis*, and the nearby Klamath largescale sucker, *C. snyderi*, by its small eye, small conical head, small scales and a nearly closed frontoparietal fontanelle (Rutter 1908). Martin (1967, 1972) further characterized the morphometric and meristic characters and elucidated osteological differences in the jawbones of the two species. Subsequent authors and researchers have differentiated the two species primarily by lateral line scale and dorsal fin ray counts, or locality.

The similarity in non-breeding coloration and external morphology between Modoc and Sacramento suckers have made it difficult to field-identify specimens visually without the excessive handling necessary for meristic counts. Differentiation of the two species has been further confused by dependence on relatively few Modoc sucker specimens for the analysis of meristic characters. Recent analysis of an extensive data set of several hundred Modoc and Sacramento suckers, suggests that there is natural overlap in the meristic counts for the two species, and that the actual range for the Modoc sucker is 73-91 lateral line scales and 9-12 dorsal rays (Kettratad 2001).

Non-breeding coloration is similar in both sexes and is similar to Pit River Sacramento suckers of similar size (Moyle 2002). The back varies from greenish brown through bluish to deep grey and olive. The sides are lighter with generalized mottling, and usually with 3-4 darker blotches along the sides, which are also evident in immature Sacramento Suckers. The belly is white to cream or yellowish but unmarked and the caudal and paired fins are light yellow-orange.

Breeding coloration is particularly marked in males, which develop a strong reddish-orange lateral stripe and intensified orange coloration on the caudal fin and paired fins (Moyle 2002). Some spawning males develop strong counter-shading, with a dark back and light belly (S. Reid, pers. obs.). The lower limit of the dark dorsal coloration is about one width of the orange lateral band below the lateral line and about at (or slightly below) the level of the bottom of the eye, such that the orange lateral band is bounded by dark coloration above and below. This line of demarcation is also evident in males exhibiting a more blotchy coloration pattern intermediate to that of non-spawning individuals. Spawning males also develop extensive tuberculation on various parts of the body and fins, which varies between individuals and perhaps state of readiness to spawn. Females occasionally exhibit a weak, dull orange lateral stripe and reduced tuberculation on the fins.

Distribution

At the time of listing in 1985, the historical range of the Modoc sucker was thought to be limited to Ash and Turner sub-drainages, which are small tributaries of the Pit River in Modoc and Lassen counties, California (USFWS 1985a, Figure 2). However, it is now recognized that the historical range of the Modoc sucker also includes the Goose Lake sub-basin in southern Oregon and northern California, a currently disjunct, upstream sub-basin of the Pit River (Reid 2007a, Figure 2). Goose Lake has been hydrologically disconnected from the Pit River since the 1800's because it has not substantially overflowed into the North Fork of the Pit River since occasional events in the 1800's (Laird 1971). Although the California and Oregon populations are isolated, the Modoc sucker population in the Goose Lake sub-basin is morphologically and genetically similar to the populations in the Pit River (Dowling 2005a; Topinka 2006; Reid, unpub. data 2008).

The distribution of the Modoc sucker within its natural range currently includes populations in ten streams in three sub-drainages (Reid 2008b, Figures 2 and 3). At the time of listing, the distribution of the Modoc sucker was considered to be restricted to the Turner and Ash Creek sub-drainages of the Pit River in California (*i.e.,* Turner, Hulbert and Washington creeks [all tributaries to Turner Creek], and Johnson Creek [a tributary of Rush Creek]). The original listing also recognized four additional creeks (Ash, Dutch Flat, Rush, and Willow creeks) as having been occupied historically. However, these populations were presumed lost due to hybridization with Sacramento suckers (*Catostomus occidentalis*), although there was no genetic corroboration of hybridization available at that time (Ford 1977, Mills 1980, USFWS 1985a).

The Service is currently aware of three additional populations not considered in the original listing (*i.e.,* Coffee Mill and Garden Gulch creeks in the Turner sub-drainage and Thomas Creek in the Goose sub-basin), and has revised information on the four populations considered lost to hybridization in 1985. The seven populations that were not considered as occupied in the 1985 distribution are reviewed below. The Thomas Creek population is in the Goose Lake sub-basin of Oregon; all of the other populations are in the Pit River sub-basin in California.

1. **Coffee Mill Creek** – In 1987, CDFG transplanted twenty Modoc suckers from Washington Creek to Coffee Mill Creek, a tributary of Washington Creek (Figure 2) that appeared to have suitable habitat but was considered historically fishless due to a possible high gradient barrier at its mouth. The transplant included 12 adults and 8 juveniles, and was intended to establish an additional population in the Turner Creek drainage (CDFG 1986). Modoc suckers appear to be well established and relatively abundant in Coffee Mill Creek; spawning adults and juvenile suckers have been consistently observed there during recent visual surveys (Reid 2008b).

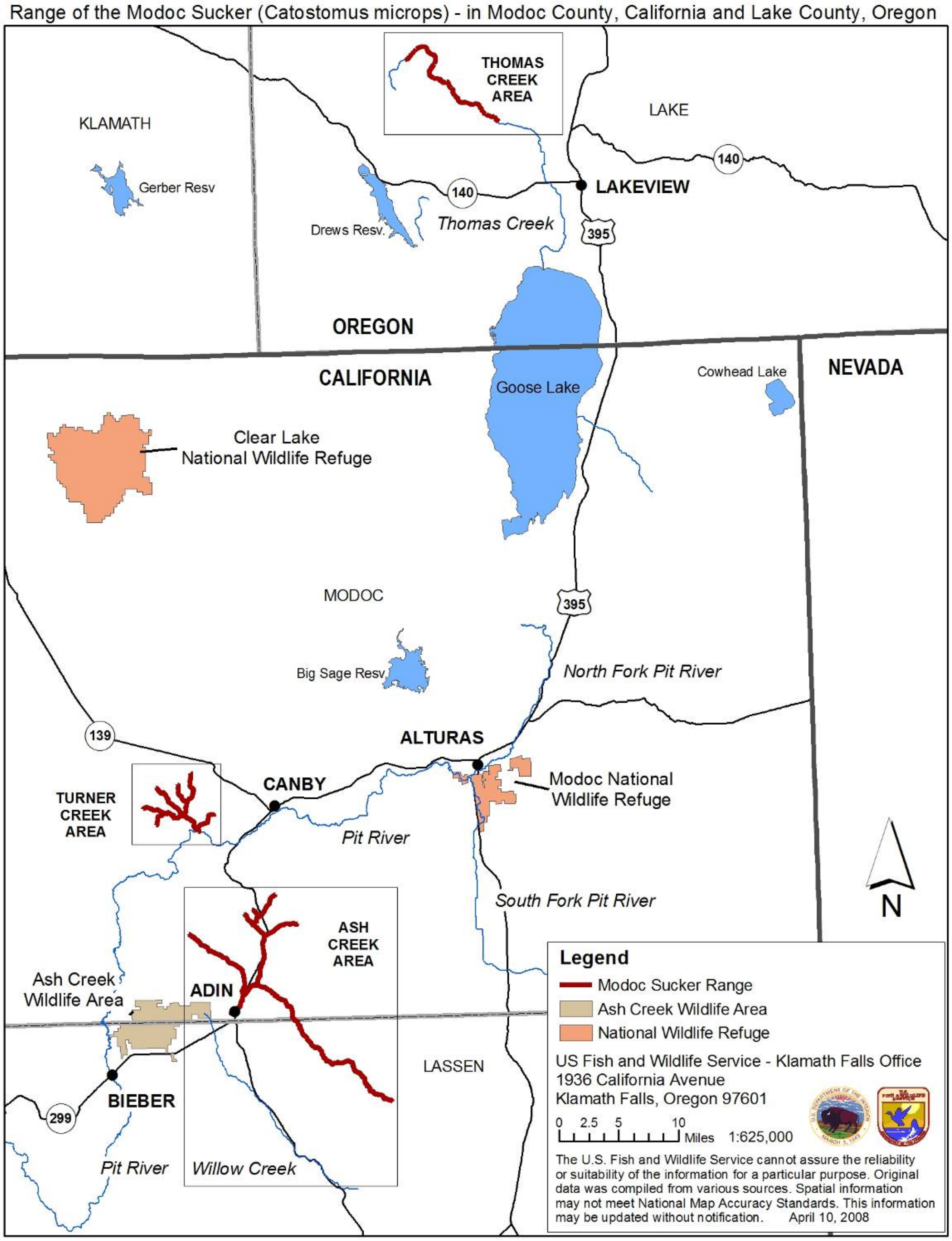

Figure 2. Map showing Modoc sucker range in Lake County, Oregon and Modoc and Lassen counties, California.

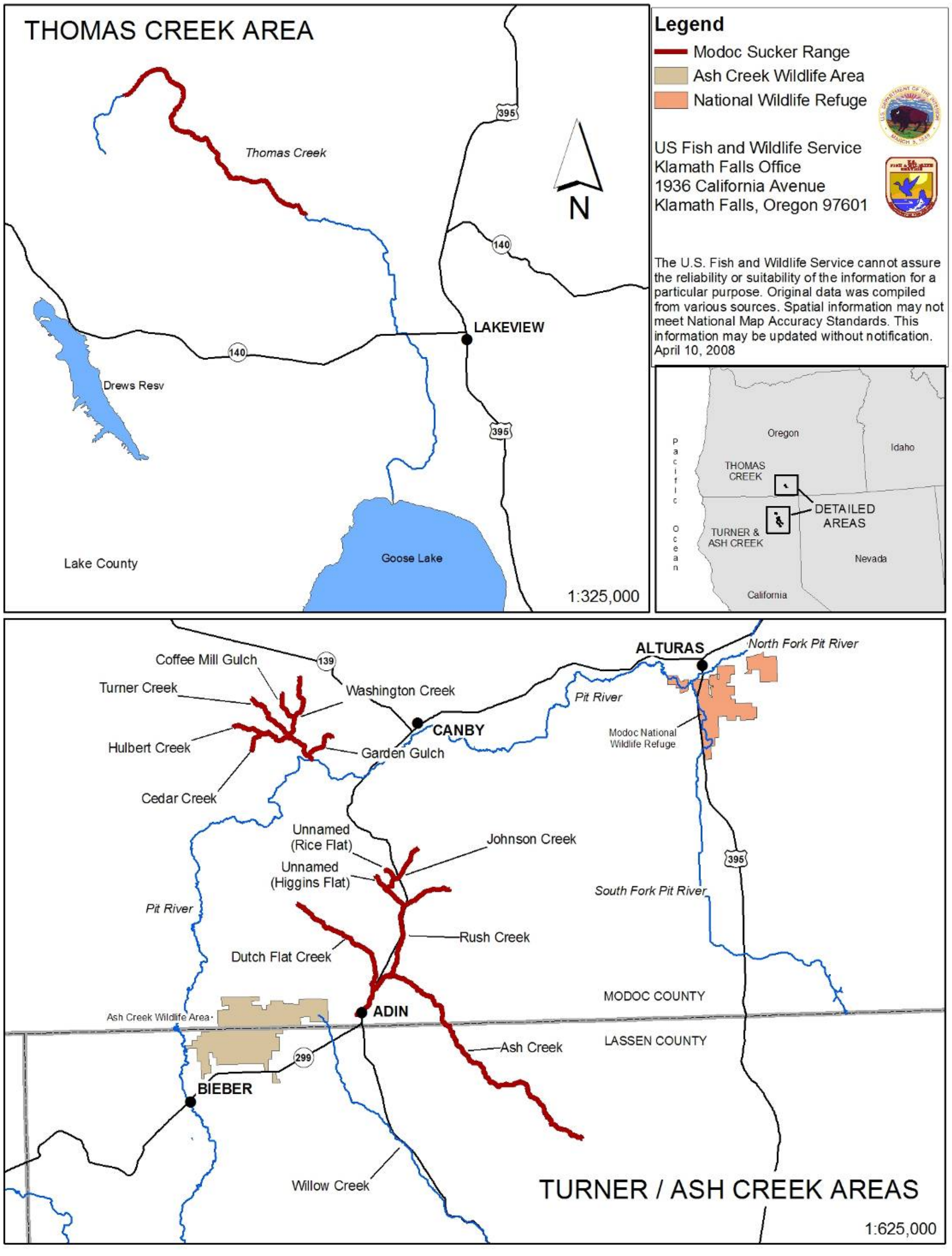

Figure 3. Map showing detailed distribution of the Modoc sucker in the Thomas Creek drainage, Oregon, of the Goose Lake sub-basin and the Turner/Ash Creek drainages, California, in the upper Pit River sub-basin.

2. **Garden Gulch** – A previously unreported population of Modoc suckers has been found in Garden Gulch, a small tributary of Turner Creek near its confluence with the Pit River and about two miles downstream of Hulbert and Washington Creeks (Reid, unpub. data 2001; Moyle 2002; Topinka 2006, Figure 2). Garden Gulch contains

about 1 mile of suitable habitat. The population was estimated at about 50, 1+ year-old Modoc suckers (Reid 2008c).

3. **Thomas Creek –** At the time of listing, the historical range of the Modoc sucker was thought to have been limited to small streams tributary to the Pit River in Modoc and Lassen counties, California (USFWS 1985a, Figure 2). However examination of the Oregon State University fish collection revealed several lots of Modoc suckers collected in Thomas Creek that were misidentified as Sacramento suckers (S. Reid, pers. comm. 2001). Modoc sucker specimens were found in collections from five sites on Thomas Creek and included collections from 1954, 1974, 1993 (two collections), and 1997.

   In 2007, surveys confirmed that Modoc suckers were present throughout at least 14 miles of upper Thomas Creek (Reid 2007a, Heck *et al.* 2008). Surveys focused on all principal Oregon streams in the Goose Lake Basin within the known elevational range (4900-5700 feet) of the Modoc Sucker population in Thomas Creek to determine the distribution of the Modoc and Sacramento suckers. The results of these surveys indicate that Thomas Creek holds the only substantial population of Modoc Suckers occupying higher elevation streams (>4900 feet) outside the distribution of the Goose Lake sucker (*Catostomus occidentalis lacusanserinus*, a sub-species of the Sacramento sucker found in the Goose Lake drainage). Modoc suckers were found only in Thomas Creek, where they were continuously distributed and relatively common, from 4900 feet (lower survey limit at the waterfall) up to 5840 feet above Cox Flat, a distance of 14.2 miles. This extended the Modoc sucker's distribution in Thomas Creek by 2.0 miles and 140 feet of elevation. Modoc suckers may extend farther upstream at lower densities or during other seasons. Goose Lake suckers were found in the lower reaches of nine streams, with an elevational upper limit ranging from 4880-5265 feet. No Goose Lake suckers were, or have been, collected from the surveyed reach of Thomas Creek above the waterfall however, there is evidence that the distribution of Modoc suckers extends farther downstream onto the valley floor in Thomas Creek and its tributaries (S. Reid, pers. comm. 2008).

4. **Dutch Flat Creek** – Recent collections and preliminary genetic analysis indicate that, 23 years after the original listing, Modoc suckers in Dutch Flat Creek (tributary to Ash Creek) exhibit little introgression (the entry or introduction of an allele from one population into another, as by hybridization between species) of Sacramento sucker alleles (Topinka 2006).

5. **Ash Creek** – Thirty years after previous collections (Moyle and Marciochi 1975, Moyle and Daniels 1982), suckers exhibiting the morphological characteristics of Modoc suckers are still present in Ash Creek; however, based on genetic analysis, there is considerable introgression with sympatric (occurring in the same streams) Sacramento suckers in this population (Topinka 2006; Reid, unpub. data 2002, Figures 2 and 3). Sacramento suckers have also been reported from upper Ash Creek since 1963, and were collected from about 10 miles downstream in 1898, with no intervening barriers (Miller 1963, Rutter 1908, Reid 2008a). Therefore it is believed that Sacramento suckers have not recently invaded the Ash Creek system and that the observed introgression is a historically natural phenomenon. Due to its unique

introgressed character and full sympatry with Sacramento suckers, the Ash Creek population is treated herein as an extant population, but for the purpose of evaluating the status of the species, it is not included in counting secure populations, because it is uncertain how genetically secure this population is.

6. **Rush Creek** – Rush Creek is a tributary to Ash Creek (Figure 3), and contains the type locality of the Modoc sucker. Visual surveys there indicate that Modoc suckers still occupy the historically occupied reaches (Reid 2008b), and there has been no change in the fish fauna or replacement with warm-water fishes that would likely be associated with Sacramento suckers (*e.g.,* Sacramento pikeminnow [*Ptychocheilus grandis*], hardhead [*Mylopharodon conocephalus*], and non-native sunfishes [family Centrachidae]; Moyle and Daniels 1982).

7. **Willow Creek** – Surveys and collections in Willow Creek (Lassen County, tributary to Ash Creek; Figure 3) in the early 1970's and more recently in 2000, 2002, and 2008 have encountered only Sacramento suckers; although, some Modoc sucker genetic markers are present in the population (Moyle and Daniels 1982; Reid 2007b, 2008b; Topinka 2006). Previous reports of Modoc suckers in Willow Creek are based on limited and unverifiable reports (Reid 2008b). Therefore, it is unknown if a population of Modoc suckers was present in Willow Creek in the recent past, and for the purpose of this status review, Willow Creek is not considered to contain an extant population of Modoc suckers.

Population Dynamics

There have been five attempts to estimate the population sizes of the Modoc sucker (Table 2). All of these surveys were for populations in the Pit River drainage of California; no population size estimates are currently available from the Oregon portion of the range.

At the time of listing in 1985, it was thought there were less than 5,000 Modoc suckers, of which only an estimated 1,300 were considered genetically "pure," the remainder being treated as hybrids with Sacramento suckers (USFWS 1985a). These estimates were based on limited sampling and visual surveys along with qualitative estimates of un-surveyed stream reaches or populations (Moyle 1974, Ford 1977).

Table 2. Comparison of Pit River system Modoc Suckers population estimates.

Stream Drainage	**Estimated Population Size**				
	Moyle 1974	Ford 1977	White 1989	Scoppettone *et al.* 1992	Reid 2008
Turner Creek Drainage	100	-	-	640+	552+
Turner	-	100	-	249+	265+
Washington	-	50	-	230	100+
Coffee Mill	-	-	-	50	106+
Hulbert	-	500	-	106	31+
Garden Gulch	-	-	-	-	~50
Ash Creek Drainage	-	-	-	-	-
Johnson	3,163	700	-	653	128+
Rush	535	1,000		-	-

Stream Drainage	Estimated Population Size				
	Moyle 1974	Ford 1977	White 1989	Scoppettone *et al.* 1992	Reid 2008
Dutch Flat	-	40	133-358	1,300+	101+
Ash	300	200	-	-	-
Willow	-	15[3]	-	-	0

Moyle (1974) suggested that the total number of Modoc suckers in the known populations was unlikely to exceed 5,000 individuals (Table 2). This was based on his 1973 sampling of 124 stream sections (mostly about 108 feet long), primarily focused on the Rush Creek drainage (67 reaches). He estimated a population size of 3,500 Modoc suckers for most of the Rush Creek drainage, plus an additional 150 to 200 suckers in un-sampled irrigation ditches off lower Rush Creek. There was considerable uncertainty in the exact population size because the standard deviations reported generally exceeded the estimates owing to high variance in counts from each segment. Also, too few samples were taken in other streams to quantify populations. No population estimates are available from Thomas Creek in the Goose Lake sub-basin. However, Moyle estimated probably less than 300 Modoc suckers in Ash Creek and less than 100 in the entire Turner Creek drainage.

Ford (1977) estimated a total population of 2,600 Modoc suckers, with about half occurring on USFS-managed lands (Table 2). His estimates included all known populations, including: Willow (15), Ash (200), Dutch Flat (40), Rush (1,000), Johnson (700), Turner (100), Hulbert (500) and Washington (50). Mills (1980), who was cited in the 1985 listing, did not actually survey, but cited Moyle (1974) and Ford (1977), then reduced the estimate of what he considered "pure" Modoc suckers to 1,250 (including only those from Hulbert, Washington, and Johnson Creeks) based on an assumption that all Modoc sucker populations sympatric with Sacramento suckers were lost as a result of hybridization.

Two additional attempts to estimate Modoc sucker population sizes were made by in the 1980s and 1990s by Scoppettone *et al.* (1992) and White (1989). Scoppettone *et al.* (1992) carried out preliminary surveys in the Turner Creek drainage, Johnson Creek, and Dutch Flat Creek near the end of a substantial drought. They primarily surveyed visually from the bank, with snorkel surveys in the lower reaches of all but Dutch Flat Creek. Suckers were counted but not identified to species; however, it is reasonable to assume that most of the suckers, with the exception of those in the lowest stratum of Turner Creek, were Modoc suckers. Excluding the lower Turner stratum ("Stratum 6"), they counted a minimum of 640 suckers in the upper Turner drainage, over 1,300 suckers in Dutch Flat Creek, and 650 suckers in Johnson Creek. This results in a very conservative total of over 2,600 Modoc suckers, not including Garden Gulch, Rush, or Ash creeks (Table 1).

The results of surveys done in the Turner Creek drainage and in Johnson Creek in 1992 by Scoppettone *et al.* (1992) suggest that the Modoc sucker populations in those systems had remained relatively stable, when compared to estimates by Ford (1977), and were much higher than those estimated by Moyle (1974) for the entire Turner Creek system (including Hulbert, Washington, and Coffee Mill creeks). A one-day survey of Dutch Flat Creek by White (1989) counted 130 definite suckers and 225 probable suckers, and Scoppettone *et al.*'s 1992 estimate

[3] These 15 suckers are most likely Sacramento suckers based on their morphology (Reid 2007b, 2008b).

for the Dutch Flat population substantially exceeded Ford's (1977) estimate of 40 individuals by over 1,200 individuals.

Reid (2008d) recently developed a survey protocol that has several advantages over previous methods, and it was used in 2008 to survey for Modoc suckers in the Pit River portion of the range (Reid 2008c, Table 2). The surveys were done at night and counts were made of ≥ 2.4 inches standard length (distance between the snout and caudal peduncle) (1+ year old) because they are more visible and more readily identified than smaller fish. Although the surveys were done at night when suckers are most visible, the numbers are minimums, because it is likely that some suckers were not seen.

Population estimates by Reid (2008e) are similar to those of Scoppettone *et al.* (1992) for most streams. The primary exception is Dutch Flat where Scoppettone *et al.* (1992) had estimated >1,000 individuals and Reid (2008e) estimated approximately 100 individuals. It is not known what accounts for these differences, but it could be due to differences in sizes of suckers counted by the two researchers. Scoppettone *et al.* (1992) counted all suckers regardless of size, whereas Reid (2008e) only counted those estimated to be ≥ 2.4 inches standard length. Therefore it is likely that the higher counts by Scoppettone *et al.* (1992) were due to the inclusion of the more numerous young-of-the-year suckers. Based on available habitat in Dutch Creek, Reid is skeptical that it could support many more 1+ year old Modoc suckers than he observed (S. Reid, pers. comm. 2009).

Although the population estimates presented in Table 2 are subject to error, they do suggest that the populations have been relatively stable over the 35 years that the species has been monitored. Additionally, as discussed below, the species has occupied most of the available habitat. These data suggest that the populations are resilient to threats such as drought and exotic predators that affect survival and reproduction.

Habitat Characteristics

Modoc suckers are primarily found in relatively small (second- to fourth-order), perennial streams. They occupy an intermediate zone between the high-gradient and higher elevation, coldwater trout zone and the low-gradient and low elevation, warm-water fish zone. Most streams inhabited by Modoc suckers (Turner and Ash creek drainages) are second- to fourth-order streams with moderate gradients (15-50 feet drop per mile), low summer flows (1-4 cubic feet per second), and relatively cool (59-72° F) summer temperatures (Moyle and Daniels 1982).

In the Pit River system, Modoc suckers occupy stream reaches above the Sacramento sucker/pikeminnow/hardhead zone of the main-stem Pit River and the lower reaches of its primary tributaries (Moyle and Marciochi 1975, Moyle and Daniels 1982). The known elevational range of Modoc sucker is from about 4,200 to 5,000 feet in the upper Pit River drainage (Ash and Turner Creeks) and from about 4,700 to 5,800 feet in the Goose Lake sub-basin (Reid 2007a,b). However, most known populations are constrained upstream by the effective limit of the permanent stream habitat. Only Rush and Thomas creeks extend substantially above the elevations occupied by Modoc suckers.

The pool habitat occupied by Modoc suckers generally includes soft to small cobble bottoms, substantial detritus, and abundant in-water cover. Cover can be provided by overhanging banks, larger rocks, woody debris, and aquatic rooted vegetation or filamentous algae. Larvae occupy shallow vegetated margins and juveniles tend to remain free-swimming in the shallows of large pools, particularly near vegetated areas, while larger juveniles and adults remain mostly on, or close to, the bottom (Martin 1967, 1972; Moyle and Marciochi 1975).

Modoc suckers often segregate themselves along the length of a stream by size with larger individuals being more common in lower reaches of streams. This may indicate a temperature-growth relationship or it may indicate that larger Modoc suckers move downstream into larger, deeper, warmer pool habitats as they outgrow the relatively limited habitat in upper stream reaches. Spawning often occurs in the lower end of the pools over gravel-dominated substrates containing gravels, sand, silt and detritus. Intermittent tributaries are apparently also used for spawning, when these habitats are available. The limited number of observations and the diversity of the observation sites limits the extent to which specific spawning habitat requirements can be characterized, other than to reinforce the overall importance of gravel substrates and relatively low energy habitat.

Spawning occurs in the spring from mid-April through early June, with localized spawning activity restricted to 3-4 weeks (Martin 1967; Moyle and Marciochi 1975; Boccone and Mills 1979; S. Reid, pers. obs.). In some years, suckers do not even become apparent in visual observations of spawning pools until May (Johnson Creek, Washington Creek and Garden Gulch), suggesting that inter-annual flow and/or temperature differences may influence timing of spawning activity (S. Reid, pers. obs. 2001-2003).

Because spawning and rearing habitats are relatively non-specific and common, suitable habitat is not considered limiting except during severe droughts. There are approximately 40 miles of suitable habitat within their range and most of that is occupied (see Table 3).

Table 3. Comparison of available and occupied perennial habitat of Modoc sucker.

Drainage: Stream	Available Habitat (miles)[4]	Occupied Habitat 2008 (miles)
Turner Creek Drainage:		
Turner	5.5	5.5
Washington	4.5	3.4
Coffee Mill	1.5	0.8
Hulbert	~ 3.0	~3.0
Garden Gulch	0.3	1.0
Ash Creek Drainage:		
Johnson	2.7+	2.7
Rush	4.6	4.6
Dutch Flat	~ 2.0	~1.4
Ash	?	~2.0
Willow	?	?
Goose Lake Drainage:		
Thomas Creek (above the falls)	15.2+	15.2

[4] A plus (+) sign indicates that additional habitat is present but has not been surveyed.

Drainage: Stream	Available Habitat (miles)[4]	Occupied Habitat 2008 (miles)
Thomas Creek (below the falls)	~5.0+	~5
Totals	**>40**	**>40**

Source: Reid 2008b

Modoc suckers appear to be opportunistic feeders, similar to other catostomids, feeding primarily on algae, small benthic invertebrates, and detritus (Moyle 2002). Moyle and Marciochi (1975) reported the digestive tracts contained detritus (47 percent by volume), diatoms (19 percent), filamentous algae (10 percent), chironomid larvae (18 percent), crustaceans (mostly amphipods and cladocerans; 4 percent), and aquatic insect larvae (mostly tricopteran larvae, 2 percent). The contents suggest that the suckers were feeding in low-energy pool environments, where detritus settles and chironomids live.

Although no comprehensive study of activity patterns has been done for Modoc suckers, they do appear to exhibit both diurnal and seasonal differences in activity. They are most active, and visible to creek-side observers, later in the morning and through the afternoon. At this time they are frequently seen foraging on the substrate (including rocks) and along submerged plant stems (Reid 2008b). While they spend much of their time apparently resting on the bottom, they are quick to swim away and respond to disturbance, but even during undisturbed observations, they frequently change positions and locations within a pool. In contrast, extensive night snorkeling observations indicate that Modoc suckers are resting and relatively somnolent after dusk (Reid 2008b).

Genetics

In 1999, the Service initiated a program to examine the genetics of suckers in the upper Pit River drainage (including Goose Lake) and determine the extent and role of hybridization between the Modoc and Sacramento suckers (discussed below under Factor E) using both nuclear and mitochondrial genes (Palmerston *et al.* 2001 – allozymes; Wagman and Markle 2000 – nuclear genes; Dowling 2005a – mitochondrial genes; Topinka 2006 – nuclear amplified fragment length polymorphisms (AFLP's); Abernathy Fish Technology Center [FTC], unpubl. data 2008–microsatellites). The results from all approaches indicate that the two species are genetically similar, suggesting that they are relatively recently differentiated and/or have a history of introgression throughout their range that has obscured their differences (Wagman and Markle 2000, Dowling 2005a, Topinka 2006). Although the available evidence does not allow rejection of either hypothesis, the genetic similarity in all three sub-drainages, including those populations shown to be free of introgression based on species-specific genetic markers (Topinka 2006; Abernathy Fish FTC, unpubl. data 2008), suggests that introgression has occurred on a broad temporal and geographic scale and therefore is not a localized or recent phenomenon caused or affected by human activities.

A phylogenetic analysis using mitochondrial DNA placed Modoc and Sacramento suckers in the same lineage, distinct from neighboring sucker species, but did not distinguish the two morphological species, suggesting either recent divergence or the broad replacement of one species' mitochondrial genome by that of the other (Dowling 2005a). The analysis did, however, identify geographic patterns of distinctiveness between the three sub-drainages examined (*i.e.,* Ash, Turner, Goose), suggesting relatively low levels of genetic exchange.

The analyses using nuclear AFLP's and faster evolving microsatellites also show differences between sub-drainages (Topinka 2006; Abernathy FTC, unpubl. data 2008). However, they further identified consistent species-specific alleles (different forms of a gene) indicating reproductive independence in the two species. Therefore, the available evidence supports the distinctiveness of the two species and the management of the three sub-drainage populations of Modoc sucker as separate units.

Preliminary microsatellite results indicate that the amount of genetic diversity observed within populations of Modoc suckers (as measured by allelic diversity at 8 microsatellite loci) is similar to, but slightly lower than, that observed in Sacramento suckers (Abernathy FTC, unpubl. data 2008). This result is reassuring given that Modoc sucker populations are considerably smaller than Sacramento sucker populations and that the samples of the latter were pooled from large populations at multiple sites along the upper Pit River.

3.6. Oregon chub, *Oregonichthys crameri*

Listing Status and Proposed Critical Habitat

The Service listed the Oregon chub as an endangered species on October 18, 1993 (USFWS 1993c). A final recovery plan for the Oregon chub was published in the Federal Register on September 03, 1998 (USFWS 1998d). In 2008, the Service completed a 5-year review of the Oregon chub, concluding that downlisting criteria had been met and the species should be down listed to threatened (USFWS 2008d). A proposal to downlist the Oregon chub is expected by the Service in 2009.

A proposed critical habitat rule for the Oregon chub was published in the Federal Register on March, 10, 2009 (USFWS 2009). In the proposed rule, the Service determined that 25 units totaling approximately 53.5 ha (132.1 acres) in Benton, Lane, Linn and Marion counties meet the proposed definition of critical habitat. Land ownership of the proposed critical habitat is as follows: 13.3 ha (32.9 acres) private, 12.2 ha (30.11 acres) state, 26.8 ha (66.3 acres) Federal and 1.2 ha (2.8 acres) other governmental lands. As proposed, the PCEs of Oregon chub critical habitat are the habitat components that provide:

1. Off-channel water bodies such as beaver ponds, oxbows, side-channels, stable backwater sloughs, low-gradient tributaries, and flooded marshes, including at least 500 continuous square meters (0.12 acres) of surface area and depths between approximately 0.5 and 2.0 m (1.6 and 6.6 ft).

2. Aquatic vegetation covering a minimum of 250 square meters (0.06 ac) (or between approximately 25 and 100 percent of the total surface area of the habitat). This vegetation is primarily submergent for purposes of spawning, but also includes emergent and floating vegetation, and algae, which is important for cover throughout the year. Areas with sufficient vegetation are likely to also have the following characteristics:

    a. Gradient less than 2.5 percent;

b. No or very low water velocity in late spring and summer;
c. Silty, organic substrate; and
d. Abundant minute organisms such as rotifers, copepods, cladocerans, and chironomid larvae.

3. Late spring and summer subsurface water temperatures between 15 and 25 °C (59 and 78 °F), with natural diurnal and seasonal variation.

4. No or negligible levels of nonnative aquatic predatory or competitive species. Negligible is defined for the purpose of this proposed rule as a minimal level of nonnative species that will still allow the Oregon chub to continue to survive and recover.

Species Description

The Oregon chub is a small minnow (Family: *Cyprinidae*) with an olive-colored back grading to silver on the sides and white on the belly. Scales are relatively large with fewer than 40 occurring along the lateral line and scales near the back are outlined with dark pigment (Markle *et al.* 1991, Bond 1994). Adults are typically less than nine centimeters (3.5 inches) in length. Several size classes of Oregon chub have been collected. Young of the year are 7 to 32 millimeters (0.25 to 1.25 inches), those presumed to be 1-year old are 33 to 46 millimeters (1.25 to 1.75 inches), those presumed to be 2-years old are 47 to 64 millimeters (1.75 to 2.5 inches), and those presumed to be 3-years old are more than 65 millimeters (2.5 inches) (Pearsons 1989). The largest Oregon chub on record was collected from the Santiam River and measured 89 millimeters (3.5 inches) (Scheerer *et al.* 1995).

Life History and Habitat Needs

The Oregon chub is endemic to the Willamette River drainage of western Oregon. This species was formerly distributed throughout the Willamette River Valley in off-channel habitats such as beaver ponds, oxbows, side channels, backwater sloughs, low gradient tributaries, and flooded marshes (Snyder 1908). Historical records show Oregon chub were found as far downstream as Oregon City and as far upstream as Oakridge. Records of Oregon chub collections exist for the Clackamas River, Molalla River, Mill Creek, South Santiam River, North Santiam River, Luckiamute River, Long Tom River, McKenzie River, Calapooia River, Muddy Creek, Mary's River, Coast Fork Willamette River, Middle Fork Willamette River, and the mainstem Willamette River (Markle *et al.* 1991, Scheerer and McDonald 2000).

Based on a 1987 survey (Markle *et al.* 1989) and compilation of all known historical records, at the time of the petition for listing in 1991, viable populations of the Oregon chub occurred in Dexter Reservoir, Shady Dell Pond, Buckhead Creek near Lookout Point Reservoir, Elijah Bristow State Park, William L. Finley National Wildlife Refuge, Greens Bridge, and East Fork Minnow Pond. These locations represented a small fraction (estimated as two percent based on stream miles) of the species' formerly extensive distribution within the Willamette River drainage.

Of the known Oregon chub populations, the sites with the highest diversity of native fish, amphibian, and reptile species have the largest populations of Oregon chub (Scheerer and McDonald 2000). Beavers (*Castor canadensis*) appear to be especially important in creating and maintaining habitats that support these diverse native species assemblages (Scheerer and Apke 1998).

Oregon chub are found in slack water off-channel habitats such as beaver ponds, oxbows, side channels, backwater sloughs, low gradient tributaries, and flooded marshes. These habitats usually have little or no water flow, are dominated by silty and organic substrate, and contain considerable aquatic vegetation providing cover for hiding and spawning (Pearsons 1989, Markle *et al.* 1991, Scheerer and McDonald 2000). The average depth of habitat utilized by Oregon chub is less than six feet, and summer water temperatures typically exceed 61 °F.

Adult chub seek dense vegetation for cover and frequently travel in the mid-water column in beaver channels or along the margins of aquatic plant beds. Larval chub congregate in shallow near-shore areas in the upper layers of the water column, whereas juveniles venture farther from shore into deeper areas of the water column (Pearsons 1989). In the winter months, Oregon chub can be found buried in the detritus or concealed in aquatic vegetation (Pearsons 1989). Fish of similar size school and feed together. In the early spring, Oregon chub are most active in the warmer, shallow areas of the ponds.

Oregon chub spawn from April through September. Individuals are not known to spawn more than once a year. Spawning activity has only been observed at water temperatures exceeding 61 °F. Males over 35 millimeters (1.4) inches have been observed exhibiting spawning behavior (Pearsons 1989). Egg masses have been found to contain 147 to 671 eggs (Pearsons 1989).

Oregon chub are obligatory sight feeders (Davis and Miller 1967). They feed throughout the day and stop feeding after dusk (Pearsons 1989). Chub feed mostly on water column fauna. The diet of Oregon chub adults collected in a May sample consisted primarily of minute crustaceans including copepods, cladocerans, and chironomid larvae (Markle *et al.* 1991). The diet of juvenile chub also consists of minute organisms such as rotifers, copepods, and cladocerans (Pearsons 1989).

Population Dynamics

Since the time of listing, several Oregon chub populations have been extirpated, a number of new populations have been discovered, and there have been a number of successful introductions. According to ODFW's 2008 Monitoring Report, Oregon chub now occur at approximately 38 locations in the Santiam River, McKenzie River, Mid-Willamette River, Middle Fork Willamette River, Coast Fork Willamette River drainages (Bangs *et al.* 2008).

The Recovery Plan for the Oregon Chub (USFWS 1998d) established recovery criteria for downlisting the species to "threatened" and for delisting the species. The criteria for downlisting the species are: (1) establish and manage 10 populations of at least 500 adult fish; (2) all ten populations must exhibit a stable or increasing trend for five years; and (3) at least three populations meeting criterion 1 and 2 must be located in each of the three recovery areas (Middle Fork Willamette River, Santiam River, and Mid-Willamette River tributaries).

In 2006, there were 18 populations totaling 500 or more individuals (Sheerer *et al.* 2006). Thirteen of these populations also met the second recovery criteria. Of the 13 populations meeting recovery criteria 1 and 2, eight were located in the Middle Fork Willamette drainage, three were located in the Mid-Willamette River drainage, and two were located in the Santiam River drainage. In 2007, Oregon chub reached the downlisting criteria (from "endangered" to "threatened") outlined in the Oregon chub recovery plan (USFWS 1998d). Nineteen populations totaled 500 or more individuals and 15 of these populations also met the second recovery criteria. Of the 15 populations meeting recovery criteria 1 and 2, eight were located in the Middle Fork Willamette River drainage, four were located in the Mid-Willamette River drainage, and three were located in the Santiam River drainage (Scheerer *et al.* 2007b, USFWS 2008d).

Reasons for Listing and Threats

A variety of factors are likely responsible for the decline of the Oregon chub. These include habitat loss and alteration; the proliferation of non-native fish and amphibians; accidental chemical spills; runoff from herbicide or pesticide application on farms and timberlands or along roadways, railways, and power line rights-of way; the application of rotenone to manage sport fisheries; desiccation of habitats; unauthorized water withdrawals, diversions, or fill and removal activities; sedimentation resulting from timber harvest in the watershed, and possibly the demographic risks that result from a fragmented distribution of small, isolated populations (USFWS 1998d).

The establishment and expansion of non-native species in Oregon have contributed to the decline of the Oregon chub and limits the species' ability to expand beyond its current range. Many species of non-native fish have been introduced to, and are common throughout, the Willamette Valley, including largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*), crappie (*Pomoxis* sp.), bluegill (*Lepomis macrochirus*), and western mosquitofish (*Gambusia affinis*). The bullfrog, a non-native amphibian, also occurs in the valley and breeds in habitats preferred by the Oregon chub (Hjort *et al.* 1984, Scheerer *et al.* 1992).

The current pattern of distribution and abundance of Oregon chub populations reflects the fundamental alteration in the natural processes under which the species evolved. Sites with Oregon chub can be categorized as having high or low connectivity to the Willamette River and its tributaries; those sites with low connectivity tend to have large populations of chub and fewer species of non-native fish (Scheerer *et al.* 2002). Thus, Oregon chub now thrive particularly in habitats that are isolated and bear little resemblance to the species' dynamic natural environment. Efforts to restore floodplain function and connectivity may facilitate the introduction of non-native fishes into isolated habitats, which could have devastating effects to populations of Oregon chub (Scheerer *et al.* 2002).

3.7. Fender's blue butterfly, *Icaricia icarioides fenderi*

Listing Status and Critical Habitat

Fender's blue butterfly was listed as endangered, without critical habitat, on January 25, 2000 (USFWS 2000a). Critical habitat for the Fender's blue butterfly was designated on October 6, 2006 (USFWS 2006c). A draft recovery plan that includes this species (the Draft Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington) was published in August of 2008 (USFWS 2008b).

Critical habitat units have been designated in Benton, Lane, Polk and Yamhill counties, Oregon.

The PCEs of critical habitat for the Fender's blue butterfly are the habitat components that provide:

1. Early seral upland prairie or oak savanna habitat with undisturbed subsoils that provides a mosaic of low growing grasses and forbs, and an absence of dense canopy vegetation allowing access to sunlight needed to seek nectar and search for mates;

2. Larval host plants: *Lupinus sulphureus* ssp. *kincaidii* (Kincaid's lupine), *L. arbustus* (longspur lupine), or *L. albicaulis* (sickle-keeled lupine);

3. Adult nectar sources, such as: *Allium acuminatum* (tapertip onion), *Allium amplectens* (narrow-leaved onion), *Calochortus tolmiei* (Tolmie's mariposa lily), *Camassia quamash* (common camas), *Cryptantha intermedia* (clearwater cryptantha), *Eriophyllum lanatum* (common woolly sunflower), *Geranium oreganum* (Oregon geranium), *Iris tenax* (Oregon iris), *Linum angustifolium* (pale flax), *Linum perenne* (blue flax), *Sidalcea campestris* (meadow checker-mallow), *Sidalcea malviflora* ssp. *virgata* (rose checker-mallow), *Vicia cracca* (bird vetch), *V. sativa* (common vetch) and *V. hirsute* (tiny vetch); and

4. Stepping stone habitat: undeveloped open areas with the physical characteristics appropriate for supporting the short-stature prairie, oak savanna plant community (well drained soils), within and between natal lupine patches (about 2 km [1.2 miles]), necessary for dispersal, connectivity, population growth, and, ultimately, viability. Critical habitat does not include human-made structures existing on the effective date of the rule and not containing one or more of the PCEs, such as buildings, aqueducts, airports, and roads, and the land on which such structures are located.

Population Trends and Distribution

The historic distribution of Fender's blue butterfly is not precisely known due to the limited information collected on this species prior to its description in 1931. Although the type specimen for this butterfly was collected in 1929, few collections were made between the time of the subspecies' discovery and Macy's last observation of the Fender's blue on May 23, 1937, in Benton County, Oregon (Hammond and Wilson 1992). Uncertainty regarding the butterfly's host plant caused researchers to focus their survey efforts on common lupine species known to occur in the vicinity of Macy's collections. Fifty years passed before the butterfly was found again.

Fender's blue butterfly was rediscovered in 1989 at the McDonald Research Forest, Benton County, Oregon; it was found to be associated primarily with *Lupinus sulphureus* ssp. *kincaidii*, a rare lupine, and occasionally *L. arbustus* or *L. albicaulis* (Hammond and Wilson 1993). Recent surveys have determined that Fender's blue butterfly is endemic to the Willamette Valley and persists at about 30 sites on remnant prairies in Yamhill, Polk, Benton and Lane counties (Hammond and Wilson 1993, Schultz 1996, Schultz *et al.* 2003, U.S. Fish and Wildlife Service unpublished data). Fender's blue butterfly populations occur on upland prairies characterized by native bunch grasses (*Festuca* spp.) The association of Fender's blue butterfly with upland prairie is mostly a result of its dependence on *Lupinus sulphureus* ssp. *kincaidii*, although Fender's blue butterfly often uses wet prairies for nectaring and dispersal habitat. Sites occupied by Fender's blue butterfly are predominantly located on the western side of the Willamette

Valley, within 33 km (21 miles) of the Willamette River. A recent synthesis of existing data found the current rangewide number of butterflies to be about 3,000 to 5,000 individuals (Schultz *et al*. 2003). Fewer than ten sites with populations of 100 adult butterflies or more are known. On 30 sites surveyed for Fender's blue butterfly on non-Federal lands between 2000 and 2007, the average estimated number of butterflies per site, averaged across years, was 144. The median number of butterflies (averaged across sites and years) was 51, with a low of 2 and a high of 1040 (U.S. Fish and Wildlife Service, unpublished data).

Life History and Ecology

Adult Fender's blue butterflies live approximately 10 to 15 days and apparently rarely travel farther than 2 km (1.2 miles) over their entire life span (Schultz 1998). Although only limited observations have been made of the early life stages of Fender's blue butterfly, the life cycle of the species likely is similar to other subspecies of *Icaricia icarioides* (Hammond and Wilson 1993). The life cycle of Fender's blue butterfly may be completed in one year. An adult Fender's blue butterfly may lay approximately 350 eggs over her 10 to 15-day lifespan, of which perhaps fewer than two will survive to adulthood (Schultz 1998, Schultz *et al*. 2003). Females lay their eggs on perennial lupines (*Lupinus sulphureus* ssp. *kincaidii*, *L. arbustus* or occasionally *L. albicaulis*), which are the larval food plants during May and June (Ballmer and Pratt 1988). Newly hatched larvae feed for a short time, reaching their second instar in the early summer, at which point they enter an extended diapause. When the lupine plant senesces, diapausing larvae remain in the leaf litter at or near the base of the host plant through the fall and winter. Larvae become active again in March or April of the following year, although some larvae may be able to extend diapause for more than one season depending upon the individual and environmental conditions. Once diapause is broken, the larvae feed and grow through three to four additional instars, enter their pupal stage, and, after about two weeks, emerge as adult butterflies in May and June (Schultz *et al.* 2003).

Fender's blue butterflies have limited dispersal ability. Adult butterflies may remain within 2 km (1.2 miles) of their natal lupine patch (Schultz 1998), although anecdotal evidence exists of adult Fender's blues dispersing as far as 5 to 6 km (3.1 to 3.7 miles) (Hammond and Wilson 1992, Schultz 1998); dispersal of this magnitude is not likely anymore because of habitat fragmentation. At large patches like the main area at Willow Creek in Lane County, 95 percent of adult Fender's blue butterflies are found within 10 m (33 feet) of lupine patches (Schultz 1998).

Habitat Characteristics

Habitat requirements for Fender's blue butterfly include lupine host plants (*Lupinus sulphureus* ssp. *kincaidii* or *L. arbustus*, and occasionally *L. albicaulis*) for larval food and oviposition sites and native wildflowers for adult nectar food sources. Nectar sources used most frequently include *Allium amplectens*, *Calochortus tolmiei*, *Sidalcea malviflora* ssp. *virgata*, *Eriophyllum lanatum* and *Geranium oreganum* (Wilson *et al.* 1997, York 2002, Schultz *et al.* 2003). Non-native vetches (*Vicia sativa* and *V. hirsuta*) are also frequently used as nectar sources, although they are inferior to the native nectar sources (Schultz *et al.* 2003). Population size of Fender's blue butterfly has been found to correlate directly with the abundance of native nectar sources (Schultz *et al.* 2003). At least 5 ha (12 acres) of high quality habitat are necessary to support a population of Fender's blue butterflies (Crone and Schultz 2003, Schultz and Hammond 2003);

most prairies in the region are degraded and of low quality, and thus a much larger area is likely required to support a viable butterfly population.

Lupinus sulphureus ssp. *kincaidii* is the preferred larval host plant at most known Fender's blue butterfly populations. At two sites, Coburg Ridge and Baskett Butte, Fender's blue butterfly feeds primarily on *Lupinus arbustus*, even though *Lupinus sulphureus* ssp. *kincaidii* is present (Schultz *et al.* 2003). A third lupine, *Lupinus albicaulis*, is used by Fender's blue butterfly where it occurs in poorer quality habitats (Schultz *et al.* 2003). It is interesting to note that Fender's blue butterfly has not been found to use *Lupinus latifolius* (broadleaf lupine), a plant commonly eaten by other subspecies of *Icaricia icarioides*, even though it occurs in habitats occupied by the butterfly (Schultz *et al.* 2003).

Reasons for Listing

Habitat loss, encroachment into prairie habitats by shrubs and trees due to fire suppression, fragmentation, invasion by non-native plants and elimination of natural disturbance regimes all threaten the survival of Fender's blue butterfly. Few populations occur on protected lands; most occur on private lands which are not managed to maintain native prairie habitats. These populations are at high risk of loss to development or continuing habitat degradation (USFWS 2000a).

The prairies of western Oregon and southwestern Washington have been overtaken by non-native plants, which shade out or crowd out important native species. Fast growing non-native shrubs (*Rubus armeniacus* [Armenian blackberry] and *Cytisus scoparius* [Scotch broom]), non-native grasses such as *Arrhenatherum elatius* (tall oatgrass), and non-native forbs, such as *Centaurea* x *pratensis* (meadow knapweed), can virtually take over the prairies, inhibiting the growth of the lupine larval host plants and native nectar sources (Hammond 1996, Schultz *et al.* 2003). When these highly invasive non-native plants become dominant, they can effectively preclude butterflies from using the native plant species they need to survive and reproduce (Hammond 1996). In the absence of a regular disturbance regime, native trees and shrubs also threaten to overtake prairie habitats; common native species found to encroach on undisturbed prairies include *Pseudotsuga menziesii* (Douglas-fir), *Quercus garryana* (Oregon white oak), *Fraxinus latifolia* (Oregon ash), *Crataegus douglasii* (Douglas' hawthorn) and *Toxicodendron diversilobum* (poison oak).

Habitat fragmentation has isolated the remaining populations of Fender's blue butterfly to such an extent that butterfly movement among suitable habitat patches may now occur only rarely, which is not expected to maintain the population over time (Schultz 1998). The rarity of host lupine patches and fragmentation of habitat are seen today as the major ecological factors limiting reproduction, dispersal, and subsequent colonization of new habitat (Hammond and Wilson 1992, 1993, Hammond 1994, Schultz 1997, Schultz and Dlugosch 1999). Extirpation of remaining small populations is expected from localized events and probable low genetic diversity associated with small populations (Schultz and Hammond 2003).

Recent population viability analyses have determined that the Fender's blue butterfly is at high risk of extinction throughout most of its range (Schultz and Hammond 2003). Even the largest populations have a poor chance of survival over the next 100 years (Schultz *et al.* 2003).

Conservation Measures

Biologists from Federal and state agencies and private conservation organizations are engaged in active research and monitoring programs to improve the status of Fender's blue butterfly. Recent research has focused on population viability analyses (Schultz and Hammond 2003), metapopulation dynamics and the effects of habitat fragmentation (Schultz 1998), population response to habitat restoration (Wilson and Clark 1997, Kaye and Cramer 2003, Schultz *et al.* 2003), and developing protocols for captive rearing (Shepherdson and Schultz 2004).

Recent studies have shown that Fender's blue butterfly populations respond positively to habitat restoration. Mowing, burning and mechanical removal of weeds have all resulted in increasing Fender's blue butterfly populations. At two sites in the West Eugene Wetlands (The Nature Conservancy's Willow Creek Natural Area and the BLM's Fir Butte site), both adults and larval Fender's blue butterflies have increased in number following mowing to reduce the stature of herbaceous non-native vegetation, although the response to habitat restoration is often complicated by other confounding factors, such as weather fluctuations (Schultz and Dlugosch 1999, Fitzpatrick 2005, Kaye and Benfield 2005a). Wilson and Clark (1997) conducted a study on the effects of fire and mowing on Fender's blue butterfly and its native upland prairie at Baskett Slough National Wildlife Refuge in the Willamette Valley. Although fire killed all larvae in burned patches, female Fender's blue butterflies from the nearby unburned source patch were able to colonize the entire burned area, including lupine patches that were 107 m (350 feet) from the unburned source plants. They found that Fender's blue butterfly eggs were 10 to 14 times more abundant in plots that were mowed or burned compared to undisturbed, control plots. Woody plants were reduced 45 percent with burning and 66 percent with mowing.

Fender's blue butterfly population trends have been correlated with lupine vigor; high leaf growth appears to produce larger butterfly populations. At the U.S. Army Corps of Engineers' Fern Ridge Reservoir, the Fender's blue butterfly population has increased dramatically since fall mowing of lupine patches has been implemented. The abundance of Fender's blue butterfly eggs was found to be correlated with the abundance of Kincaid's lupine leaves at a number of study sites (Kaye and Cramer 2003); egg abundance increased substantially at sites which had been treated to control non-native weeds (Schultz *et al.* 2003).

Fender's blue butterfly populations occur on public lands or lands that are managed by a conservation organization at the U.S. Fish and Wildlife Service's Baskett Slough National Wildlife Refuge, the Army Corps of Engineers' Fern Ridge Reservoir, the BLM's West Eugene Wetlands, The Nature Conservancy's Willow Creek Preserve and Coburg Ridge easement, and on a small portion of Oregon State University's Butterfly Meadows in the McDonald State Forest. All of these parcels have some level of management for native prairie habitat values. The U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program works with private landowners to restore wildlife habitats; native prairie restoration and Fender's blue butterfly recovery are key focus areas of the program in the Willamette Valley.

3.8. Golden Indian paintbrush, *Castilleja levisecta*

Listing Status and Critical Habitat

Golden paintbrush was listed as threatened, without critical habitat, on June 11, 1997 (USFWS 1997). A recovery plan was published for this species on August 23, 2000 (USFWS 2000b). A draft recovery plan that includes conservation measures to restore this species in the Willamette Valley (the Draft Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington) was published in August of 2008 and will augment, not replace, the existing recovery plan for Golden paintbrush when it is finalized (USFWS 2008b).

Population Trends and Distribution

Historically, golden paintbrush has been reported from more than 30 sites in the Puget Trough of Washington and British Columbia, and as far south as the Willamette Valley of Oregon (Hitchcock *et al.* 1959, Sheehan and Sprague 1984, Gamon 1995, Gamon *et al.* 2001). Many populations have been extirpated as their habitats were converted for agricultural, residential, and commercial development. Eleven populations are currently known to exist in Washington and British Columbia; more than half of these populations occur on Whidbey, San Juan and Lopez islands off the north coast of the Washington mainland. In Oregon, golden paintbrush historically occurred in the grasslands and prairies of the Willamette Valley in Linn, Marion and Multnomah counties; the species was apparently extirpated from all of these sites as the habitat has been changed or modified by urbanization or agriculture. The last sighting of a naturally-occurring golden paintbrush in Oregon was in 1938 in Linn County; recent surveys have failed to re-locate the species in Oregon (Sheehan and Sprague 1984, Caplow 2004). Recently, small populations of golden paintbrush have been planted in the Willamette Valley from seed taken from Washington populations. One of these populations, at the Fish and Wildlife Service's Baskett Slough National Wildlife Refuge, appears to be successfully established; another population at William L. Finley National Wildlife Refuge may also survive and be counted as a new, established population in Oregon (K. Norman, pers. comm. 2008).

Life History and Ecology

Golden paintbrush is a short-lived perennial herb. Individual plants generally do not survive longer than 5 to 6 years. This species apparently reproduces exclusively by seed; vegetative spread has never been observed or reported. Plants may flower as early as February, and flowers are observed into summer. The fruit is a capsule, which matures in August; by mid-summer, the plants senesce, although some plants produce shoots in the fall that overwinter. Capsules persist on the plants well into winter.

The genus *Castilleja,* like many others in the figwort family, is hemi-parasitic (Center for Plant Conservation 2005). Roots of paintbrushes are capable of forming parasitic connections to roots of other plants. Paintbrush plants are probably not host-specific (Mills and Kummerow 1988). It has been clearly shown that golden paintbrush grows well independently of a host plant and that they do not necessarily require a host to survive. This evidence suggests that this species of C*astilleja* as a facultative root parasite.

The breeding system of golden paintbrush has not been thoroughly documented. Evans *et al.* (1984) reported that a species of bumblebee, *Bombus californicus,* was observed visiting golden paintbrush. Pollinator exclusion experiments showed that fruits can be produced in the absence of pollinator visitation, but fruit set was almost five times greater in unbagged inflorescences compared to inflorescences bagged to prevent visits from pollinators (Wentworth 1994).

Although seed dispersal has not been directly observed, the seeds are probably shaken from the seed capsules and fall a short distance from the parent plant. The seeds are light and could possibly be dispersed short distances by the wind.

Habitat Characteristics

Habitat descriptions for golden paintbrush are based on those extant populations in Washington and British Columbia; absent comparable habitat information for Oregon, we assume that the habitat of the extirpated populations in the Willamette Valley was similar. Golden paintbrush occurs in upland prairies, on generally flat grasslands, including some that are characterized by mounded topography. Low deciduous shrubs are commonly present as small to large thickets. In the absence of fire, some of the sites have been colonized by trees, primarily *Pseudotsuga menziesii,* and shrubs, including *Rosa nutkana* (wild rose) and *Cytisus scoparius,* an aggressive non-native shrub.

The mainland population in Washington occurs in a gravelly, glacial outwash prairie. Other populations occur on clayey soils derived from either glacial drift or glacio-lacustrine sediments (in the northern end of the species' historic range). All of the extant populations are on soils derived from glacial origins. At the southern end of its historic range, populations occurred on clayey alluvial soils, in association with *Quercus garryana* woodlands. Recent analyses of likely sites for reintroduction of golden paintbrush found that habitats are dominated by non-native annuals, and will require management before successful reintroductions can be expected (Lawrence 2005).

Reasons for Listing

Threats to golden paintbrush include habitat modification as succession causes prairies and grasslands to become shrub and forest lands; development for commercial, residential, and agricultural use; low potential for expansion of golden paintbrush populations and their refugia because existing habitat is constricted; and recreational picking and herbivory (USFWS 1997).

Conservation Measures

Some research has been conducted on the population biology, fire ecology, propagation and restoration of golden paintbrush (Dunwiddie *et al.* 2001, Gamon *et al.* 2001, Kaye 2001, Kaye and Lawrence 2003, Caplow 2004, Lawrence 2005). The results of these studies have been used to direct the management of the species at sites managed for upland prairies, and are critical to the future reintroduction and recovery of the species. A reintroduction plan has been prepared (Caplow 2004), as directed by the Golden Paintbrush Recovery Plan (USFWS 2000b); reintroduction into likely historical habitat is the best hope for the species to recover in the prairies of Oregon and southwestern Washington. Recent research has considered the most appropriate seed sources and site characteristics for the reintroduction of golden paintbrush to the Willamette Valley (Lawrence 2005). The findings of this study are consistent with those recommended for the other prairie species addressed in this restoration program, in that the optimal sites for reintroduction were high quality prairies dominated by native perennial species with low abundance of non-native plant species. Furthermore, the study recommended against using genetic diversity, effective population size, or geographic distance in determining source material for reintroductions, instead suggesting that plant materials from Whidbey Island, Washington, had the greatest potential for successful reintroductions to the Willamette Valley (Lawrence 2005). Greenhouse trials and surveys of potential reintroduction sites in the Willamette Valley have recently been completed (Lawrence 2005). Seeds of this species have been banked at the Berry Botanic Garden in Portland, Oregon (Berry Botanic Garden 2005) and the University of Washington Botanic Garden.

3.9. Bradshaw's lomatium, *Lomatium bradshawii*

Listing Status and Critical Habitat

Bradshaw's lomatium (also known as Bradshaw's desert-parsley) was listed as endangered, without critical habitat, on September 30, 1988 (USFWS 1988b). A recovery plans for this species was published in 1993 (USFWS 1993a). A draft recovery plan that includes this species (the Draft Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington) was published in August of 2008 (USFWS 2008b), and replaces and supersedes the earlier plan.

Population Trends and Distribution

Bradshaw's lomatium was historically overlooked and poorly documented, and there were no known collections between 1941 and 1969, leading to the assumption that the taxon might be extinct. By 1980, following a study of the species, six populations of the species had been located, including one large population (Kagan 1980). Since 1980, over 40 new sites have been discovered, including three large populations.

For many years Bradshaw's lomatium was considered an Oregon endemic, its range limited to the area between Salem and Creswell, Oregon (Kagan 1980). However, in 1994, two populations of the species were discovered in Clark County, Washington. There are currently about 38 occurrences of Bradshaw's lomatium in three populations centers located in Benton, Lane, Linn and Marion counties, Oregon (Gisler 2004, Oregon Natural Heritage Information Center 2004). Most of these populations are small, ranging from about 10 to 1,000 individuals, although the two largest sites each have over 100,000 plants.

Some populations that were large when discovered have since declined in size substantially. A large population at Buford Park near Eugene, Oregon, dropped from about 23,000 plants in 1993 to just over 3,000 plants in 1994 (Greenlee and Kaye 1995), and continued to decline to less than 1,000 plants in 1999. Herbivory by a booming vole population was the suspected to be the cause of the decline. The Washington populations, though fewer in number, are larger in population size, with one site estimated to have over 800,000 individuals (U.S. Fish and Wildlife Service unpublished data).

Life History and Ecology

Bradshaw's lomatium blooms in the spring, usually in April and early May. The flowers have a spatial and temporal separation of sexual phases, presumably to promote outcrossing, resulting in protandry on a whole plant basis, and protogyny within the flowers. A typical population is composed of many more vegetative plants than reproductive plants. The plant is pollinated by insects. Over 30 species of solitary bees, flies, wasps and beetles have been observed visiting the flowers (Kaye and Kirkland 1994, Jackson 1996). The very general nature of the insect pollinators probably buffers Bradshaw's lomatium from the population swings of any one pollinator (Kaye 1992).

Bradshaw's lomatium does not spread vegetatively and depends exclusively on seeds for reproduction (Kaye 1992). The large fruits have corky thickened wings, and usually fall to the ground fairly close to the parent. Fruits appear to float somewhat, and may be distributed by water. The fine-scale population patterns at a given site appear to follow seasonal, microchannels in the tufted hairgrass prairies, but whether this is due to dispersal, habitat preference, or both, is not clear (Kaye 1992, Kaye and Kirkland 1994).

In a genetic study that included six populations of Bradshaw's lomatium, the species displayed little population differentiation but the level of diversity was high across the species (Gitzendanner 2000). Isolated populations in Washington appear to have lower levels of diversity, but they do not appear to be genetically differentiated from the other populations of the species, consistent with historical gene flow among all populations, and a recent bottleneck in the Washington populations.

The species generally responds positively to disturbance. Low intensity fire appears to stimulate population growth of Bradshaw's lomatium. The density and abundance of reproductive plants increased following fires (Kaye and Pendergrass 1998, Pendergrass *et al.* 1999), although monitoring showed the effects to be temporary, dissipating after one to three years. Frequent burns may be required to sustain population growth, as determined from population models (Caswell and Kaye 2001, Kaye *et al.* 2001a,b).

Habitat Characteristics

Bradshaw's lomatium is restricted to wet prairie habitats. These sites have heavy, sticky clay soils or a dense clay layer below the surface that results in seasonal hydric soils. Most of the known Bradshaw's lomatium populations occur on seasonally saturated or flooded prairies, which are found near creeks and small rivers in the southern Willamette Valley (Kagan 1980). The soils at these sites are dense, heavy clays with a slowly permeable clay layer located between 15 and 30 cm (6 and 12 inches) below the surface. This slowly permeable clay layer, which results in a perched water table in winter and spring, allows soils to be saturated to the surface or slightly inundated during the wet season. The soils include Dayton silt loams, Natroy silty clay loams or Bashaw clays; other soils on which the species has been found include Amity, Awbrig , Coburg, Conser, Courtney, Cove, Hazelair, Linslaw, Oxley, Panther, Pengra, Salem, Willamette, and Witzel.

Less frequently, Bradshaw's lomatium populations are found on shallow, basalt areas in Marion and Linn County near the Santiam River. The soil type is characterized as Stayton Silt Loam; it is described as well drained, in alluvium underlain by basalt (Kaye and Kirkland 1994). The shallow depth to bedrock, 50 cm (20 inches) or less, results in sites which are poorly suited to agriculture. This soil type occurs at scattered locations in sites with deeper soils belonging to the Nekia-Jory association, which were originally vegetated by grassland and oak savanna (Alverson 1990). Bradshaw's lomatium at these sites occurs in areas with very shallow soil, usually in vernal wetlands or along stream channels.

Bradshaw's lomatium is often associated with *Deschampsia cespitosa*, and frequently occurs on and around the small mounds created by senescent *Deschampsia cespitosa* plants. In wetter areas, Bradshaw's lomatium occurs on the edges of *Deschampsia cespitosa* or sedge bunches in patches of bare or open soil. In drier areas, it is found in low areas, such as small depressions, trails or seasonal channels, with open, exposed soils. The grassland habitat of Bradshaw's lomatium frequently includes these species: *Carex* spp., *Danthonia californica*, *Eryngium petiolatum* (coyote-thistle), *Galium cymosum* (bedstraw), *Grindelia integrifolia* (Willamette Valley gumweed), *Hordeum brachyantherum* (meadow barley), *Juncus* spp., *Luzula campestris* (field woodrush), *Microseris laciniata* (cut-leaved microseris), and *Perideridia* sp. (yampah) (Siddall and Chambers 1978, Kagan 1980). In most sites, introduced pasture grasses (*Anthoxanthum odoratum* [sweet vernal grass], *Holcus lanatus* [velvet grass], *Poa pratensis* [Kentucky bluegrass], *Agrostis capillaries* [colonial bentgrass], *Dactylis glomerata* [orchard-grass]and *Festuca arundinacea* [tall fescue]) are present.

Reasons for Listing

Expanding urban development, pesticides, encroachment of woody and invasive species, herbivory and grazing are threats to remaining Bradshaw's lomatium populations (USFWS 1988b). The majority of Oregon's Bradshaw's lomatium populations are located within a 16-km (10-mile) radius of Eugene. The continued expansion of this city is a potential threat to the future of these sites. Even when the sites themselves are protected, the resultant changes in hydrology caused by surrounding development can alter the species' habitat (Meinke 1982, Gisler 2004). The majority of sites from which herbarium specimens have been collected are within areas of Salem or Eugene which have been developed for housing and agriculture (Siddall and Chambers 1978). The populations in Washington occur on private lands and are not protected (Gisler 2004).

Populations occurring on roadsides are at risk from maintenance activities, and from adverse effects of management on adjacent lands. Pesticide use on agricultural fields and herbicide application adjacent to roads may harm Bradshaw's lomatium populations across its range. There is concern that pesticides kill the pollinators necessary for plant reproduction; Bradshaw's lomatium does not form a seed bank, therefore, any loss of pollinators (and subsequent lack of successful reproduction) could have an immediate effect on population numbers (Kaye and Kirkland 1994). Herbicides may drift, and even when Bradshaw's lomatium is not the target, applications near a population may damage or kill the plants outright. For example, an herbicide application on private land adjacent to the William L. Finley National Wildlife Refuge drifted onto the refuge and damaged or killed Bradshaw's lomatium plants in 2006 (J. Beall, pers. comm. 2008).

One of the most significant threats is the continued encroachment into prairie habitats by woody vegetation. Historically, Willamette Valley prairies were periodically burned, either by wildfires or by fires set by Native Americans (Johannessen *et al.* 1971). Since Euro-American settlers arrived, fire suppression has allowed shrubs and trees to invade grassland habitat, which ultimately will replace the open prairies with woody plant communities.

Conservation Measures

Extensive research has been conducted on the ecology and population biology of Bradshaw's lomatium, effective methods for habitat enhancement, and propagation and reintroduction techniques (Kagan 1980, Kaye 1992, Kaye and Kirkland 1994, Kaye and Meinke 1996, Caswell and Kaye 2001, Kaye and Kuykendall 2001b, Kaye *et al.* 2003a). The results of these studies have been used to direct the management of the species at sites managed for wet prairies.

Propagation studies have found that long-term (8 weeks) cold stratification was necessary to fully break dormancy in this species (Kaye *et al.* 2003a). Bradshaw's lomatium plants can be grown from seed in a greenhouse environment (Kaye *et al.* 2003a). Plants may be successfully established at existing populations or new locations through out-planting of greenhouse-grown plants. Fertilizing transplants may have a negative effect on survival in some cases. Direct seeding has a relatively high success rate (17 to 38 percent), and is improved by removal of competing vegetation (Kaye and Kuykendall 2001b, Kaye *et al.* 2003a). Seeds of this species have been banked at the Berry Botanic Garden in Portland, Oregon (Berry Botanic Garden 2005) and the University of Washington Botanic Garden.

Studies of the effects of cattle grazing on Bradshaw's lomatium populations show mixed results. Grazing in the springtime, when the plants are growing and reproducing, can harm the plants by biomass removal, trampling and soil disturbance; however, late-season livestock grazing, after fruit maturation, has been observed to lead to an increase in emergence of new plants, and the density of plants with multiple umbels, although it did not alter survival rates or population structure (Drew 2000). Observed increases in seedlings may be due to small disturbances in the soil, a reduction of shading by nearby plants, and reduced herbivory by small mammals.

Populations of Bradshaw's lomatium occur on public lands or lands that are managed by a conservation organization at the U.S. Fish and Wildlife Service's William L. Finley and Oak Creek units of the Willamette Valley National Wildlife Refuge Complex, the U.S. Army Corps of Engineers at Fern Ridge Reservoir, the BLM at the West Eugene Wetlands, The Nature Conservancy at Willow Creek Natural Area and Kingston Prairie Preserve, and Lane County at Howard Buford Recreation Area. All of these parcels have some level of management for native prairie habitat values. The U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program works with private landowners to restore wildlife habitats; native prairie restoration is a key focus area of the program in the Willamette Valley.

3.10. Nelson's checker-mallow, *Sidalcea nelsoniana*

Listing Status and Critical Habitat

Nelson's checker-mallow was listed as threatened, without critical habitat, on February 12, 1993 (USFWS 1993b). A recovery plan was published for this species in 1998 (USFWS 1998b). A draft recovery plan that includes this species (the Draft Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington) was published in August of 2008 (USFWS 2008b), and replaces and supersedes the former plan.

Population Trends and Distribution

In the past, Nelson's checker-mallow has been collected in Benton, Clackamas, Linn, Marion, Polk, Tillamook, Yamhill and Washington counties, Oregon, and Cowlitz and Lewis counties, Washington. Nelson's checker-mallow is currently know from about 65 sites, distributed from southern Benton County, Oregon, northward through the central and western Willamette Valley, to Cowlitz and Lewis counties, Washington (CH2MHill 1997, USFWS 1998b). This species also occurs in several higher elevation west slope Coast Range meadows that flank the western Willamette Valley in Yamhill, Washington and Tillamook counties, Oregon. Known populations range in elevation from 45 to 600 m (145 to 1,950 feet).

In the Willamette Valley, populations of Nelson's checker-mallow occur at low elevations (below 200 m [650 feet]) within a mosaic of urban and agricultural areas, with concentrations around the cities of Corvallis and Salem. In the Coast Range, Nelson's checker-mallow populations range in elevation from 490 to 600 m (1,600 to 1,960 feet), and are found in open, grassy meadows within a larger matrix of coniferous forest.

Life History and Ecology

In the Willamette Valley, Nelson's checker-mallow begins flowering as early as mid-May, and continues through August to early September, depending upon the moisture and climatic conditions of each site. Coast Range populations experience a shorter growing season and generally flower later and senesce earlier. Nelson's checker-mallow inflorescences are indeterminate, and often simultaneously exhibit fruits, open flowers, and unopened buds. Seeds are deposited locally at or near the base of the parent plant and may be shed immediately or persist into winter within the dry flower parts that remain attached to the dead stems. Above-ground portions of the plant die back in the fall, usually followed by some degree of regrowth at the base, with the emergence of small, new leaves that persist through the winter directly above the root crown. It is not uncommon for some plants to continue producing some flowers into the fall and early winter, although this is usually limited to one or two small stems per plant, with little consequent seed production (USFWS 1998b).

Perfect-flowered Nelson's checker-mallow are protandrous, with complete temporal separation of male and female phases in individual flowers (Gisler and Meinke 1998). This prevents self-fertilization, and combined with the bottom-to-top foraging observed among most bee visitors, also discourages selfing through geitonogamy. Outcrossing is encouraged because pollinators leave male-phase flowers at the top of one raceme and then fly to female phase flowers on the bottom of the next raceme. Some selfing will still occur in perfect-flowered plants, however, due to within-plant, between-raceme foraging. Female plants, which lack male flowers, are obligately outcrossed (Gisler and Meinke 1998). In most Willamette Valley (but not Coast Range) populations, female (male-sterile) Nelson's checker-mallow plants vastly outnumber perfect plants. Nelson's checker-mallow is also capable of vegetative expansion via rhizomes or laterally spreading root systems that form multiple crowns bearing distinct clusters of flowering stems (CH2MHill 1986, Glad *et al.* 1994).

Nelson's checker-mallow is pollinated by a variety of insects, including at least 17 species of bees, 3 species of wasps, 9 species of flies, 6 species of beetles, and 5 species of lepidopterans (Gisler 2003). Three species of bumblebees (*Bombus californicus*, *B. sitkensis* and *B. vosnesenskii*) were the most common and active pollinators (Gisler 2003). One solitary bee pollinator, *Diadasia nigrifrons*, is a checker-mallow specialist, and may also pollinate Nelson's checker-mallow in the Willamette Valley (Gisler and Meinke 1998).

Pre-dispersal seed predation by weevils (*Macrorhoptus sidalceae*) is extremely high in many populations, and may severely curtail, if not virtually eliminate, seed survival in many populations (Gisler and Meinke 1998). The weevils appear to be restricted to Willamette Valley, southwestern Washington and lower Coast Range populations (around Grand Ronde), but do not infest the Coast Range populations in Yamhill, Tillamook, and Washington counties. The weevils are native, host-specific, and are themselves parasitized by tiny undescribed wasps (Gisler and Meinke 1998).

Four other native *Sidalcea* species are found within the geographic range of Nelson's checker-mallow (Hitchcock and Cronquist 1973, Gisler 2004). *Sidalcea malviflora* ssp. *virgata* is typically shorter and begins flowering earlier than the other checker-mallows in the region, tends to occupy somewhat dryer, more upland sites, and has forked or branched stem hairs and distinctively deep pink to rose-colored flowers. *Sidalcea campestris* is the tallest checker-mallow in the region, and can be distinguished by its large, pale pink to white flowers. *Sidalcea cusickii* (Cusick's checker-mallow) occurs only within the extreme southern portion of Nelson's checker-mallow range, barely extending north of the city of Eugene, Oregon, and is discernable by generally forked stem hairs, broad calyx lobes, and prominently veined petals. *Sidalcea hirtipes* (Bristly-stem checker-mallow) has a longer and fuzzier calyx, longer petals, and longer hair on the stem; its range overlaps that of Nelson's checker-mallow in the Coast Range and Lewis County, Washington. *Sidalcea hirtipes* is itself considered endangered in Washington by the state's Natural Heritage Program (Washington Natural Heritage Program 2005).

There is a strong potential for interspecific hybridization among Nelson's checker-mallow and its congeners in the region, although there are some ecological and genetic reproductive barriers to prevent it from occurring (Gisler 2003, 2004). Nelson's checker-mallow flowers later in the year than sympatric populations of *Sidalcea malviflora* ssp. *virgata*, but allopatric populations sometimes overlap in flowering periods. The two species are sexually compatible, thus human-mediated movement of the plants could result in formation of hybrids. Nelson's checker-mallow and *S. cusickii* are also fully compatible, and they also share pollinators and flowering times, but their geographic ranges are parapatric, with nearest populations narrowly separated by less than a mile at the south end of Finley National Wildlife Refuge (Gisler 2004). If these species come into contact through human-mediated dispersal, hybridization could easily occur. Nelson's checker-mallow is frequently found growing together with *S. campestris*, and they also share pollinators and flowering times, but they exhibit very low sexual compatibility (probably due to chromosomal pairing problems resulting from polyploidy) (Gisler 2004). Reproductive barriers among all the checker-mallows likely evolved in response to selective pressure against hybridization; managers should be aware of the potential for hybridization as plants are moved around within the region.

Habitat Characteristics

In the Willamette Valley, Nelson's checker-mallow is known from wet prairies and stream sides. Although occasionally occurring in the understory of *Fraxinus latifolia* woodlands or among woody shrubs, Willamette Valley Nelson's checker-mallow populations usually occupy open habitats supporting early seral plant species. These native prairie remnants are frequently found at the margins of sloughs, ditches, and streams, roadsides, fence rows, drainage swales and fallow fields. Soil textures of the occupied sites vary from gravelly, well drained loams to poorly drained, hydric clay soils (CH2MHill 1986, Glad *et al.* 1994).

Some of the native plants commonly associated with Nelson's checker-mallow in the Willamette Valley include: *Achillea millefolium* (yarrow), *Juncus effusus* (common rush), *Carex* spp (sedge), *Spiraea douglasii* (western spiraea), *Crataegus douglasii*, *Geum macrophyllum* (large-leaved avens), and *Fraxinus latifolia* (Oregon Department of Agriculture 1995). Most sites have been densely colonized by invasive weeds, especially introduced forage grasses; common non-native species found with Nelson's checker-mallow include: *Festuca arundinacea*, *Rosa* spp. (rose), *Cirsium arvense* (Canada thistle), *Hypericum perforatum* (common St. John's wort), *Rubus* spp. (blackberry), *Phleum pratense* (timothy), *Holcus lanatus*, *Vicia* spp., *Chrysanthemum leucanthemum* (oxeye-daisy), *Agrostis tenuis* (colonial bent-grass), *Alopecurus pratensis* (meadow foxtail), *Phalaris arundinacea* (red canary grass), *Geranium* spp. (geranium), *Lotus corniculatus* (bird's-foot trefoil) and *Daucus carota* (wild carrot)(Oregon Department of Agriculture 1995).

Coast Range Nelson's checker-mallow populations typically occur in open, wet to dry meadows, intermittent stream channels, and along margins of coniferous forests, with clay to loam soil textures (Glad *et al.* 1987). These areas generally support more native vegetation than Willamette Valley sites. Native plants commonly associated with Nelson's checker-mallow in the Coast Range include: *Senecio triangularis* (spear-head senecio), *Fragaria virginiana*, *Juncus* spp., *Carex* spp., and *Achillea millefolium*; non-native associated species often include *Senecio jacobaea* (tansy ragwort), *Holcus lanatus, Phleum pretense.*

A variety of animal species are associated with Nelson's checker-mallow. Stems and inflorescences are commonly eaten by deer and elk. Nelson's checker-mallow flowers are visited by a diverse assemblage of insects, including leafcutter bees (Megachilidae), honey bees (Apidae), bumble bees (Bombidae), hover flies (Syrphidae), butterflies (Hesperiidae), and pollen-foraging beetles (Cerambycidae and Meloidae). The species is also a host for various phytophagous insects such as aphids (Aphididae), stinkbugs (Pentatomidae), scentless plant bugs (Rhopalidae), spotted cucumber beetles (Chrysomelidae), plant bugs (Miridae), milkweed bugs (Lygaeidae), spittlebugs (Cercopidae), butterfly larvae (Lycaenidae: *Strymon melinus*; Nymphalidae: *Vanessa anabella*), and in the Willamette Valley, weevils (Curculionidae: *Macrohoptus sidalcae*). Other insects found in association with Nelson's checker-mallow include ants (Formicidae) and earwigs (Forficulidae) (Bureau of Land Management 1985, CH2M Hill 1986, Oregon Department of Agriculture 1995).

Reasons for Listing

Nelson's checker-mallow is threatened by urban and agricultural development, ecological succession that results in shrub and tree encroachment of open prairie habitats, and competition with invasive weeds (USFWS 1993b).

At many Willamette Valley sites, seedling establishment is inhibited by the dense thatch layer of non-native grasses (Gisler 2004). Other factors specific to Nelson's checker-mallow include pre-dispersal seed predation by weevils (Gisler and Meinke 1998), the potential threat of inbreeding depression due to small population sizes and habitat fragmentation (Gisler 2003).

Conservation Measures

Extensive research has been conducted on the ecology and population biology of Nelson's checker-mallow, methods of seed predator control, and propagation and reintroduction techniques (Gisler and Meinke 1998, Bartels and Wilson 2001, Gisler and Meinke 2001, Gisler 2003, Wilson 2004). The results of these studies have been used to direct the management of the species at sites managed for wet prairies.

Studies of the reproductive ecology of Nelson's checker-mallow have shown that it has a highly complex breeding system that facilitates both outcrossing and selfing (Gisler and Meinke 1998); this study also suggested that control of seed predation by native weevils may be needed to enhance reproductive success at some populations which are heavily infested with weevils. Research into habitat management techniques indicates that burning may not be directly beneficial to Nelson's checker-mallow, and that caution should be used in management of native prairie fragments with populations of Nelson's checker-mallow (Bartels and Wilson 2001, Wilson 2004). The species has proved to be readily grown in controlled environments, and several approaches have successfully cultivated healthy plants for augmentation of existing populations (Gisler 2003). Seeds of this species have been banked at the Berry Botanic Garden in Portland, Oregon (Berry Botanic Garden 2005) and the University of Washington Botanic Garden.

Populations of Nelson's checker-mallow are protected on lands managed by the U.S. Fish and Wildlife Service at William L. Finley and Baskett Butte National Wildlife Refuges, the Confederated Tribes of the Grand Ronde in Polk County, and by the BLM at Walker Flat in Yamhill County, Oregon. In December 2007, Ridgefield National Wildlife Refuge, in Clark County, Washington, outplanted 2530 seedlings to establish a new population of Nelson's checker-mallow at the refuge; monitoring and management of the new population is ongoing. The U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program works with private landowners to restore wildlife habitats; native prairie restoration is a key focus area of the program in the Willamette Valley.

3.11. Willamette daisy, *Erigeron decumbens* var. *decumbens*

Listing Status and Critical Habitat

Willamette daisy was listed as endangered, without critical habitat, on January 25, 2000 (USFWS 2000a). A draft recovery plan that includes this species (the Draft Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington) was published in August of 2008 (USFWS 2008b).

Critical habitat was designated on October 6, 2006 (USFWS 2006c). Critical habitat units for Willamette daisy have been designated in Benton, Lane, Linn, Marion and Polk counties, Oregon. The PCEs of critical habitat are the habitat components that provide early seral upland prairie or oak savanna habitat with a mosaic of low growing grasses, forbs, and spaces to establish seedlings or new vegetative growth, with an absence of dense canopy vegetation providing sunlight for individual and population growth and reproduction, and with undisturbed subsoils and proper moisture and protection from competitive invasive species. Critical habitat does not include human-made structures existing on the effective date of the rule and not containing one or more of the PCEs, such as buildings, aqueducts, airports, and roads, and the land on which such structures are located.

Population Trends and Distribution

Willamette daisy is endemic to the Willamette Valley of western Oregon. Herbarium specimens show a historical distribution of Willamette daisy throughout the Willamette Valley; frequent collections were made in the period between 1881 and 1934, yet no collections or observations were recorded from 1934 to 1980, and the plant was presumed to be extinct (Clark *et al.* 1993, Gisler 2004). The species was rediscovered in 1980 in Lane County, Oregon, and has since been identified at more than 30 sites. Willamette daisy has been collected in Benton, Clackamas, Lane, Linn, Marion, Polk, Yamhill, and Washington counties, Oregon, but today the species occurs in Benton, Lane, Linn, Marion, and Polk counties, Oregon; at those sites, there are about 116 ha (286 acres) of occupied habitat.

Population size may fluctuate substantially from year to year. Monitoring at the Oxbow West site, near Eugene, found 2,299 Willamette daisy plants in 1999, 2,912 plants in 2000, and only 1,079 plants in 2001 (Kaye 2002). The population at Baskett Butte declined to 48 percent of the original measured population between 1993 and 1999 (Clark 2000, Ingersoll *et al.* 1993, 1995). Detecting trends in Willamette daisy populations is complicated by the biology and phenology of the species. For instance, Kagan and Yamamoto (1987) found it difficult to determine survival and mortality between years because of sporadic flowering from year to year. They suggested that some plants may not flower in some years, as indicated by the sudden appearance of large plants where they were not previously recorded, and the disappearance and later re-emergence of large plants within monitoring plots. In addition, Clark *et al.* (1993) stated that non-reproductive individuals can be very difficult to find and monitor due to their inconspicuous nature, and that the definition of individuals can be complicated when flowering clumps overlap.

Life History and Ecology

Willamette daisy is an herbaceous perennial that occurs as single plants or clumps of genetically identical ramets (Clark *et al.* 1993). It blooms in June and early July and produces seeds in late summer (Cronquist 1955). Seedlings emerge in late winter or early spring, and plants require two to four years in the wild to reach flowering size. Large plants appear to spread vegetatively, but this spread is localized around the established plant (Clark *et al.* 1995). Field investigators have developed a distance-based rule for consistently differentiating closely-spaced plants. If it is unclear that two adjacent clumps are united underground, they are assumed to be distinct individuals if they are separated by 7 cm (3 inches) or more. Clumps closer than 7 cm (3 inches) are assumed to be part of the same plant (Kaye and Benfield 2005b).

The fruits of Willamette daisy are single-seeded achenes, like those of other *Erigeron* species, and have a number of small capillary bristles (the pappus) attached to the top, which allow them to be distributed by the wind. Population size can substantially affect reproductive success in this species. Populations of Willamette daisy with fewer than 20 individuals appear to suffer a high rate of reproductive failure due to inbreeding depression and reduced probability of being pollinated by a compatible mate (Wise and Kaye 2006).

A variety of insects have been observed to visit the flowers of Willamette daisy; potential pollinators include solitary bees (*Ceratina* sp., *Megachile* sp., *Nomada* sp., *Halictus ligatus,* and *Ashmeadiella* sp.), beetles (*Meligethes nigrescens* and *Acanthoscelides pauperculus*), flies

(*Toxomerus marginata, T. occidentalis* and *Tachina* sp.), and butterflies (*Phyciodes campestris*) (Kagan and Yamamoto 1987, Clark *et al.* 1993, Jackson 1996, Gisler 2004).

Habitat Characteristics

Willamette daisy typically occurs where woody cover is nearly absent and where herbaceous vegetation is low in stature (Clark *et al.* 1993). It occurs in both wet prairie grasslands and drier upland prairie sites. The wet prairie grassland community is typically dominated by *Deschampsia cespitosa* (tufted hairgrass), *Danthonia californica* (California oatgrass) and a number of Willamette Valley endemic forbs. It is a flat, open, seasonally wet prairie with bare soil between the pedestals created by the bunching *Deschampsia cespitosa* (Kagan and Yamamoto 1987). On drier upland prairie sites, associated species commonly include *Aster hallii*, *Festuca idahoensis* ssp. *roemeri* (Roemer's bunchgrass) and *Toxicodendron diversilobum* (Meinke 1982, Clark *et al*. 1993). Willamette daisy prefers heavier soils, and has been found on the following soil associations: Bashaw, Briedwell, Chehulpum, Dayton, Dixonville, Dupee, Hazelair, Marcola, Natroy, Nekia, Pengra, Philomath, Salkum, Saturn, Stayton, and Witzel.

Reasons for Listing

Like many native species endemic to Willamette Valley prairies, Willamette daisy is threatened by habitat loss due to urban and agricultural development, successional encroachment into its habitat by trees and shrubs, competition with non-native weeds, and small population sizes (Kagan and Yamamoto 1987, Clark *et al.* 1993, Gisler 2004). The U.S. Fish and Wildlife Service (2000a) estimated that habitat loss is occurring at 80 percent of the remaining 84 remnants of native prairies occupied by Willamette daisy and *Lupinus sulphureu*s ssp. *kincaidii*. At the time of its listing, we estimated that 24 of the 28 extant Willamette daisy populations occurred on private lands and, "without further action, are expected to be lost in the near future" (USFWS 2000a).

Populations occurring on private lands are the most vulnerable to threats of development, because state and Federal plant protection laws have little effect on private lands, although publicly owned populations are not immune from other important limitations or threats to the species. For instance, Clark *et al.* (1993) identified four populations protected from development on public lands (Willow Creek, Basket Slough National Wildlife Refuge, Bald Hill Park, and Fisher Butte Research Natural Area), but stated that even these appear to be threatened by the proliferation of non-native weeds and successional encroachment of brush and trees. Likewise, vulnerability arising from small population sizes and inbreeding depression may be a concern for the species, regardless of land ownership, especially among 17 of the 28 remaining sites that are smaller than 3.5 ha (8 acres) (USFWS 2000a). Given that the majority of populations are on private lands, working with private landowners is critical if we are to promote the eventual conservation and recovery of Willamette daisy.

Conservation Measures

Some research has been conducted on the ecology and population biology of Willamette daisy, effective methods for habitat enhancement, and propagation and reintroduction techniques (Ingersoll *et al.* 1993, 1995, Clark *et al.* 1995, 1997, Wilson and Clark 1997, Kaye and Kuykendall 2001b, Leininger 2001, Kaye *et al.* 2003b). The results of these studies have been used to direct the management of Willamette daisy populations at sites that are managed for native prairie values.

The efficacy of mowing and burning as tools to restore habitat for Willamette daisy is under investigation. Preliminary findings indicate that Willamette daisy responded with increased crown cover in mowed plots as compared to unmowed plots; this study is continuing and will also evaluate the effects of fire on Willamette daisy (Kaye *et al.* 2003b).

Several studies have investigated the feasibility of growing Willamette daisy in controlled environments for augmentation of wild populations. Cold stratification or seed-coat scarification is necessary for successful germination (Clark *et al.* 1995, Kaye and Kuykendall 2001b). Stem and rhizome cuttings have also been used successfully to establish plants in the greenhouse (Clark *et al.* 1995, Wilson *et al.* 2001). Attempts to establish Willamette daisy at new sites has shown that transplanting cultivated plants is much more effective than sowing seeds directly (Kaye *et al.* 2003a). It is likely that conservation of Willamette daisy may require augmenting small populations with propagated individuals (Clark *et al.* 1995). Seeds of this species have been banked at the Berry Botanic Garden in Portland, Oregon (Berry Botanic Garden 2005).

Habitat for Willamette daisy occurs on public lands or lands that are managed by a conservation organization at the U.S. Fish and Wildlife Service's Baskett Slough National Wildlife Refuge, the U.S. Army Corps of Engineers' Fern Ridge Reservoir, the BLM's West Eugene Wetlands, and The Nature Conservancy's Willow Creek Preserve. All of these parcels have some level of management for native prairie habitat values. The U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program works with private landowners to restore wildlife habitats; native prairie restoration is a key focus area of the program in the Willamette Valley.

3.12. Kincaid's lupine, *Lupinus sulphureus* var. *kincaidii*

Listing Status and Critical Habitat

Kincaid's lupine was listed as threatened, without critical habitat, on January 25, 2000 (USFWS 2000a). A recovery outline for the species was published in 2006 (USFWS 2006d), and a draft recovery plan that includes this species (the Draft Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington) was published in August of 2008 (USFWS 2008b).

Critical habitat was designated on October 6, 2006 (USFWS 2006c). Critical habitat units for Kincaid's lupine have been designated in Benton, Lane, Polk and Yamhill counties, Oregon, and Lewis County, Washington. The PCEs of critical habitat are the habitat components that provide: (1) early seral upland prairie or oak savanna habitat with a mosaic of low growing grasses, forbs, and spaces to establish seedlings or new vegetative growth, with an absence of dense canopy vegetation providing sunlight for individual and population growth and reproduction, and with undisturbed subsoils and proper moisture and protection from competitive invasive species; and (2) the presence of insect pollinators, such as bumblebees (*Bombus mixtus* and *B. californicus*), with unrestricted movement between existing lupine patches, critical for successful lupine reproduction. Critical habitat does not include human-made structures existing on the effective date of the rule and not containing one or more of the PCEs, such as buildings, aqueducts, airports, and roads, and the land on which such structures are located.

Population Trends and Distribution

Kincaid's lupine is found in dry upland prairies from Lewis County, Washington, in the north, south to the foothills of Douglas County, Oregon; however, most of the known and historical populations are found in the Willamette Valley. Historically, the species was documented from Vancouver Island, British Columbia, Canada (Dunn and Gillet 1966), but has not been located in that region since the 1920s (Kaye 2000). Kincaid's lupine is currently known at about 57 sites, comprising about 160 ha (395 acres) of total coverage (Kaye and Kuykendall 1993, Wilson *et al.* 2003). Until the summer of 2004, Kincaid's lupine was known from just two extant populations in Washington, in the Boistfort Valley in Lewis County, more than 160 km (100 miles) from the nearest population in the Willamette Valley. In 2004, two small populations were found at Drew's Prairie and Lacamas Prairie to the east of the Boistfort Valley in Lewis County; only one plant was observed at Drew's Prairie, and more than 40 plants were found at Lacamas Prairie (Caplow and Miller 2004; T. Thomas, pers. comm. 2006). Before Euro-American settlement of the region, Kincaid's lupine was likely well distributed throughout the prairies of western Oregon and southwestern Washington; today, habitat fragmentation has resulted in existing populations that are widely separated by expanses of unsuitable habitat.

Monitoring the size of Kincaid's lupine populations is challenging because its pattern of vegetative growth renders it difficult to distinguish individuals (Wilson *et al.* 2003). Instead of counting plants, most monitoring for this species relies on counting the number of leaves per unit area, partly because there is a strong correlation between Fender's blue butterfly egg numbers and lupine leaf density (Schultz 1998, Kaye and Thorpe 2006). Leaf counts are time consuming, however, and recent evaluations have shown that lupine cover estimates are highly correlated with leaf counts, much faster to perform, and useful for detecting population trends (Kaye and Benfield 2005a).

Life History and Ecology

Flowering begins in April and extends through June. As the summer dry season arrives, Kincaid's lupine becomes dormant, and is completely senescent by mid-August (Wilson *et al.* 2003). Pollination is largely accomplished by small native bumblebees (*Bombus mixtus* and *B. californicus*), solitary bees (*Osmia lignaria*, *Anthophora furcata*, *Habropoda* sp., *Andrena* spp., *Dialictus* sp.) and occasionally, European honey bees (*Apis mellifera*) (Wilson *et al.* 2003). Insect pollination appears to be critical for successful seed production (Wilson *et al.* 2003).

Kincaid's lupine reproduces by seed and vegetative spread. It is able to spread extensively through underground growth. Individual clones can be several centuries old (Wilson *et al.* 2003), and become quite large with age, producing many flowering stems. Excavations and morphological patterns suggest that plants 10 m (33 feet) or more apart can be interconnected by below-ground stems, and that clones can exceed 10 m (33 feet) across (Wilson *et al.* 2003). As part of a genetic evaluation, collections taken from small populations of Kincaid's lupine at the Baskett Slough National Wildlife Refuge were found to be genetically identical, indicating that the population consists of one or a few large clones (Liston *et al.* 1995). Reproduction by seed is common in large populations where inbreeding depression is minimized and ample numbers of seeds are produced. In small populations, seed production is reduced and this appears to be due, at least in part, to inbreeding depression (Severns 2003).

Kincaid's lupine is vulnerable to seed, fruit and flower predation by insects, which may limit the production of seeds. Seed predation by bruchid beetles and weevils and larvae of other insects has been documented, and may result in substantially reduced production of viable seed (Kaye and Kuykendall 1993, Kuykendall and Kaye 1993). Floral and fruit herbivory by larvae of the silvery blue butterfly (*Glaucopsyche lygdamus columbia*) has also been reported (Kuykendall and Kaye 1993, Schultz 1995). The vegetative structures of Kincaid's lupine support a variety of insect herbivores, including root borers, sap suckers and defoliators (Wilson *et al.* 2003). Kincaid's lupine is the primary larval host plant of the endangered Fender's blue butterfly (Wilson *et al.* 2003). Female Fender's blue butterflies lay their eggs on the underside of Kincaid's lupine leaves in May and June; the larvae hatch several weeks later and feed on the plant for a short time before entering an extended diapause, which lasts until the following spring (Schultz *et al.* 2003). Kincaid's lupine, like other members of the genus *Lupinus,* is unpalatable to vertebrate grazers. Kincaid's lupine forms root nodules with *Rhizobium* spp. bacteria that fix nitrogen, and also has vesicular-arbuscular mycorrhizae, which may enhance the plant's growth (Wilson *et al.* 2003).

Habitat Characteristics

In the Willamette Valley and southwestern Washington, Kincaid's lupine is found on upland prairie remnants where the species occurs in small populations at widely scattered sites. A number of populations are found in road rights-of-way, between the road shoulder and adjacent fence line, where they have survived because of a lack of agricultural disturbance. Common native species typically associated with Kincaid's lupine include: *Festuca idahoensis* ssp. *roemeri*, *Danthonia californica*, *Calochortus tolmiei*, *Eriophyllum lanatum*, and *Fragaria virginiana* (wild strawberry). The species appears to prefer heavier, generally well-drained soils and has been found on 48 soil types, typically Ultic Haploxerolls, Ultic Argixerolls, and Xeric Palehumults (Wilson *et al.* 2003).

In Douglas County, Oregon, Kincaid's lupine appears to tolerate more shaded conditions, where it occurs at sites with canopy cover of 50 to 80 percent (Barnes 2004). In contrast to the open prairie habitats of the more northerly populations, in Douglas County, tree and shrub species dominate the sites, including *Pseudotsuga menziesii*, *Quercus kelloggii* (California black oak), *Arbutus menziesii* (Pacific madrone), *Pinus ponderosa* (ponderosa pine), *Calocedrus decurrens* (incense cedar), *Arctostaphylos columbiana* (hairy manzanita) and *Toxicodendron diversilobum*.

In contrast to historical ecosystem composition, invasive non-native species are a significant component of Kincaid's lupine habitat today. Common invasives include: *Arrhenatherum elatius*, *Brachypodium sylvaticum* (slender false brome), *Dactylis glomerata*, *Festuca arundinacea*, *Rubus armeniacus* and *Cytisus scoparius* (Wilson *et al.* 2003). In the absence of fire, some native species, such as *Toxicodendron diversilobum* and *Pteridium aquilinum* (bracken fern), invade prairies and compete with Kincaid's lupine.

Reasons for Listing

The three major threats to Kincaid's lupine populations are habitat loss, competition from non-native plants and elimination of historical disturbance regimes (Wilson *et al.* 2003). Habitat loss from a wide variety of causes (*e.g.*, urbanization, agriculture, silvicultural practices and roadside maintenance) has been the single largest factor in the decline of Kincaid's lupine (USFWS 2000a). Land development and alteration in the prairies of western Oregon and southwestern Washington have been so extensive that the remaining populations are essentially relegated to small, isolated patches of habitat. Habitat loss is likely to continue as private lands are developed; at least 49 of 54 sites occupied by Kincaid's lupine in 2000 at the time listing occurred were on private lands and are at risk of being lost unless conservation actions are implemented (USFWS 2000a).

Habitat fragmentation and isolation of small populations may be causing inbreeding depression in Kincaid's lupine. The subspecies was likely wide-spread historically, frequently outcrossing throughout much of its range, until habitat destruction and fragmentation severely isolated the remaining populations (Liston *et al.* 1995). There is some evidence of inbreeding depression, which may result in lower seed set (Severns 2003). Hybridization between Kincaid's lupine and *Lupinus arbustus* has been detected at Baskett Slough National Wildlife Refuge (Liston *et al.* 1995).

Invasion by a few aggressive plant species is a threat to many prairies and the presence of other non-native species within degraded prairies contributes to lower prairie quality and concomitant reduced population viability of native species, including Kincaid's lupine. Some aggressive non-native plants form dense monocultures, which compete for space, water and nutrients with the native prairie species, and ultimately inhibit the growth and reproduction of Kincaid's lupine by shading out the plants (Wilson *et al.* 2003).

Most prairie sites require frequent disturbances to hold back the natural succession of trees and shrubs. Before settlement by Euro-Americans, the regular occurrence of fire maintained the open prairie habitats essential to Kincaid's lupine. The loss of a regular disturbance regime, primarily fire, has resulted in the decline of prairie habitats through succession by native trees and shrubs, and has allowed the establishment of numerous non-native grasses and forbs. When this species was listed, we estimated that 83 percent of upland prairie sites were succeeding to forest in the range of Kincaid's lupine (USFWS 2000a).

Conservation Measures

Active research efforts have focused on restoring the essential components of Kincaid's lupine habitat by mimicking the historical disturbance regime with the application of prescribed fire, mowing and manual removal of weeds. Research and habitat management programs for Kincaid's lupine have been implemented at several sites, including Baskett Slough National Wildlife Refuge, BLM's Fir Butte site and The Nature Conservancy's Willow Creek Preserve (Wilson *et al.* 2003, Kaye and Benfield 2005a). Prescribed fire and mowing before or after the growing season have been effective in reducing the cover of invasive non-native plants; following treatments, Kincaid's lupine has responded with increased leaf and flower production (Wilson *et al.* 2003). Research has also been conducted on seed germination, propagation and reintroduction of Kincaid's lupine (Kaye and Kuykendall 2001a, 2001b, Kaye and Cramer 2003, Kaye *et al.* 2003a). Seeds of this species have been banked at the Berry Botanic Garden in Portland, Oregon (Berry Botanic Garden 2005).

The BLM, Umpqua National Forest and Service completed a programmatic conservation agreement for Kincaid's lupine in Douglas County, Oregon, in April 2006 (Roseburg Bureau of

Land Management *et al*. 2006). The objectives of the agreement are: (1) to maintain stable populations of the species in Douglas County by protecting and restoring habitats, (2) to reduce threats to the species on BLM and Forest Service lands, (3) to promote larger functioning metapopulations, with increased population size and genetic diversity, and (4) to meet the recovery criteria in the Recovery Outline for the species (USFWS 2006d).

Populations of Kincaid's lupine occur on public lands or lands that are managed by a conservation organization at the U.S. Fish and Wildlife Service's William L. Finley National Wildlife Refuge and Baskett Slough National Wildlife Refuge, the Army Corps of Engineers' Fern Ridge Reservoir, BLM units in Lane and Douglas counties, the Umpqua National Forest, The Nature Conservancy's Willow Creek Preserve, and at a small portion of Oregon State University's Butterfly Meadows in the McDonald State Forest. All of these parcels have some level of management for native prairie habitat values. The U.S. Fish and Wildlife Service's Partners for Fish and Wildlife Program works with private landowners to restore wildlife habitats; native prairie restoration is a key focus area of the program in the Willamette Valley.

4. ENVIRONMENTAL BASELINE

The environmental baseline is defined as "the past and present impacts of all Federal, state or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State and private actions which are contemporaneous with the consultation in process [50 CFR 402.02]."

4.1. Bull trout

The action area encompasses the Oregon portion of the range of the species. The bull trout environmental baseline in the action area is described below using data compiled and summarized during the comprehensive Bull Trout Five Year Review process (USFWS 2005a, USFWS 2008a), the draft bull trout Recovery Plan chapters (USFWS 2002b, USFWS 2004a,b,c), the Washington Department of Natural Resources Forest Practices Habitat Conservation Plan BO (USFWS 2006a) and the Final Rule designating bull trout critical habitat (USFWS 2005b). These data are the most recent and comprehensive in analyzing current bull trout recovery status, including review of (from broad-scale to fine-scale) interim recovery units (former DPSs), Management Units, Core Areas, and associated population abundance, trends, risks and current status. The Service therefore incorporates these documents by reference for purposes of describing bull trout environmental baseline; these documents considered adverse effects and incidental take determined from past bull trout biological opinions in the action area.

Critical habitat designated in Oregon includes 939 stream miles and 27,322 acres of lakes or reservoirs and an additional 17 stream miles designated in Oregon/Idaho within nine critical habitat units, as follows: Klamath River Basin, Willamette River Basin, Hood River Basin, Deschutes River Basin, Umatilla-Walla Walla River Basins, Grand Ronde River Basin, Imnaha-Snake River Basins, Hells Canyon Complex, and the Malheur River Basin. Only areas that were found to be occupied within the last twenty years, that contain features essential to the conservation of bull trout, and that do not already have conservation efforts in place were designated. Over 75 percent of the lands adjacent to designated critical habitat are private, with the remainder under local government, State, Tribal and Federal ownership (USFWS 2005b).

Two interim recovery units (formerly known as DPSs) occur in the action area: Columbia River and Klamath River. The Columbia River interim recovery unit includes the Willamette River, Hood River, Deschutes River, Odell Lake, John Day River, Umatilla-Walla Walla Rivers, Grande Ronde River, Imnaha-Snake Rivers, Hells Canyon Complex and Malheur River Management Units. The Klamath River interim recovery unit includes the Klamath River Management Unit (see Figure 4).

Columbia River Interim Recovery Units

<u>Willamette River Management Unit: Upper Willamette Core Area.</u> The Upper Willamette Core Area is comprised of three local populations: McKenzie River, South Fork McKenzie, and Trailbridge Reservoir. Population estimates indicate less than 300 adult bull trout survive in this core area. Annual redd counts have decreased gradually over the last five years (2000-2004) in the mainstem McKenzie River local population, from a high of 92 redds in 2000, to 61 redds in 2003. Over the same time frame, redd counts have remained stable for the South Fork McKenzie River local population (annual average of 29), and increased in the Trail Bridge local population from two redds in 2000 to 25 redds in 2004. The ODFW has been annually reintroducing bull trout fry into historic, unoccupied habitat in the Middle Fork Willamette River. No reproduction has been noted, but adult bull trout were captured in Hills Creek Reservoir in 2003 and 2004, and several age classes of bull trout were collected in and below the bull trout release sites. While there is some limited connectivity within and among local populations in this core area, there are some significant fish passage barriers posed by large dams. Habitat and population baseline conditions for the bull trout in the Willamette Basin are sub-optimal based on current condition, elevated risk from stochastic events, and the low probability of recolonization through dispersal due to the distance to other bull trout core areas in the lower Columbia River.

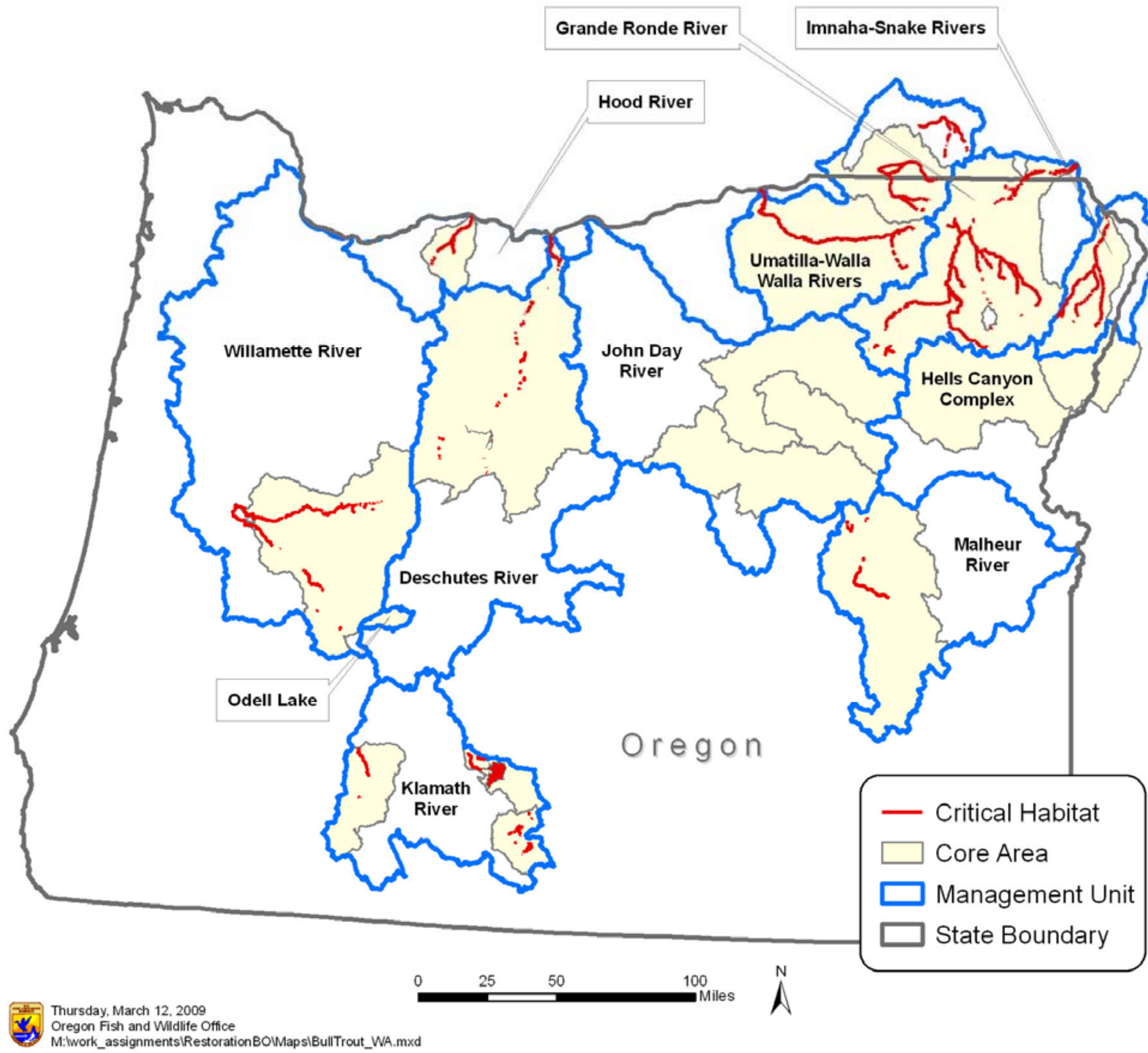

Figure 4. Overview map showing management units, core areas, and designed critical habitat for bull trout in the action area (Oregon).

<u>Hood River Management Unit: Hood River Core Area.</u> The Hood River Core Area is comprised of two local populations: Clear Branch River and Hood River. Accurate adult abundance estimates for the Hood River Core Area are not available; however, 300 or less bull trout are believed to occur in the core area. Trap count and snorkel count data support this belief: snorkel surveys conducted at Clear Branch above the dam found a total of 51 to 200 bull trout annually between 1996 and 2003, while surveys below the dam found a total of zero to three bull trout annually between 1996 and 2003. Some migratory forms occur in the core area, and are believed to overwinter in the lower Hood River and Bonneville Pool of the Columbia River. The two local populations are isolated by an impassable dam. Bull trout are consistently found in the Hood River, the Middle Fork Hood River and the Clear Branch of Hood River. Bull trout distribution in the East and West Forks of Hood River are based on isolated, infrequent sightings. Historical distribution is believed to approximate current distribution based on existing knowledge. Habitat baseline conditions are degraded in the Hood River Core Area, with

numerous water diversions impacting connectivity. The USFS has undertaken numerous habitat restoration activities in the Clear Branch local population area.

Lower Deschutes River Management Unit: Lower Deschutes Core Area. The Lower Deschutes Core Area includes all current and historic bull trout habitat in the Deschutes River and tributaries from Big Falls downstream to the confluence of the Deschutes with the Columbia River. It contains five local populations: Shitike Creek, Warm Springs River, Whitewater River, Jefferson/Candle/Abbot river complex, and Canyon/Jack/Heising/mainstem Metolius river complex. Spawning, rearing, foraging, migrating and overwintering habitats are present in the core area. Redd count data collected between 1998 and 2004 found that bull trout spawner numbers had generally increased in two of the three Metolius River basin local populations (Jefferson/Candle/ Abbot complex and Canyon/Jack/Heising/mainstem Metolius river complexes combined redd counts increased from 180 in 1998 to 1,045 in 2004), remained stable in the Metolius basin's Whitewater River (data from the Whitewater River are limited, but suggest that the population there is about 30 adults), and remained stable in the lower Deschutes River's Shitike Creek and Warm Springs River populations (Shitike Creek remained steady between 1998 and 2004: 117 redds were counted in 1998, and counts have averaged 137 redds (110 adults) in the last five years. In the Warm Springs River 101 redds were counted in 1998, and redd counts averaged 89 redds (71 adults) in the last five years.

In late summer of 2003, the 91,902 acre B&B fire burned through large areas of the Metolius River basin. It burned areas of the Jefferson/Candle/Abbot river complex and Canyon/Jack/Heising/mainstem Metolius river complex, but did not affect the Whitewater River population. Habitat conditions in the two burned local populations are at elevated risk from increased sediment delivery, with resultant changes including sedimentation of spawning areas, loss of juvenile rearing habitat, increases in peak flows, and increases in stream temperature.

Odell Lake Management Unit: Odell Lake Core Area. The Odell Lake Core Area has a single local population, the Odell Lake local population, encompassing Odell Lake and its tributaries (including Odell Creek and its tributaries). The number of adult spawning bull trout in the Odell Lake Core Area is estimated to be below 100 individuals. Redd surveys for Trapper Creek, the only tributary where Odell Lake bull trout spawn, were zero to 24 between 1994 and 2004. Juvenile bull trout counts in Trapper Creek have been consistent between 1996 and 2004, totaling between 26 and 208 juveniles annually. Small numbers of juvenile bull trout also have been observed in Odell Creek and its tributaries.

Odell Lake Core Area bull trout have been isolated from other core areas for nearly 6000 years. Recent genetic analysis indicated Odell Lake bull trout have very little genetic variability and have experienced significant genetic drift.

Threats to Odell Lake bull trout include kokanee salmon redd superimposition on bull trout redds, limited spawning and rearing habitat, introduced lake trout in Odell Lake, and introduced brook trout in Odell Lake basin tributary streams. Several habitat improvement projects have been recently completed in the basin.

John Day River Management Unit: Middle Fork John Day River, North Fork John Day River, and John Day River (Upper Mainstem) Core Areas. The Middle Fork John Day Core Area consists of three local populations: Granite Boulder Creek, Big Creek, and Clear Creek. Total numbers of bull trout, consisting of primarily juvenile and subadult fish, were estimated in 1999 to be 1,950 individuals in Big Creek, 640 individuals in Clear Creek, and 368 individuals in Granite Boulder Creek. Resident bull trout are the predominant life history form in the core area, and occupy tributary habitats, but some migratory bull trout have been collected in the Middle Fork John Day River and on spawning locations within tributaries. Sedimentation within this core area is a severe problem. Catastrophic fires burned through the core area in recent years causing erosion and high sediment yields. These effects combine with sedimentation from mining, the removal of streamside vegetation by livestock, and already existing habitat fragmentation to make the path to bull trout recovery difficult.

The North Fork John Day River Core Area consists of seven local populations: Upper North Fork John Day River, Upper Granite Creek, Boulder Creek, Clear/Lightning creeks above ditch, Clear Creek below ditch, Desolation Creek, and South Fork Desolation Creek above the falls. Resident and migratory forms are found in the core area. Overall population trend for the North Fork John Day Core Area is upward. Habitat fragmentation, connectivity and water quality issues still occur. The threats associated with mining still exist, but have been reduced through improved administration and cooperation between the USFS and local miners. The presence of brook trout throughout the core area, including the high mountain lakes, continues to be a serious threat to bull trout.

The John Day River Core Area consists of two local populations: Upper John Day River and Indian Creek. Spawning surveys in 1999 and 2000 of bull trout habitat in tributary streams to the mainstem John Day River showed few fish spawning in the local population, with most occupied streams having less than 20 redds. Redd surveys in 1990 estimated that the upper mainstem, and Call and Rail creeks may have more than 300 total spawning adults. Some new, small populations of resident bull trout have been discovered in smaller Core Area streams. Migratory bull trout commonly occur from the John Day River headwaters to the City of John Day, with at least seasonal use as far down as the town of Spray, below the John Day and North Fork John Day rivers' confluence. Indian Creek is seasonally blocked by a diversion that dewaters the lower reaches and creates a migration barrier. The overall trend for bull trout in this core area is upward. Water quality issues, passage problems and competition from brook trout all continue to be major problems.

<u>Umatilla-Walla Walla Rivers Management Unit: Umatilla River and Walla Walla Core Areas.</u>
The Umatilla River Core Area consists of two local populations: Upper Umatilla River Forks and North Fork Meacham Creek. Adult bull trout abundance in the Core Area in 2000 was estimated at 385 individual bull trout. Resident forms occur in the North Fork Meacham local population, and resident and migratory forms exist in the Upper Umatilla River local population. Bull trout in the Umatilla Core Area persist at low numbers. In 1998 and 2000, adult bull trout population estimates in the North Fork Umatilla River were 192 and 327 individuals, respectively. Most spawning occurs between Coyote and Woodward creeks, a total of five river kilometers. Very low numbers of bull trout occupy and spawn in the North Fork Meacham Creek local population. Based on limited collections, migratory adult and juvenile bull trout appear to use the mainstem Umatilla River downstream to Pendleton for migratory and overwintering habitat. Numerous opportunities exist for habitat restoration and re-connection of isolated habitats in this Core Area.

The Walla Walla River Core Area consists of three local populations: Walla Walla River, Touchet River, and Mill Creek. The Walla Walla local population is supported mainly by the

South Fork Walla Walla bull trout population. The local population occurs in Oregon, though fluvial fish may seasonally occur in Washington. Population estimates for the South Fork Walla Walla River for 2003 was 8,533 fish. Redd counts have been done each year since 1998 on the South Fork Walla Walla River and sporadically in the North Fork Walla Walla River. Despite some annual variability, redd totals have generally been increasing on the South Fork Walla Walla River, with annual redd counts below 200 from 1994-1997, but consistently above 330 since 1999, including a peak of 483 redds in 2001). Very little spawning is occurring on the North Fork Walla Walla River (8 redds found in 2002, zero redds in 2003 and 2004). Physiological and physical barriers to bull trout passage and rearing are extensive in terms of stream miles affected. Water temperature appears to be the most critical physiological barrier, particularly for passage or rearing. Seasonal temperature-related barriers for bull trout generally occur in lower areas of the Walla Walla River. Connectivity between populations and habitat conditions (*i.e.,* water temperature, instream flows, passage barriers) in the mainstem Walla Walla River continue to be of concern. However, considerable progress has been made in eliminating barriers to fish passage on the Walla Walla River through screening irrigation ditches, consolidating ditches, and modifying diversion structures. In 2001, for the first summer in nearly a century, increased Walla Walla River flows resulted in a watered stretch of the river between Milton-Freewater, Oregon, and the WA/OR state line. Since implementation of the flow agreement, there has not been a fish stranding problem in this area. In 2001, a major new fish ladder was installed at Nursery Bridge near Milton Freewater to facilitate passage of bull trout.

The Touchet River local population includes bull trout in the Wolf Fork, North Fork, and South Fork of the Touchet River, Washington. Wolf Fork Touchet River supports the largest bull trout population in the Touchet River local population, although redd totals on that stream have fluctuated a great deal (from 71 in 1994, down to four in 1997, then up to 101 in 2003). Despite the high variability, the overall trend in redds per year has been upward in Wolf Fork since 1998. On the North Fork Touchet River, redd totals hovered in the 40s from 1998 to 2001, but have dropped each year since to a low of 22 in 2004, which is in the vicinity of counts from the mid-1990s. It is unclear if this represents natural fluctuations or a steady decline. A new spawning population of migratory bull trout was discovered in the South Fork Touchet River in 2000. However, after 16 redds were observed in the South Fork in 2001, the count dropped to one redd in 2002, and no redds were seen in 2003 and 2004 surveys. The upper Touchet watershed has one of the relatively high quality salmonid habitats remaining in the Walla Walla River Basin. However, the lower and middle portions of the South Fork Touchet River maintain very low flows during summer months, and instream large woody debris throughout the upper Touchet is limited, which has resulted in a lack of pool habitat. Throughout the Touchet River local population, barriers and impediments to bull trout passage and rearing (physical and physiological) are extensive in terms of stream miles affected.

The Mill Creek local population supports sizeable bull trout populations. Sections of Mill Creek occur in both Oregon and Washington, and bull trout have been observed in both states. Mill Creek redd counts have been conducted each year since 1998. Redd count totals have generally been stable on Mill Creek. Since 1994, annual redd counts have stayed in a range between 118 and 220, with an average of 170, and no discernible up or downward trend. Numerous barriers exist in the local population; many barriers are physical structures or dewatered streambeds that block movement, others are physiological barriers (*e.g.,* temperature, sediment, lack of pools). Physiological and physical barriers to bull trout passage and rearing were extensive in terms of stream miles affected. Connectivity between populations and habitat conditions (*i.e.,* water temperature, instream flows, passage barriers) in middle and lower sections of Mill Creek and the mainstem Walla Walla River continue to be areas of concern. However, considerable progress has been made in eliminating barriers to fish passage on Mill Creek through screening irrigation ditches, consolidating ditches, and modifying diversion structures. In 2004, a video monitoring effort was initiated at the Mill Creek Diversion Dam (Bennington Dam) and 20 bull trout passing up the ladder were detected.

<u>Grande Ronde River Management Unit: Grande Ronde River and Little Minam River Core Areas.</u> The Grande Ronde Core Area has eight local populations: Upper Grande Ronde complex, Catherine Creek and tributaries, Indian Creek and tributaries, Minam River/Deer Creek complex, Lostine River/Bear Creek complex, Upper Hurricane Creek, Wenaha River, and Lookingglass Creek, and are described below.

Current distribution of bull trout in the Grande Ronde River Management Area includes the mainstem Grande Ronde River from its headwaters in Oregon to the confluence with the Snake River in Washington, and possibly into the Snake River for overwintering; tributaries including Catherine Creek, Indian Creek, Lookingglass Creek, Wallowa River and its tributaries (Minam, Deer, Bear, Lostine, and Hurricane creeks), and the Wenaha River and its tributaries. Wenatchee Creek historically had bull trout, but has not been surveyed recently. To the best of our knowledge, with the exception of the Wallowa River above Wallowa Dam, historic distribution is closely reflected by the current distribution. Approximately 4,000 bull trout spawned in each of the past few years in the Grande Ronde Core Area. The majority of spawning likely occurs in the Wenaha River and Minam River/Deer Creek complex, both which exists primarily in wilderness areas. In the Little Minam Core Area approximately 750 bull trout spawned in each of the past few years.

Redd count data averaged 104.5 redds from 1999 to 2004 for three combined stream index reaches within Lostine River/Bear Creek, Lookingglass Creek, and Catherine Creek (surveys from North Fork Catherine Creek) local populations. The year 2002 had a low of 69 redds and 2001 and 2003 had a high of 123 and 125 redds, respectively. The overall population trends for the above three local populations within this core area is estimated to be stable (for the past 6 years).

The general status for all populations in the Grande Ronde Core Area appears to be stable, and contains both migratory and resident bull trout. The Wenaha River local population is one of the strongholds as it has multiple age classes, contains fluvial fish, has an anadromous prey base, has connectivity with the Grande Ronde and Snake rivers, and contains pristine habitat (consistent redd count data unfortunately is not available for this population). Other healthy bull trout populations include Lookingglass Creek, Lostine River, and Deer Creek. Minam River has had surveys conducted by ODFW in past years, with limited documentation of bull trout observed. Hurricane Creek is at high risk of extinction due to low numbers of resident bull trout, hybridization with brook trout, and limited habitat due to their isolation in the headwaters upstream of Alder Slope diversion dam and downstream of Slick Rock Falls. Lostine River and Bear Creek contain brook trout and the degree of hybridization is unknown. Limited redd count data is available on Bear Creek and this portion of the Lostine River/Bear Creek local population has been listed as special concern. The Upper Grande Ronde River, Catherine Creek, and Indian Creek populations contain primarily resident life history forms and are at moderate risk of extinction. Limited data is available is available for these systems, with the exception of Catherine Creek. Catherine Creek has some limited numbers of fluvial size fish as reported at the CTUIR adult weir on Catherine Creek. North Fork Catherine Creek has redd count data collected from 1998 to 2004 and the trend appears to be stable. Connectivity between local populations is limited by two major dams, numerous water diversions, and various culverts and other blockages, introduced brook trout, and water quality (thermal warming and sediment) and other habitat degradation concerns exist in these local populations.

The Little Minam River Core Area has a single local population: Little Minam River. Most, if not all, of the current spawning activity appears to occur in the mainstem of the Little Minam River above the barrier waterfall or in Dobbin Creek. Only resident bull trout are present, due to the waterfall barrier. Redd count data averaged 306 redds from 1997 to 2004 for the Little Minam River local population. The year 2003 had a low of 209 redds and 2001 had a high of 432 redds. The overall population trend for the Little Minam River population is estimated to be stable (for the past 8 years). The Little Minam River local population lies within a wilderness area, and has good quality habitat.

Imnaha-Snake Rivers Management Unit: Imnaha River Core Area. The Imnaha River Core Area contains four local populations: Imnaha River (above the mouth of Big Sheep Creek), Big Sheep Creek, Little Sheep Creek, and McCully Creek.

Depending on the season, bull trout can be found throughout the Imnaha River. Summer distribution in the mainstem Imnaha River extends from at least river mile 40 to the Forks at river mile 73, whereas fall and spring distributions include the lower Imnaha and Snake Rivers. Bull trout have been observed throughout the mainstem of the Imnaha River as well as in the South Fork, Middle Fork, and North Fork of the Imnaha. In the Middle Fork, upstream distribution appears to be limited by a waterfall that is approximately 1.2 river miles from the mouth. Bull trout have also been observed in Bear, Blue, and Soldier Creeks, all tributaries to the South Fork of the Imnaha River. Although there have been isolated reports of bull trout in Lightning Creek, standard surveys have not been able to document meaningful numbers of spawning and rearing fish.

Spawning in the Imnaha River presumably occurs in the headwater areas as well as in some headwater tributaries. Most known summer rearing and holding areas in the Imnaha River are on National Forest or wilderness lands above Summit Creek. On an intermittent basis, bull trout can also be found distributed throughout the mainstem Imnaha River, perhaps migrating to and from various tributaries or following sources of food. It is certain that some fluvial bull trout from the Imnaha River migrate out of the Imnaha River and overwinter in the Snake River and, given recent radiotelemetry data, fish found in the Imnaha River below Summit Creek are probably moving between summer or spawning habitat and overwinter habitat in the lower Imnaha or Snake Rivers. Fluvial adults appear to migrate upstream in the Imnaha River during the months of May, June, July, and perhaps August. Fluvial adults appear to move downstream in the Imnaha River during the months of August, September, October, and perhaps November.

Redd count data averaged 5.8 redds/mile or 239 total redds, from 2000 to 2004 for combined index reached in the Big Sheep and Imnaha local populations. 2000 had a low of 2.8 redds/mile or 104 redds, and 2001 and 2004 had a high of 7.9-7.4 redds/mile, or 315-336 redds, respectively. The overall population trends for the above two populations is estimated to be stable (for the past five years). The Imnaha River local population is rated at low risk of extinction, Little Sheep is rated at high risk of extinction, McCully Creek is rated at moderate risk of extinction, and Big Sheep is rated "of special concern". A major canal bisects three of the local populations, and bull trout have been observed in the canal, indicating artificial, one-way movement between local populations as well as potential entrainment loss onto agricultural fields. In addition, the canal has no upstream passage at any of its stream crossings, therefore migratory bull trout cannot ascend into Big Sheep, Little Sheep, or McCully Creeks and access their respective local populations of bull trout.

Hells Canyon Complex Management Unit: Pine-Indian-Wildhorse and Powder River Core Areas. The Pine-Indian-Wildhorse Core Area within the action area has four local populations: Upper Pine Creek, Clear Creek, East Pine Creek, and Elk Creek. Bull trout abundance in the Pine Creek basin in 1994 was estimated for four streams. Maximum estimated abundance for bull trout was less than 400 individuals for each stream. In the eight streams where bull trout redd index sites exist, the actual number of redds observed ranged from 0 to 43 per site during 1998 through 2000, which is equivalent to 0 to 60.0 redds per mile of stream length. The majority of bull trout in this local population are resident, however, radiotelemetry studies have identified that migratory bull trout do occur in the local population. However, the Pine Creek basin has numerous water diversions, which impede upstream fish passage and entrain bull trout moving downstream.

The Powder River Core Area has eight local populations: Upper Powder River, North Powder River, Big Muddy Creek, Anthony Creek, Wolf Creek, Salmon Creek, Pine Creek, and Lake Creek. Less than 500 bull trout are thought to occur in this Core Area. All bull trout inhabiting the Powder River basin are thought to be resident fish. Bull trout densities were estimated in five tributaries of the upper Powder River and North Powder River in 1996. Mean densities of bull trout were 1.0 to 9.5 individuals per 330 feet of stream length. Multiple redd counts were conducted annually in September and October 1996 through 1999. The total number of redds observed per year in the study was 7 to 36 redds. A total of 885 bull trout greater than 5 inches were estimated to occur in Silver Creek in 1999. Existing local populations of bull trout in this core area are isolated and with the exception of Silver Creek, have low numbers. Bull trout only remain in the uppermost parts of the watershed that have not been degraded. Thief Valley, Wolf Creek, and Mason Dams have isolated bull trout local populations within the Powder River drainage and prevent two-way fish passage. Brownlee Dam has further isolated bull trout populations in this core area and eliminated connectivity between the Powder, Burnt River, and adjacent drainages.

Malheur River Management Unit: Malheur River Core Area. The Malheur River Core Area contains two local populations: Upper Malheur River and North Fork Malheur River. Resident and some migratory forms of bull trout occur in the Upper Malheur River Core Area. Redd data collected in the upper Malheur subbasin is confounded by the presence of brook trout. Spawning index reaches on Meadow Fork Big Creek and Snowshoe Creek had 49 to 54 redds per year in 1998-2000. A high count of 108 redds was recorded in 2001, then counts dropped again to 16 and 6 in 2002 and 2003 respectively. The survey results for 2002 did not include Snowshoe Creek due to the inability of conducting surveys while firefighting activities were ongoing. Effects from the forest fire in 2002 (9,873 acres) contributed to degraded habitat conditions in Meadow Fork Big Creek. A debris torrent in July of 2003, severely scoured the stream, displacing bull trout and severely altering the stream substrate. In sections, the stream substrate was displaced approximately 6 feet lower in elevation than prior to the debris flow event. Zero bull trout redds were recorded for Meadow Fork Big Creek in 2003. Declines in bull trout redd counts within the two combined index reaches are likely due to a combination of several years of low stream flow, a debris torrent in 2003 which altered spawning habitat, and the presence of brook trout which hybridize with and compete with bull trout.

Fluvial and adfluvial forms of bull trout occur in the North Fork Malheur River local population. Spawning has been documented in the mainstem North Fork Malheur upstream of the mouth of Deadhorse Creek and in the following tributaries: Horseshoe Creek, Swamp Creek, Sheep Creek, Elk Creek, Crane Creek, and Little Crane Creek. Bull trout have been observed in Cow Creek during spawning surveys, but no redds have been found. Habitat conditions in the spawning areas are of generally good quality, however, downstream rearing areas are impacted by ongoing livestock grazing. Continuous redd count history dating 1992 to 2003 for North Fork Malheur streams indicate an increasing trend from 1992 to 2000. Redd counts ranged from as few as 8 to 38 in early 1990's, rising to approximately 153 redds in 2000. Since 2000, redd counts have declined, with only 63 bull trout redds recorded during 2003. Subadult rearing and adult foraging occurs from the headwaters of the North Fork Malheur River down to, and in, Beulah Reservoir. Bull trout rearing habitat occurs in the North Fork Malheur River downstream to Little Malheur River confluence, as well as within numerous North Fork Malheur River tributaries. Studies of bull trout in Beulah Reservoir indicate that bull trout are entrained through the outlet works of the dam. Once entrained through the dam, there is no existing facility for fish to return to the reservoir. Habitat conditions in the stream below the reservoir are not optimal for bull trout survival, given the elevated summer stream temperatures and numerous irrigation water withdrawals.

Klamath River Interim Recovery Unit

Klamath River Management Unit: Sycan Core Area. The Sycan Core Area is comprised of two local populations: Long Creek and Coyote Creek. The distribution, range, and abundance of bull trout in the Sycan Core Area is greatly reduced from historic conditions, and most bull trout are now restricted to headwater locations. Recent population trends seem to indicate declines in resident bull trout abundance in Long Creek, and some remnant migratory bull trout in lower Long Creek. Coyote Creek population status and trends are unknown. Little connectivity occurs between these local populations. Habitat quality decreases in a downstream direction. Brook trout are a major threat.

Klamath River Management Unit: Upper Klamath Lake Core Area. The Upper Klamath Lake Core Area is comprised of three local populations: Sun Creek, Threemile Creek, and Lost Creek. Population and trends in Sun and Threemile creeks have recently improved, following brook trout eradication efforts. No population information is available for the Lost Creek local population. Resident forms of bull trout predominate in this core area, with no connectivity between local populations. Habitat quality decreases in a downstream direction in these streams. Brook trout hybridization with bull trout is a major threat below recently-treated habitats on Sun and Threemile creeks.

Klamath River Management Unit: Upper Sprague River Core Area. The Upper Sprague River Core Area is comprised of seven local populations: Deming Creek, Boulder Creek, Dixon Creek, Brownsworth Creek, Leonard Creek, North Fork Sprague River, and Sheepy Creek. With the exception of Brownsworth Creek (slight population improvement between 2000 and 2004 surveys), the status of local bull trout populations in the Upper Sprague River Core Area is unknown. Populations continue to survive in fragmented and degraded habitats, and are subject to interspecific competition with non-native brook and brown trout and hybridization with non-native brook trout. Local populations consist mainly of isolated, headwater populations of resident fish, with a small, remnant migratory component occurring in the North Fork Sprague River below the confluence of Boulder/Dixon creeks. Habitat quality decreases in a downstream direction in these streams; however, due to close geographic proximity, significant opportunity exists within the core area to reconnect isolated local populations via habitat restoration actions.

Consulted-on Effects

Consulted-on effects are those effects that have been analyzed through section 7 consultation as reported in a BO. These effects are an important component of characterizing the current condition of the species. To assess consulted-on effects to the bull trout, we conducted a review of all of the BOs received by the Region 1 and Region 6 Offices, from the time of listing until August 2003; this totaled 137 BOs. Of these, 124 BOs (91 percent) applied to activities affecting bull trout in the Columbia Basin DPS, 12 BOs (9 percent) applied to activities affecting bull trout in the Coastal-Puget Sound DPS, 7 BOs (5 percent) applied to activities affecting bull trout in the Klamath Basin DPS, and 1 BO (<1 percent) applied to activities affecting the Jarbidge and St. Mary Belly DPSs (Note: these percentages do not add to 100, because several BOs applied to more than one DPS). The geographic scale of these consultations varied from individual actions (*e.g.,* construction of a bridge or pipeline) within one basin to multiple-project actions occurring across several basins.

Our review shows that we consulted on a wide array of actions which had varying level of effects. Many of the actions resulted in only short-term adverse effects and some with long-term beneficial effects. Some of the actions resulted in long-term adverse effects. No actions that have undergone consultation were found to appreciably reduce the likelihood of survival and recovery (*i.e.,* jeopardy determination) of the bull trout or adversely modify critical habitat.

4.2. Lahontan cutthroat trout

The action area encompasses the Oregon portion of the range of the species. In Oregon, Lahontan cutthroat trout occur in the Coyote Lake subbasin, Quinn River subbasin, and in the Alvord Lake subbasin. Alvord Lake subbasin populations originated from Coyote Lake subbasin transplants. Five of the six native Lahontan cutthroat trout populations in Oregon exist in the Coyote Lakes basin of southeast Harney County in Willow Creek, Whitehorse Creek, Little Whitehorse Creek, Cottonwood Creek, Doolitle Creek and Fifteen Mile Creek.

In surveys of Coyote Lake subbasin streams conducted by ODFW in 2005, locations of high population density were found to be similar to those detected in 1995, 1989, and 1994, although it is worth noting that different methodologies were used. Lahontan cutthroat trout occupy approximately 32 kilometers (20 miles) of stream in the Willow Creek drainage, and approximately 63 kilometers (39 miles) of stream in the Whitehorse Creek complex. In the 2005 surveys, ODFW also detected Lahontan cutthroat trout at two of four sample sites in Shepline Creek, a stream where presence had been suspected but not verified. They were not detected in Antelope Creek near an area where they were detected in 1998. Because of low water levels and dry conditions in the creek, ODFW believes the absence of trout may represent the loss of the Antelope Creek population (Jones *et al.* 1998, Gunckel and Jacobs 2006).

Lahontan cutthroat trout also occur in the Quinn River Basin; distribution in Oregon is limited to 15 kilometers (9 miles) in Sage and Line Canyon creeks (ODFW 2005). Quinn River subbasin Lahontan cutthroat trout populations are at risk of extinction, as three of four populations have been extirpated due to hybridization with non-native rainbow trout (Tenmile Creek, Oregon Canyon Creek, and McDermitt Creek and all its tributaries except Sage Creek). Lahontan cutthroat trout are found in approximately 13 kilometers (8 miles) of stream in the Sage Creek complex, only resident forms exist, and adult Lahontan cutthroat trout population numbers are low (<200 adults)(ODFW 2005). Alvord Lake subbasin Lahontan cutthroat trout populations were all introduced from Coyote Lake subbasin stocks, and currently naturally reproduce. All populations are very limited in extent and population size.

Consulted-on Effects

Consulted-on effects are those effects that have been analyzed through section 7 consultation as reported in a BO. These effects are an important component of characterizing the current condition of the species. To assess consulted-on effects to the Lahontan cutthroat trout, we conducted a general review of all BOs completed at the Oregon Fish and Wildlife Office from January 1993 until March 2009. A total of 56 formal BOs were addressed during this time frame.

Our review shows that we consulted on a wide array of actions which had varying level of effects. The primary action consulted on was associated with livestock grazing activities on Bureau of Land Management's (BLM) grazing allotments. Some of the other actions included habitat improvements/restoration, management plans, and water quality issues. No actions that have undergone consultation were found to appreciably reduce the likelihood of survival and recovery (*i.e.,* jeopardy determination) of the Lahontan cutthroat trout.

4.3. Warner sucker

The action area encompasses the Oregon portion of the range of the species. The Warner sucker inhabits the lakes and low gradient stream reaches of the Warner Valley, and is comprised by two life history forms: lake and stream morphs. The lake suckers normally spawn in the streams unless upstream migration is blocked by low stream flows during low water years or by irrigation diversion dams. When this happens spawning may occur in nearshore areas of the lakes (White *et al.* 1990). During droughts, the suckers inhabiting the lakes have been lost in the past when lakes have dessicated; lakes have been recolonized by suckers in the streams (White *et al.* 1991, Allen *et al.* 1994). The stream suckers inhabit and spawn in three major tributary drainages: Honey, Deep, and Twentymile Creeks (Scheerer *et al.* 2007a).

ODFW surveys in 2006 and 2007 found lake populations of Warner suckers to be depressed, and populations in tributaries have patchy distributions with zero suckers in a large proportion of the survey reaches and rare pockets of relatively high sucker abundance. Survey results were similar to stream Warner sucker population assessments last available in 1994, although the recent surveys documented a broader distribution than the 1994 surveys. Recent surveys documented suckers in lower Deep Creek, which had not been sampled earlier. Data suggest that lower Deep

Creek may provide important sucker spawning and rearing habitat (Scheerer *et al.* 2006b, Scheerer *et al.* 2007a).

In 1991, BLM installed a modified steep-pass Denial fish passage facility on the Dyke diversion on lower Twentymile Creek. The fishway is intended to re-establish a migration corridor, and allow access to high quality spawning and rearing habitats. The Dyke diversion structure is a 1.2 meter (4 feet) high irrigation diversion that was impassable to Warner sucker and redband trout before the fishway was installed. It blocked all migration of fishes from the lower Twentymile Creek, Twentymile Slough and Greaser Reservoir populations from moving upstream to spawning or other habitats above the structure. To date, no suckers have been observed or captured passing the structure, but redband trout have been observed and captured in upstream migrant traps.

An evaluation of fish passage alternatives has been done for diversions on Honey Creek which identifies the eight dams and diversions on the lower part of the creek that are barriers to fish migration (Campbell-Craven Environmental Consultants 1994). In May 1994, a fish passage structure was tested on Honey Creek. It consisted of a removable fishway and screen. The ladder immediately provided passage for a small redband trout. These structures were removed by ODFW shortly after their installation due to design flaws that did not pass allocated water.

Research through 1989 summarized in Williams *et al.* (1990) consisted of small scale surveys of known populations. Williams *et al.* (1990) primarily tried to document spawning and recruitment of the Hart Lake population, define the distributional limits of the Warner sucker in the streams, and lay the groundwork for further studies. White *et al.* (1990) conducted trap net surveys of the Anderson Lake, Hart Lake, Crump Lake, Pelican Lake, Greaser Reservoir, and Twentymile Slough populations. A population estimate was attempted for the Hart Lake population, but was not successful. Lake spawning activity was observed in Hart Lake, though no evidence of successful recruitment was found.

White *et al.* (1991) documented the presence of suckers in the Nevada reach of Twelvemile Creek. This area had been described as apparently suitable habitat by Williams *et al.* (1990), but suckers had not previously been recorded there. Kennedy and North (1993) and Kennedy and Olsen (1994) studied sucker larvae drift behavior and distribution in streams in an attempt to understand why recruitment had been low or nonexistent for the lake morphs in previous years. They found that larvae did not show a tendency to drift downstream and theorized that rearing habitat in the creeks may be vital to later recruitment.

Tait and Mulkey (1993a,b) investigated factors limiting the distribution and abundance of Warner sucker in streams above the man-made stream barriers. A population estimate of Warner sucker in streams was conducted in 1993 on the Honey Creek and Twentymile Creek drainages (Tait and Mulkey 1993b). Approximately 20 percent of available stream habitat in the Honey Creek drainage was sampled. The population within the area sampled was estimated at 77 adults, 172 juveniles, and 4,616 young of year. Approximately 60 percent of the available stream habitat in the Twentymile Creek drainage was also sampled. The population estimates within this area sampled was 2,563 adults, 2,794 juveniles, and 4,435 young of year. The detrimental effects of these barriers are well-known, but there may be other less obvious factors that are also affecting the suckers in streams. These studies found that general summertime stream conditions, particularly water temperature and flows, were poor for most fish species.

Recent studies have concentrated on population estimates, marking fish from Hart Lake and monitoring the recolonization of the lakes by native and non-native fishes (Allen *et al.* 1995a, Allen *et al.* 1995b, Allen *et al.* 1996).

The Federal agencies responsible for management of the habitat in the Warner Basin have consulted on activities that might impact the Warner sucker. On May 21, 1995, the BLM, USFS, National Marine Fisheries Service and the Service signed the Streamlining/Consultation Guidelines to improve communication and efficiency between agencies. In the Warner Basin, the outcome of streamlining has been regular meetings between the Federal agencies conducting and reviewing land management actions that may affect Warner sucker. These meetings have greatly improved the communication among agencies and have afforded all involved a much better understanding of issues throughout the entire watershed. As a result of close coordination, the USFS and BLM have modified many land management practices, thus reducing negative impacts, and in many cases bringing about habitat improvements to Warner sucker and Warner Valley redband trout.

Consulted-on Effects

Consulted-on effects are those effects that have been analyzed through section 7 consultation as reported in a BO. These effects are an important component of characterizing the current condition of the species. To assess consulted-on effects to the Warner sucker, we conducted a general review of all BOs completed at the Oregon Fish and Wildlife Office from January 1993 until March 2009. A total of 64 formal BOs were addressed during this time frame.

Our review shows that we consulted on a wide array of actions which had varying level of effects. Since the listing of Warner sucker as threatened in 1985, the Lakeview Resource Area has completed numerous consultations on BLM actions affecting Warner sucker. The following lists the subject and year the consultation was completed: Habitat Management Plan for the Warner Sucker 1985; Fort Bidwell-Adel County road realignment 1987; Warner Wetlands Habitat Management Plan 1990; relocation of Twentymile stream gauge 1993; Lakeview BLM grazing program 1994; reinitiation of consultation on grazing program 1995; Noxious Weed Control Program 1996; reinitiation of consultation on grazing program 1996; informal consultation on guided fishing activities 1997; reinitiation of consultation on grazing program and consultation on a number of small non-grazing projects 1997; reinitiation of consultation on grazing program 1999; informal consultation on Long Canyon Prescribed Fire 1999; grazing permit renewal concurrence 1999; consultation on the Resource Management Plan for BLM activities 2003; reinitiation of consultation on grazing program 2000 through 2004; and Hart Lake pump station and screen installation and operation 2006.

In 1994, Lakeview Resource Area determined that ongoing site-specific livestock grazing actions were likely to adversely affect Warner sucker in the Warner Valley Watersheds and has, to date, consulted under recurring biological opinions with the Service. Present grazing prescriptions and monitoring protocols are in accordance with biological opinions issued by the Service, and results of grazing monitoring appear annually in reports to the Service. Consultation for Lakeview Resource Area's grazing activities has been reinitiated due to changes in the action, changes due to new information, and for failure to comply with terms and conditions of the biological opinions.

Some of the other actions included habitat improvements/restoration, management plans, water quality issues, and roadway construction (*e.g.,* Warner sucker population and habitat monitoring in Oregon funded by the Service's Federal Aid Section 6 Grants 2006, Caspian tern management in the Columbia River Estuary 2005 by the Service and U.S. Army Corps of Engineers, and consultation on three irrigation system projects in the Warner Basin funded by the Natural Resources Conservation Service's Environmental Quality Incentives and Conservation Security programs 2007). None of these actions that have undergone consultation were found to appreciably reduce the likelihood of survival and recovery (*i.e.,* jeopardy determination) of the Warner sucker.

4.4. Lost River and Shortnose suckers

The action area encompasses the Oregon portion of the range of the species (see Figure 1). The factors affecting the species environment in the action area include: degradation and loss of habitat as a result of Klamath Irrigation Project facilities and operations; agricultural and livestock grazing activities; Klamath Hydroelectric Project facilities and operations; non-native fish interactions; and poor water quality (*i.e.,* high pH, high ammonia, low dissolved oxygen) resulting from watershed alterations associated with agriculture, livestock grazing, and forest practices (Eilers *et al.* 2004, Bradbury *et al.* 2004, USFWS 2002a). These factors have resulted in the threats and impacts discussed below.

Degradation and Loss of Habitat

Historically, Lost River and shortnose suckers occupied four lakes: Clear Lake, Tule Lake, Upper Klamath Lake and Lower Klamath Lake and their associated tributaries in the Upper Klamath Basin (USBR 2002, Figure 1). Watershed development, including construction of the Klamath Project, associated agriculture and refuge development, and construction of dams on the Klamath River for hydroelectric power, substantially changed sucker habitat. New sucker habitat was created as a result of construction of Gerber, J.C. Boyle, Copco, and Iron Gate Dams and reservoirs, and sucker habitat in Clear Lake has expanded as a result of construction of the dam. In contrast, major reductions in habitat at Tule Lake (75-90 percent reduction from pre-development levels) and Lower Klamath Lake (97 percent reduction) occurred as a result of reclamation projects (USBR 2002). Moderate reductions (66 percent) in sucker habitat have occurred in Upper Klamath Lake as a result of diking and draining projects unrelated to those on the Klamath Project (Geiger 2001, ASR 2005). Most of this loss was related to private diking and draining of emergent wetlands. However, approximately 18,000 acres of open water and wetland habitat around Upper Klamath Lake is currently being restored and reconnected to the lake.

Changes in lake size resulted in changes in available sucker habitat. In the late 1800s, prior to most watershed development, 223,000-330,000 acres (276,000 average) of shallow lake and associated wetland habitat existed (Akins 1970, USBR 2002) compared to 76,000-122,000 acres (99,000 average) currently. Overall, suckers' lake and wetland habitat has decreased approximately 64 percent (177,000 acres) over the last century (Reclamation 2002). A concurrent, substantial decline in sucker populations over this time period was related in part to the large loss of lake and wetland habitat areas, but was also attributable to suckers' blocked access to spawning and rearing areas, low instream flows, entrainment losses resulting from diversions, and other factors (USFWS 2002a).

Review of recent U.S. Army Corps of Engineers section 7 ESA consultations indicate that some relatively minor wetland losses still occur in the Upper Klamath Basin, but effects of these actions on sucker populations are minimized during project planning and consultation (USFWS 2007b). In an attempt to compensate for wetland losses over the last century, both the Federal and State governments and privately funded organizations have purchased former farmed and ranched wetland areas and are reclaiming these areas as wetlands.

Migration Barriers

Dams block sucker migration corridors, isolate population segments, prevent genetic exchange between populations, and concentrate suckers in limited spawning areas, possibly increasing the likelihood of hybridization between species (USFWS 2002a). Dams may also change stream channel, alter water quality, and provide habitat for non-native fish that prey on suckers or compete with them for food and habitat (Reclamation 2001). There are seven major Project dams that may affect the migration patterns of listed suckers: Clear Lake, Link River, Gerber, Malone, Miller Creek, Wilson, and Anderson-Rose Dams. Only the Link River Dam is equipped with a fish ladder designed specifically for sucker passage; it was completed in 2005.

Entrainment

Entrainment is defined as the downstream movement of fish into power or irrigation diversions or spillways caused by water management as opposed to passive drift due to wind- or gravity-driven currents or volitional emigration. Historically, before construction of Link River Dam and development of the Klamath Project, suckers probably dispersed downstream and reared in Lake Ewauna and Lower Klamath Lake (USFWS 2002a). Reports of large runs of suckers up the Link River indicated that many of these fish survived to return to Upper Klamath Lake. The rate of entrainment of suckers that leave the lake may be much different now than what it was prior to the development of the Project because of changes in habitat conditions in Upper Klamath Lake and tributaries where suckers spawn, changes in lake levels and in the timing and amount of flow at the lake outlet, the channel cut through the reef at the lake outlet, and construction of Link River Dam and Eastside and Westside power diversions. Survival of suckers leaving the lake is much lower now because of habitat degradation and loss downstream and blocked passage at Link River Dam (USFWS 2007c,d). Upstream passage for adult fish was improved in 2005 when Reclamation installed a sucker-friendly fish ladder at the dam.

Instream Flows

Because the Lost River and shortnose suckers are lake dwellers and riverine spawners, adequate instream flows are necessary for access to and availability of spawning habitat and transport of larvae downstream to lacustrine rearing areas (Buettner and Scoppettone 1990, Perkins *et al.* 2000, Cooperman and Markle 2004). Most of the tributaries supporting the major populations of Lost River and shortnose suckers (Clear Lake, Gerber Reservoir, and Upper Klamath Lake) are minimally regulated particularly during the spawning season and therefore have little effect on sucker spawning, egg incubation, and larval emigration (USFWS 2002a). However, instream flows that are intensively managed in the Link River, Miller Creek, and Lost River are likely to benefit suckers when there are flows and adversely affect them when flows are stopped (USBR 2000, 2007; USFWS 2002a).

Watershed Alterations Affecting Water Quality in Upper Klamath Lake

Upper Klamath Lake was historically eutrophic but is now hypereutrophic (ODEQ 2002). It has been suggested that large scale watershed development from the late 1800s through the 1900s has contributed to Upper Klamath Lake's current hypereutrophic condition (Bortleson and Fretwell 1993, Eilers *et al.* 2001, Bradbury *et al.* 2004, Eilers *et al.* 2004; ASR 2005). Accelerated sediment and nutrient loading to Upper Klamath Lake consistent with land use practices in the Upper Klamath watershed have contributed to erosion and transport of nutrients to Upper Klamath Lake (Eilers *et al.* 2004). This nutrient loading has resulted in algae blooms of higher magnitude and longer duration (Kann 1997). These blooms have led to extreme water quality conditions (high pH, low dissolved oxygen, and high ammonia) that likely impact fish health and increase the size and frequency of fish die-offs (Perkins *et al.* 2000). In recent decades, Upper Klamath Lake has experienced serious water quality problems that have resulted in massive fish die-offs, as well as pronounced horizontal re-distribution of suckers in response to changes in water quality (Buettner and Scoppettone 1990, Peck 2000, Banish *et al.* 2007).

Nutrient Loading

High nutrient loading to Upper Klamath Lake promotes correspondingly high algae production, which in turn, modifies physical and chemical water quality characteristics that can directly diminish the survival and production of fish populations. Accelerated phosphorus loading is likely a key factor driving the massive Aphanizomenon flos-aquae (AFA, blue-green algae) blooms that now dominate Upper Klamath Lake. Through modeling and analysis efforts, ODEQ (2002) determined that phosphorus reduction would be the most effective means of improving water quality conditions in Upper Klamath Lake. In 2002, ODEQ established a Total Maximum Daily Load (TMDL) for Upper Klamath Lake. This TMDL targets the reduction of phosphorus as a means to reduce AFA production and improve water quality conditions. Although nitrogen is also an important nutrient for structuring algae communities and determining algal productivity, AFA is able to fix atmospheric nitrogen to meet its nitrogen needs in what may otherwise be a nitrogen-limiting environment (ODEQ 2002). Thus, phosphorus loading is particularly important in Upper Klamath Lake in determining algal productivity and biomass, which in turn influences water quality conditions affecting native fishes (ODEQ 2002). However, there is debate as to whether external phosphorus load reduction will improve water quality conditions within Upper Klamath Lake (NRC 2004) due to internal nutrient loading driven by the release of phosphorous from the lake bed sediments (Laenen and Le Tourneau 1996, Fisher and Wood 2004, NRC 2004, Kuwabara *et al.* 2007).

Although high background phosphorus levels in Upper Klamath Basin tributaries existed before development, data from several studies indicates that phosphorus loading and concentrations are elevated above these background levels (Miller and Tash 1967, USACE 1982, Campbell 1993, Kann and Walker 1999, Bradbury *et al.* 2004, Eilers *et al.* 2004). This accelerated phosphorus loading occurred at the same time as an increase in development and intensive land use activities in the Upper Klamath Basin, including substantial timber harvesting, drainage of wetlands, and agricultural activities (Bradbury *et al.* 2004, Eilers *et al.* 2004, ODEQ 2002).

Throughout the Upper Klamath Basin, timber harvesting and associated activities (road building) by Federal, State, tribal, and private landowners have resulted in soil erosion on harvested lands and transport of sediment into streams and rivers adjacent to or downstream from those lands (USFWS 2002a). Past logging and road building practices often did not provide for adequate soil stabilization and erosion control. Risley and Laenen (1999) reported that timber harvest and associated roads have contributed to the high sediment and nutrient inputs to Upper Klamath Lake from tributary watersheds. However, the magnitude of impact from timber harvest on nutrient and sediment input to Upper Klamath Lake is unquantified. Timber harvest peaked in the 1940s at about 800 million board feet (mbf) and ranged from about 400 to 450 mbf from 1970 to 1990 (Risley and Laenen 1999). Since the 1990s there has been a substantial reduction in harvest; in 2003, 200 mbf were harvested in Klamath County. Nevertheless, a high density of forest roads remain in the watershed and many of these are located near streams where they likely contribute sediment (USFS 1994, 1995 a & b, 1996, 1997, 1998).

Livestock grazing, the major agricultural activity in the Upper Klamath Lake watershed has likely accelerated erosion leading to an increase in sediment and nutrient loading rates to Upper Klamath Lake (USFWS 2002a). Livestock, particularly cattle, have heavily grazed flood plains, wetlands, forest, rangelands, and riparian areas, resulting in the degradation of these areas. The increase in sediment accumulation and nutrient loading are consistent with the changes in land use in the Upper Klamath watershed occurring over the last century (Eilers *et al.* 2001, Bradbury *et al.* 2004, Eilers *et al.* 2004, ASR 2005). However, the magnitude of impact from agriculture and livestock grazing on nutrient and sediment input to Upper Klamath Lake is unquantified. Approximately 35 percent of the watershed above Upper Klamath Lake is used for livestock grazing. Cattle production in Klamath County peaked in 1960 with 140,000 animals (Eilers *et al.* 2001). In the Wood River Valley approximately 35,000 cattle graze on pastures during the summer and fall and less than 1,000 during the other months (Eilers *et al.* 2001). In the Sprague River Valley approximately 20,000 cattle graze on pastures in summer and approximately 1,500 graze during winter (Eilers *et al.* 2001). In recent years the number of cattle has been reduced by approximately 50 percent; in 2007 the number of cattle reported was 81,000 (USBR 2007).

Diking and draining of wetlands for non-Project agricultural development accounted for a conversion of over 50,000 acres in the Upper Klamath Lake watershed (ASR 2005). Note that some of these reclaimed wetlands still are classified as wetlands because they hydric (wetland) soils and are seasonally flooded; however, some functions, such as water quality improvement, are lost. Of the 50,000 acres of converted wetlands, about 35,000 acres immediately adjacent to Upper Klamath Lake that provided habitat for fish were converted to agricultural lands from the 1880s to 1960s (ASR Resources 2005, Snyder and Morace 1997).

The drained wetlands are also a source of nutrients to Upper Klamath Lake. Direct phosphorus loading from drained wetland properties surrounding Upper Klamath Lake is also very high (188 kg/km^2; Kann and Walker 1999). Nutrient loading studies indicate that despite contributing only 3 percent of the water inflow (43,000 acre-feet/year), direct agricultural input from pumps that remove water from the drained wetlands around Upper Klamath Lake accounted for 11 percent of the annual external phosphorus budget (21 metric tons/year) and as much as 32 percent of the total during the peak pumping period of February through May (Kann and Walker 1999). However, in recent years about 18,000 acres of drained wetlands are in the process of being converted back to wetland and lake habitat, likely resulting in a decrease in nutrient loading to Upper Klamath Lake (ASR 2005).

Internal phosphorus loading is another significant component of the nutrient budget affecting algal bloom dynamics and water quality in Upper Klamath Lake (Barbiero and Kann 1994, Leanen and Le Toureau 1996, Kann 1998, Kann and Walker 1999). Nutrient loading studies show that the largest flux of phosphorus to Upper Klamath Lake during the summer months comes from internal sources (Kann and Walker 1999). On average, the internal loading accounts for approximately 60 percent while external loading accounts for approximately 40 percent of the annual phosphorus load to Upper Klamath Lake (Walker 2001).

Algae Productivity and Associated Poor Water Quality

In hypereutrophic lakes with large amounts of nutrient input, algal production increases and algal biomass accumulates until light, nutrients or some other factor limits further growth. As biomass increases, the available soluble forms of nitrogen and phosphorus decrease because the nutrients are progressively accumulated in the algal biomass and are therefore unavailable for further algal production. The nutrient needed for growth that is in the shortest supply, thus becomes the limiting nutrient. When light, nutrients, or other conditions for algae become unfavorable, the production of the algal bloom will cease or rapidly decline, resulting in an algal "crash".

The massive blooms of AFA and the subsequent rapid decline (crash) can cause extremes in water quality including elevated pH, low dissolved oxygen concentrations (hypoxia), and elevated levels of un-ionized ammonia, which can be toxic to fish (Kann and Smith 1993, Kann and Smith 1999, Perkins *et al.* 2000, Walker 2001, Welch and Burke 2001, Wood *et al.* 2006, Kuwabara *et al.* 2007, Morace 2007). In the process of rapid growth, algal biomass can form extremely dense blooms, which can vary in magnitude depending on the availability of growth-promoting conditions (Kann and Smith 1993, Kann and Smith 1999, Perkins *et al.* 2000). During the same bloom conditions and following a bloom crash, particularly when coupled with high rates of nighttime respiration, dissolved oxygen can drop to levels that that can be stressful or even lethal to fish. In addition, when dense algae blooms die off, the microbial decomposition of the algae and organic matter in the sediment can further deplete dissolved oxygen and produce increased concentrations of ammonia (Kann and Smith 1993, Risley and Laenen 1999, Perkins *et al.* 2000).

Fish Health

Disease and parasite prevalence were not identified as threats at the time of listing for Lost River and shortnose suckers. However, recent information indicates that pathogens affect sucker health and survival, especially during adverse water quality events (USFWS 2007c; USFWS 2007d, Appendix 2). Fish susceptibility to pathogens in the Upper Klamath Basin may, in part, be affected by stressful water quality conditions, as well as a variety of other factors including low water levels and a high biomass of fish. Although adult sucker die-offs that occurred in Upper Klamath Lake in the 1990s were likely a response to low levels of dissolved oxygen, disease outbreaks also probably contributed to mortality during these events (Perkins *et al.* 2000, NRC 2004).

A number of pathogens have been identified from sick and dying suckers, but Columnaris disease seems to be the primary organism involved (Foott 1997, Holt 1997). Columnaris disease is caused by the bacterium *Flavobacterium columnare,* which can cause massive damage to the gills and produces lesions elsewhere on the body. This leads to respiratory problems, an imbalance of internal salt concentrations, and provides an entry route for systemic pathogens that can cause death (USFWS 2007c,d).

Non-native Fish Interactions

In the last century, the Upper Klamath Basin has been invaded by about 20 non-native fish species (Logan and Markle 1993, Moyle 2004). Most of these species are not particularly common in the basin, but some are abundant and widespread and their effects on listed suckers are poorly understood.

Non-native fishes can have complex interactions with native fishes, and their relative impact can depend on the presence or absence of altered habitats such as impoundments and on the availability of smaller-scale habitat structure such as substrates (Markle and Dunsmoor 2007). In highly modified habitats like Lost River, Klamath River, and Klamath River reservoirs, non-native fish appear to be dominant and have a greater negative impact on endangered suckers (Koch and Contreras 1973, Desjardins and Markle 2000). Many of the non-native fish species are more tolerant of habitat degradation and occupy a wider range of habitats than the suckers (Moyle 2004). The degraded habitats have resulted in less shoreline vegetation that provided suckers protection from predation by non-native fish (Markle and Dunsmoor 2007, NRC 2004).

Human-induced Climate Change

Climate change is expected to significantly affect water resources in the western United States by the mid 21st century (Leung *et al.* 2004, Barnett *et al.* 2008). Climate change is generally predicted to result in increased air and water temperatures, decreased water quality, increased evaporation rates, increased proportion of precipitation as rain instead of snow, earlier and shorter runoff seasons, and increased variability in precipitation patterns (Adams and Peck 2006, Doppelt *et al.*2008). Several studies have shown declining snowpack, earlier spring snowmelt, and earlier stream runoff in the western United States over the past few decades (Hamlet *et al.* 2005, Stewart *et al.* 2005, Doppelt *et al.* 2008). Winter precipitation and snowpack have been shown to be strongly correlated with stream flow in the Pacific Northwest (Leung and Wigmosta 1999).

Increasing temperature trends are the major drivers of these observed trends, particularly at the moderate elevations and relatively warm winter temperatures characteristic of the Pacific Northwest (Hamlet *et al.*, 2005, Stewart *et al.*, 2005). In southern Oregon, annual average temperatures are likely to increase from 1 to 3° F (0.5 to 1.6° C) by around 2040, and 4 to 8° F (2.2 to 4.4° C) by around 2080, and summer temperatures may increase dramatically reaching 7 to 15° F (3.8 to 8.3° C) above baseline by 2080, while winter temperatures may increase 3 to 8°F (1.6 to 3.3° C; Doppelt *et al.* 2008). Projections of changes in precipitation with climate change vary widely among models, but some investigators report that increasing temperatures and resulting evapotranspiration losses will result in decreasing April 1st snow packs that will offset any precipitation increases in the region (Hamlet *et al.* 2005).

A preliminary analysis of climatologic and hydrologic information for the Upper Klamath River Basin indicates Upper Klamath Lake inflows, particularly baseflows, have declined over the last several decades (Mayer 2008). Net inflow to Upper Klamath Lake and tributary flow to Upper Klamath Lake (an independent measure of inflow) are both strongly dependent on climate, particularly precipitation, as demonstrated in Mayer (2008). Part of the decline in baseflows is explained by decreasing precipitation but there may be other factors involved as well, including increasing temperatures and the resulting decrease in April 1st snow water equivalent; increasing evapotranspiration and consumptive use; or increasing surface water diversions or ground water pumping above the lake.

Both the Oregon Climate Division 5 temperature dataset and the U.S. Historical Climatological Network temperature dataset for Crater Lake show increasing trends in winter temperatures since the 1970s. Present-day winter temperatures are as warm or warmer than at any time during the last 80 to 100 years. Bartholow (2005) found that water temperatures in the Lower Klamath River have been increasing by about 0.5EC per decade since the 1960s.

At most snow-course locations in the western U.S., April 1st snow water equivalent (SWE) has been found to be the maximum annual value of snowpack and is highly correlated with stream flow (MaCabe and Dettinger 2002). April 1st SWE in the southern Cascades has declined since the 1930s, based on data from two high elevation sites near Crater Lake (Mayer 2008). Trends in the April 1st SWE at the two sites may be related to trends in winter temperature as well as precipitation.

One of the most intriguing studies on long-term climate trends in the basin is the study by Petersen *et al.* (1999) correlating tree-ring growth with annual precipitation and lake levels at Crater Lake. In the paper, the authors view Crater Lake as the “world’s largest rain gage” and they create a surrogate record of precipitation and lake levels based on tree-ring growth over the last three hundred years or more. Their results suggest that both precipitation and lake levels have been in a multi-century decline since about 1700.

Much of the decline in Upper Klamath Lake net inflows and tributary flows is certainly due to associated trends in climate. The observed changes are consistent with regional observations of climate change-related phenomena throughout the western U.S. Other factors such as increased consumptive use or ground water pumping above the lake may contribute to the decline too. Regardless, the implications of these declines are that there will be less water available in the system, particularly during the baseflow period. Hydrologic modeling and inflow forecasting based on historic lake inflows may not be representative of future conditions to the extent that it overestimates available water.

In addition to having multiple effects on water resources, such as reducing snow-pack, increasing winter run-off, increasing evapotranspiration-related water losses from wetlands and open water, and increasing agricultural water demand, climate change may directly and indirectly affect biological resources in the Klamath Basin. Climate change could exacerbate existing poor habitat conditions for suckers by further degrading water quality. Higher temperatures could increase the incidence of episodes of peak summer temperatures and contribute to the low dissolved oxygen events that are responsible for sucker die-offs. The weather conditions documented during the last three fish die-offs in Upper Klamath Lake were characterized by higher than average temperatures (Wood *et al.* 2006) suggesting that temperature plays a role in the events. Because Upper Klamath Lake is shallow, water temperatures tend to closely follow air temperatures so even a week of high air temperatures will affect water temperatures in the lake (Wood *et al.* 1996).

Higher water temperatures could have multiple adverse effects on suckers including: (1) stressing AFA, causing bloom collapse; (2) increasing respiration rates of microorganisms, thus elevating dissolved oxygen consumption in the water column and in sediments; (3) raising respiration rates for suckers and other fish making it more difficult for them to obtain sufficient dissolved oxygen; and (4) reducing the dissolved oxygen holding-capacity of water which is highest in cold water. The productivity of Upper Klamath Lake and sucker growth rates might increase as a result of higher temperatures, but if higher temperatures lead to reduced water quality, the benefits could be negated. Because of the complex nature of the lake ecosystem, it is difficult to predict what ecological changes are likely to occur, but it is certain that some changes will happen.

Genetics

Hybridization was identified as a threat to Lost River and shortnose suckers at the time of listing (USFWS 1988a). New data suggest that hybridization among four Klamath Basin suckers (Lost River sucker, shortnose sucker, Klamath largescale sucker (*Catostomus snyderi*) and Klamath smallscale sucker (*Catostomus rimiculus*) does occur (Dowling 2005b, Tranah and May 2006). Hybridization can be cause for concern for an imperiled species, even leading to extinction (*e.g.,* Rhymer and Simberloff 1996). However, at this time, scientists who have studied Klamath suckers consider any hybridization among them is not unusual (Dowling 2005b, Tranah and May 2006). The evidence indicates that hybridization has been common throughout the evolutionary history of suckers, in general, and Klamath Basin suckers, in particular (Dowling 2005b, Markle *et al.* 2005).

Despite any hybridization that occurs, Lost River and shortnose suckers are distinguishable, for the most part, from the other Klamath Basin suckers using morphological characteristics (Dowling 2005b, Markle *et al.* 2005). They also show evidence of behavioral and ecological differences (Markle *et al.* 2005). The taxonomy of Lost River and shortnose suckers is not being questioned at this time.

Status of Proposed Critical Habitat within the Action Area

There are six proposed critical habitat units (CHU): (1) Clear Lake and watershed; (2) Tule Lake; (3) Klamath River; (4) Upper Klamath Lake and watershed; (5) Williamson and Sprague Rivers; and (6) Gerber Reservoir and watershed (Figure 5, below).

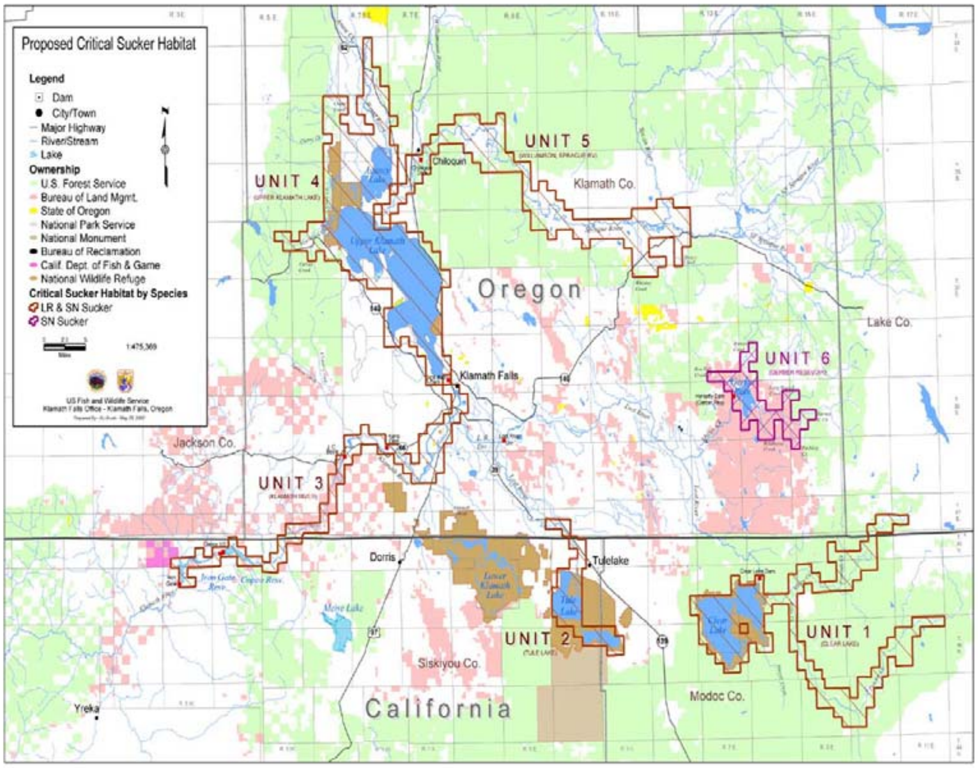

Figure 5. Map showing the six proposed critical habitat units for the Lost River and shortnose suckers.

CHU 1 (Clear Lake and watershed): Only a small portion of CHU 1 occurs within Oregon. Water quantity, water quality and physical habitat for spawning, feeding, rearing, and travel corridors are generally sufficient for Lost River and shortnose suckers. However, during extended drought conditions when Clear Lake recedes to a small size with low lake levels, reduced water quality, primarily low dissolved oxygen, both in summer and in winter below an ice cover are likely to occur. Under these stressful conditions fish are at greater risk of disease parasitism, and fish die-offs. Competition and predation by non-native fish species including Sacramento perch, and brown bullhead likely impact sucker populations particularly at low lake levels. A migration barrier at Clear Lake Dam isolates Lost River and shortnose suckers populations and prevents genetic exchange with other populations in the Upper Klamath Basin.

CHU 2 (Tule Lake): Only a small portion of CHU 2 occurs within Oregon. Physical habitat for feeding and rearing is very limited due to shallow water depths. Spawning habitat is restricted to a small area in the lower Lost River. There are no passage facilities at Anderson Rose Dam and habitat alteration in the Lost River and additional dams without passage have eliminated spawning habitat upstream. Travel corridors in the lower Lost River are restricted by shallow depths affected by sedimentation and low flows during the spawning period. Degraded water quality during the summer including high pH, ammonia, nutrients, pesticides, and low dissolved oxygen negatively impacts sucker populations. Fish die-offs in winter below an ice cover are likely to occur. Sedimentation in Tule Lake sumps limits adult habitat and restricts assess to the upstream spawning site. Competition and predation by non-native fish species likely impacts survival of larval and juvenile suckers.

CHU 3 (Klamath River): Water quality in the Klamath River reservoirs is stressful to suckers during the summer when large blue-green algae blooms and crashes occur (NRC 2004). Fish die-offs are common in Keno Reservoir (Tinniswood 2006). Emergent wetlands and shallow shoreline habitat used by larval and juvenile suckers are extremely limited in the Klamath River reservoirs with the exception of J.C. Boyle Reservoir. Spawning habitat is also lacking or limited due to high gradient and velocity of the river and absence of gravel spawning substrate. Non-native fish populations are also very large in all of the Klamath River reservoirs. Competition and predation by species including fathead minnows, yellow perch, bullheads, crappie, and largemouth bass likely impact sucker populations in the Klamath River reservoirs.

CHU 4 (Upper Klamath Lake and watershed): Seasonal reductions in water surface elevations during summer and fall of dry years negatively impact the quantity and quality of emergent wetland rearing habitat for larval and juvenile suckers, and the loss of deep-water habitats and water quality refuge areas for older fish. Substantial wetland habitat restoration is underway to provide a major increase in high quality habitat at the Williamson River delta. Water quality conditions are stressful for Lost River and shortnose suckers every summer due to massive AFA blooms and crashes that result in increased pH and ammonia, and reduced dissolved oxygen. Periodic fish die-offs occur as a result of poor water quality associated with AFA bloom crashes. Entrainment of larval and juvenile suckers at the outlet of the lake is significant and negatively impacts recruitment. Non-native fish species including fathead minnows and yellow perch likely compete for resources and prey upon suckers (Markle and Dunsmoor 2007). Tributaries to Upper Klamath Lake including the Wood River, Crooked Creek, Sevenmile Creek, and Fourmile Creek, the historic spawning habitat for suckers in Upper Klamath Lake, are degraded due to channelization and agricultural development.

CHU 5 (Williamson and Sprague Rivers): Physical habitat in the Sprague and Williamson Rivers used for spawning, larval, and juvenile rearing is degraded due to the lack of habitat complexity. These areas lack riparian vegetation, backwater wetlands, and sinuous river channels. Fish passage was restricted by Chiloquin Dam reducing access to upstream spawning habitat; however, the dam was removed in 2008. Water quality in the Sprague River is degraded due to water withdrawals during the summer and sedimentation and nutrient loading from agricultural and forestry practices adjacent to the river. Competition and predation by non-native fish species including yellow perch, largemouth bass, fathead minnows, and brown bullheads likely negatively affect larval and juvenile sucker survival.

CHU 6 (Gerber Reservoir and watershed): Water quantity, water quality, and physical habitat for spawning, feeding, rearing, and travel corridors are generally sufficient for shortnose sucker. However, during extended drought conditions when Gerber Reservoir recedes to a small size with low lake levels, reduced water quality, primarily low dissolved oxygen, both in summer and in winter below an ice cover are likely to occur. Under these stressful conditions fish are at greater risk of disease and parasitism and fish die-offs. Competition and predation by non-native fish species including yellow perch, crappie, and brown bullhead likely impact sucker populations particularly at low lake levels. A migration barrier at Gerber Dam isolates shortnose sucker populations and prevents genetic exchange with other shortnose sucker populations in the Upper Klamath basin. The dam also prevents access by Lost River suckers.

Relationship of the Action Area to Conservation of the Suckers

Conservation of the Lost River and shortnose suckers is dependent on preserving several viable self-sustaining populations of suckers in as much of their historic range as possible: (1) populations must be of adequate size and of diverse age structure to withstand stochastic events and remain viable; (2) populations must be interconnected for demographic and genetic support; and (3) adequate spawning, rearing, feeding, and over-wintering habitat must be present throughout the species range to support viable populations.

Currently, the largest populations of Lost River and shortnose suckers are found in Upper Klamath Lake and its tributaries (USFWS 2007c,d). These species rear, feed and over-winter in the lake and are affected by water level management that affects habitat availability including shoreline spawning areas for Lost River suckers, emergent wetlands and shallow shoreline areas for larvae and to a lesser extent age 0 juveniles, deeper open water habitat for juvenile and adults, and water quality refuge areas. Substantial entrainment of larval and juvenile suckers occurs at the outlet of Upper Klamath Lake. Although we cannot determine all of the factors causing the downstream movement and loss of larval and juvenile suckers at Link River Dam, Reclamation's management of the dam contributes to this loss and therefore represents a risk to the Lost River and shortnose suckers. See Entrainment section for a more detailed description.

Currently, Clear Lake has a relatively large population of Lost River and shortnose suckers. A potential threat to Clear Lake population is lack of access to Willow Creek, the principal spawning tributary. However, the proposed action is anticipated to provide adequate water depths for sucker spawning access in all years. The effects of fluctuating water elevations at Clear Lake on sucker populations in terms of population size, age-class distribution, recruitment, or decreased fitness are not fully understood. However, available information indicates that the Clear Lake sucker populations have remained viable under the current management regime and we do not anticipate that this will change unless there is a prolonged drought.

There is also a robust population of shortnose suckers in Gerber Reservoir. Similar to Clear Lake, the effects of fluctuating water levels on the shortnose sucker population in Gerber Reservoir is not fully understood. However, available information indicates that the shortnose sucker population has remained viable under the current management regime and we do not anticipate that will change unless there is a prolonged drought.

The long-term survival of suckers in Tule Lake is in doubt because of the lack adult rearing habitat (areas with water depth greater than 3 feet) and lack of flows and spawning habitat in the Lost River under the proposed action. The Tule Lake population of Lost River suckers may be crucial to recovery of that species since it represents one of only three Lost River sucker populations. Spreading the risk of extirpation among three Lost River sucker populations rather than just two populations could significantly decrease the threat of extinction risk to the species.

The Lost River and Keno Reservoir are highly altered systems and currently support small sucker populations. However, because Keno Reservoir is adjacent to Upper Klamath Lake and large numbers of suckers disperse there from upstream, it has the potential to provide rearing habitat for a large number of suckers that ultimately migrate back to Upper Klamath Lake to spawn along shoreline areas or in the tributaries. Therefore, habitat and water quality improvements in Keno Reservoir are justified.

4.5. Modoc sucker

The action area encompasses only the Oregon portion of the species range. In recent surveys, Modoc sucker were only documented in approximately 14.2 miles of stream in upper Thomas Creek primarily on U.S. Forest Service land within the Goose Lake Basin. They may extend further upstream, or downstream onto lands under private ownership on the valley floor in Thomas Creek and its tributaries (S. Reid, pers. comm. 2008). The factors affecting the species environment in the action area include: changes in habitat quantity and quality; presence of movement barriers; predation; hybridization; and drought and climate change. Ecosystem restoration and other recovery actions are taking place in efforts to meet recovery criteria from the 1984 Recovery (Action) Plan. CREP projects could potentially improve, and help to extend the amount of suitable and occupied Modoc sucker habitat.

Habitat Quantity and Quality

The 1985 listing rule stated that land management activities had: (1) dramatically degraded Modoc sucker habitat, (2) removed natural passage barriers allowing hybridization with Sacramento suckers and providing access to predaceous fishes, and (3) decreased the distribution of the Modoc sucker to only four streams (USFWS 1985a). Thomas Creek, in the Oregon portion of the Goose Lake sub-basin, was not considered to contain Modoc suckers in the original listing, because at that time the range of the sucker was considered to be confined to California. The majority of the upper Thomas Creek watershed and the stream reaches containing Modoc suckers are managed by Fremont-Winema National Forests. Prior to the recognition that there were Modoc suckers in the drainage, the Forest Service in 1986 established the Thomas Creek Riparian Recovery Project with the objective to halt erosion, stabilize stream banks, and reduce water temperatures for the benefit of native fishes. As part of this project, there have been numerous riparian restoration and channel improvement projects to promote deeper pool development and water retention, as well as improved grazing management.

There are two privately-owned meadow reaches of Thomas Creek above the lower forest boundary that are characterized by low gradient and large open pools. Both are managed for grazing by the USFS permittee. The lower parcel, which is unfenced and grazed with neighboring USFS allotments, contains substantial populations of Modoc sucker (Reid 2007a). The upper parcel is fenced and has not been surveyed, although Modoc suckers are abundant in pools at its boundaries and therefore the suckers are likely occur on the un-surveyed stream reach. At this time, the Service has no indication that current land management practices on public and private lands on Thomas Creek that are compatible with the conservation of the species will not continue, and therefore upward habitat trends are expected to continue.

Movement Barriers

The original listing assumed that natural passage barriers in streams occupied by Modoc suckers had been eliminated by human activities, allowing hybridization between the Modoc and Sacramento suckers, as well as providing access to Modoc sucker streams by non-native predatory fishes. However, review of all streams where Modoc suckers occur indicates no evidence for historical natural barriers that would have physically separated the two species in the past, particularly during higher springtime flows when Sacramento suckers make their upstream spawning migrations (Reid 2008b). There is no evidence showing that the historical range of the Modoc sucker, or its distribution within that range, has been substantially reduced in the recent past. To the contrary, continued field surveys have resulted in recent expansions of our understanding of the species' range and distribution. Furthermore, the distribution of Modoc suckers within the stream populations recognized in 1985 has either remained stable over the past 22 years, or slightly expanded, and the ten populations appear to occupy all available and suitable habitat.

Predation

The original listing identified the presence of introduced and highly piscivorous brown trout (*Salmo trutta*) as an adverse element that reduced sucker numbers through predation (USFWS 1985a). Nonnative predatory fish are a problem in parts of the range in California (Reid 2008b); however, in Thomas Creek, no nonnative fishes have been found (Reid 2007a, Heck *et al.* 2008). The Modoc sucker, which rarely exceeds 7 inches standard length in small streams, typically occupies habitat where the only native predatory fish is the native redband trout (*Oncorhynchus mykiss* ssp.). Stream-resident redband trout, which are not substantially larger than the Modoc sucker, is a primarily insectivorous species that occasionally feeds on small fishes (Moyle 2002). Because stream-resident redband trout are small and primarily feed on insects we do not believe they pose a threat to the Modoc sucker.

Hybridization

The 1985 listing identified hybridization with the Sacramento sucker, also native to the Pit River drainage, as a principal threat to the Modoc sucker. Hybridization can be cause for concern in a species with restricted distribution, particularly when a closely related non-native species is introduced into its range, and can lead to loss of genetic integrity or even extinction (Rhymer and Simberloff 1996). In 1985, it was assumed that hybridization between Modoc and Sacramento suckers had been prevented in the past by natural physical barriers, which had been recently eliminated by human activities, allowing contact between the two species. Modoc sucker populations from streams in which both species were present were considered hybrid populations and were excluded when evaluating the Modoc sucker's distribution in 1985. The assumption that extensive hybridization was occurring was based solely on the opportunity presented by co-occurrence and the identification of a few specimens exhibiting what were thought to be intermediate morphological characters. At that time, genetic information to assess this assumption was not available.

Modoc and Sacramento suckers are naturally sympatric (occurring in the same streams) in the Pit drainage. There is no indication that Sacramento suckers are recent invaders to the Pit River or its tributaries. Both morphological and preliminary genetic data suggests that the upper Pit River population of Sacramento suckers is distinct from other Sacramento River drainage populations (Ward and Fritsche 1987; Dowling, unpub. data. 2005). There is also no available information suggesting Modoc and Sacramento suckers were geographically isolated from each other in the recent past by barriers within the Pit Drainage. Separation of the two species appears to be primarily ecological, with Modoc suckers occupying smaller, headwater streams typically associated with trout and speckled dace, while Sacramento suckers primarily occupy the larger, warmer downstream reaches of tributaries and main-stem rivers with continuous flow (Moyle and Marciochi 1975, Moyle and Daniels 1982, Reid 2008b). Further reproductive isolation is probably reinforced by different spawning times in the two species and their size differences at maturity (Reid 2008b).

The morphological evidence for hybridization in 1985 listing was based on a limited understanding of morphological variation in the Modoc and Sacramento suckers, derived from the small number of specimens available at that time. Subsequent evaluation of variability in the two species, based on a larger number of specimens, shows that the overlapping character states (primarily lateral line and dorsal ray counts), interpreted by earlier authors as evidence of hybridization, are actually part of the natural meristic (involving counts of body parts such as fins and scales) range for the two species and are not associated with genetic evidence of introgression (Kettratad 2001, Reid 2008b). Furthermore, the actual number of specimens identified as apparent hybrids by earlier authors was very small and in great part came from streams without established Modoc sucker populations.

In 1999, the Service initiated a program to examine the genetics of suckers in the Pit River drainage and determine the extent and role of hybridization between the Modoc and Sacramento suckers using both nuclear and mitochondrial genes (Palmerston *et al.* 2001, Wagman and Markle 2000, Dowling 2005a, Topinka 2006). The two species are genetically similar, suggesting that they are relatively recently differentiated and/or have a history of introgression throughout their range that has obscured their differences (Wagman and Markle 2000, Dowling 2005a, Topinka 2006). Although the available evidence cannot differentiate between the two hypotheses, the genetic similarity in all three sub-drainages, including those populations shown to be free of introgression based on species-specific genetic markers (Topinka 2006), suggests that introgression has occurred on a broad temporal and geographic scale and is not a localized or recent phenomenon. Consequently the evidence indicates that introgression is natural and is not caused or measurably affected by human activities.

There is no evidence that the observed hybridization has been affected by human modification of habitat, and genetic exchange between the two species under such conditions may be a natural phenomenon and a part of their evolutionary legacy. A similar situation has been observed in suckers in the nearby Klamath River drainage, where four species have hybridized to varying degrees, but in general retain morphological, behavioral, and ecological separation (Markle *et al.* 2005, Dowling 2005a, Tranah and May 2006).

Despite any hybridization that has occurred in the past, the Modoc sucker maintains its morphological and ecological distinctiveness, even in populations showing low levels of introgression, and is clearly distinguishable from the Sacramento sucker using morphological characteristics (Kettratad 2001). Therefore, given the observed low-levels of observed introgression in nine known streams dominated by Modoc suckers, the absence of evidence for extensive ongoing hybridization in the form of first generation hybrids, the fact that Modoc and Sacramento suckers are naturally sympatric, and the continued ecological and morphological integrity of Modoc sucker populations, hybridization is not considered a threat to Modoc sucker populations.

Drought and Climate Change

The listing rule did not identify drought or climate change as threats to the continued existence of the Modoc sucker (USFWS 1985a). However, the northwestern corner of the Great Basin is naturally subject to extended droughts, during which even the larger water-bodies such as Goose Lake have dried up (Laird 1971). Regional droughts have occurred every 10 to 20 years in the last century (Reid 2008b). The "dustbowl" drought of the 1920's to 1930's appears to have been the most extreme regional drought in at least the last 270 years and probably the last 700 years (Keen 1937, Knapp *et al.* 2004).

There is no record of how frequently Modoc sucker streams went dry except for occasional pools. There is no doubt that reaches of these streams did stop flowing in the past because some reaches dry up (or flow goes through the gravel instead of over the surface) nearly every summer under current climatic conditions (Reid 2008b). Collections of Modoc sucker from Rush Creek and Thomas Creek near the end of that drought (Hubbs and Miller 1934, Merriman and Soutter 1933), and the continued persistence of Modoc sucker throughout its known range through substantial local drought years since 1985 without active management, demonstrate the resiliency of the population given availability of suitable refuge habitat. Based on this, we do not believe drought poses a substantial threat to the species.

Human-induced climate change could exacerbate low-flow conditions in Modoc sucker habitat during future droughts. A warming trend in the mountains of western North America is expected to decrease snowpack, hasten spring runoff, reduce summer stream flows, and increase summer temperatures (IPCC 2007, PPIC 2008). Lower flows as a result of smaller snowpack could reduce sucker habitat, which might adversely affect Modoc sucker reproduction and survival. Warmer water temperatures could lead to physiological stress and could also benefit non-native fishes that prey on or compete with Modoc suckers. Increases in the numbers and size of forest fires could also result from climate change (Westerling *et al.* 2006) and could adversely affect watershed function resulting in faster runoff, lower base flows during the summer and fall, and increased sedimentation rates. While it appears reasonable to assume that the Modoc sucker will be adversely affected by climate change, we lack sufficient information to accurately determine what degree of threat it poses and when the changes will occur.

Conservation and Recovery Actions

Habitat improvement projects completed in the 1980-90's and USFS management policies continue to provide habitat benefits with upward trending conditions. Recent habitat projects include: (1) fencing to exclude grazing from newly recognized occupied habitat in upper Turner Creek (USFS in progress); (2) channel improvements in lower Dutch Flat Creek (Pit Resource Conservation District); (3) extensive channel stabilization and pool development as part of the Thomas Creek Restoration Project (USFS 1986-2002); (4) exclusion of grazing from Garden Gulch (USFS 2004) and stabilization of stream channel on private lands with increased flow duration due to hayfield irrigation sub-flow (private landowner 2002); fencing to exclude cattle along privately owned reaches of Critical Habitat on Rush Creek (USFWS and private landowner 2002) and Johnson Creek below barrier (private landowner 2002); and (5) screening of reservoir outflows in the upper Washington (USFS completed 2006). Also, there is continued outreach and collaboration with landowners on Modoc Sucker streams and throughout the Pit River watershed (Clark and Reid 2004, Pit River Native Fishes Stewardship Program).

Recovery Criteria from the 1984 Recovery (Action) Plan

At the time of proposed listing in 1984, the Service, CDFG, and the Forest Service had been developing an "Action Plan for the Recovery of the Modoc Sucker" through a number of drafts and years. The signed 1984 Plan was understood to preclude the need for a formal recovery plan at the time of listing (USFWS 1984, 1985). The stated purpose of the 1984 Action Plan was to provide direction and assign responsibilities for the recovery of the Modoc sucker; it also provided action (recovery) tasks and reclassification (downlisting/delisting) criteria.

General objectives of the various action plans:

1. To restore and maintain the quality of occupied Modoc sucker habitat within the Turner Creek and Rush Creek drainages.
2. To restore the remaining suitable, but presently unoccupied, stream reaches within the Turner Creek and Rush Creek drainages.
3. To prevent the invasion of Sacramento suckers into isolated stream reaches where it was believed "pure" Modoc sucker populations persisted (Turner-Hulbert-Washington Creek and upper Johnson Creek systems). (Note: This objective is no longer a priority; see "Hybridization" discussion in this section above.)
4. To secure additional populations of Modoc suckers in additional streams within the historical range.
5. To increase the carrying capacity of currently occupied habitat for Modoc suckers and other native species (included subsequent to 1984 Plan).
6. To increase population numbers to a point where the problems associated with small population size (inbreeding depression, genetic drift, and depletion of genetic variance) do not threaten survival of the species (included subsequent to 1984 Plan).
7. To re-establish native species composition in Modoc sucker streams (included subsequent to 1984 Plan).
8. To increase private landowner awareness of Modoc sucker needs and endangered species issues as they relate to land management (inclused subsequent to 1984 Plan).
9. To allow for the recovery of the Modoc sucker to a point where the species is secure.

<u>Downlisting Criteria</u> – "Consider reclassification to 'threatened' upon establishment of pure, safe populations (for 3 to 5 years) throughout Rush and Turner Creeks watersheds."

<u>Delisting Criteria</u> – "Consider delisting upon establishment of pure, safe populations (for 3 to 5 years) throughout Rush and Turner Creeks watersheds (downlisting criteria), and in two additional streams within historic range."

Recovery tasks identified in the 1984 recovery action plan can be divided into 5 categories: (1) improve and secure habitat; (2) reduce threats from hybridization and perform genetic studies to assess degree of introgression; (3) expand range; (4) monitor populations; and (5) perform recovery-related administrative tasks. All recovery tasks from the signed 1984 recovery action plan and subsequent draft action plans are generally completed, ongoing, or have been deemed inappropriate, based on current information or policy (Reid 2008b).

4.6. Oregon chub

The action area encompasses the entire range of Oregon chub, since they are endemic to the Willamette River Valley in Oregon. Since the time of listing, several Oregon chub populations have been extirpated, a number of new populations have been discovered, and there have been a number of successful introductions (Bangs *et al.* 2008). In 2008, ODFW confirmed the continued existence of Oregon chub at 38 locations in the North and South Santiam River, McKenzie River, Middle Fork Willamette River, Coast Fork, and several tributaries to the mainstem Willamette River downstream of the Coast Fork Willamette River/Middle Fork Willamette River confluence (Bangs *et al.* 2008). These included 26 naturally occurring and 12 introduced populations. ODFW did not find Oregon chub at seven locations where they were collected on at least one occasion between 1991-2007. Non-native fish were collected at most of these locations. New populations of Oregon chub were discovered in two sloughs in the Middle Fork Willamette drainage (Bangs *et al.* 2008).

In a 5-year review completed by the Service on the listing status of Oregon chub in 2008, the findings supported a recommendation to downlist the species (USFWS 2008d). At the time of listing in 1993, there were only eight populations of Oregon chub. These populations were exposed to various threats (destruction of its habitat, predation by nonnative fishes, and the inadequacy of regulatory mechanisms) that could have caused the extinction of the species. Due to the extremely limited number of known populations, agencies active in Oregon chub conservation focused on establishing new populations in habitats without predation from non-native species. This resulted in the creation of isolated populations throughout the Oregon chubs' historic range. These efforts have been extremely effective at protecting Oregon chub from their most significant threats (predation by non-native fishes and lack of suitable habitat) that affected the species at the time of listing. Successful conservation efforts have therefore resulted in more than a four-fold increase in the number of Oregon chub populations (USFWS 2008d).

Despite the short-term successes in increasing the abundance and distribution of Oregon chub and meeting the downlisting criteria, there are potentially significant long-term threats to the species. The recovery strategy has focused on improving Oregon chub habitats in isolation due to the loss and fragmentation of suitable habitats and the threats posed by non-native fishes. Most populations of chub are currently isolated from other chub populations due to the reduced frequency and magnitude of flood events and the presence of migration barriers such as impassible culverts and permanent, high beaver dams. Unfortunately, managing Oregon chub in isolation has potentially severe consequences (Scheerer *et al.* 2006a). Isolating populations that would normally experience gene exchange can result in general decline in local genetic diversity and a corresponding increase in divergence among populations within a drainage system (Meffe and Vrijenhoek 1988). Burkey (1989) concluded that when species are isolated by fragmented habitats, low rates of population growth are typical in local populations and their probability of extinction is directly related to the degree of isolation and fragmentation. Without sufficient immigration, growth for local populations may be low and probability of extinction high (Burkey 1989 and 1995). Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events (Hard 1995, Healy and Prince 1995, Rieman and Allendorf 2001, Rieman and McIntyre 1993, Spruell *et al.* 1999).

Santiam River Drainage

Oregon chub currently exist at nine sites in the Santiam River drainage (Bangs *et al.* 2008). Six are naturally occurring populations and three (including the two largest populations in the Santiam River drainage) were introduced. In 2008, ODFW population abundance estimates found three populations in the Santiam drainage that totaled 500 or more adult Oregon chub; two populations had a stable or increasing trend in abundance for the past five years and the trend for the other population is unknown. Trends for the populations at the other sites in the Santiam drainage are unknown.

Middle Fork Willamette River Drainage

The Middle Fork Willamette drainage contains the greatest concentration of large Oregon chub populations in the Willamette Valley. In 2008, Oregon chub were found at sixteen sites and there were ten populations in the Middle Fork Willamette drainage that totaled 500 or more adults (Bangs *et al.* 2008). Eight of these populations have been stable or increasing in abundance for the past five years. Two populations had declining 5-year abundance trends. Significant increases in Oregon chub abundance occurred at two sites, and significant decreases occurred at three sites. Two of the extant populations were introduced; both are populations with over 500 adults. No chub were found at three of the 2008 survey sites where relatively low numbers of chub had been documented in the past.

Mid-Willamette River Drainage (Includes the McKenzie River Drainage)

In 2008, ODFW estimated the population abundance of Oregon chub at nine locations in the Mid-Willamette River drainage (includes the McKenzie River) (Bangs *et al.* 2008). The ODFW reported that there were six populations in the Mid-Willamette drainage that totaled 500 or more adult Oregon chub. Four of these populations have exhibited a stable or increasing abundance trend over the past five years. The three largest populations in this drainage were introductions. There were significant increases in Oregon chub abundance at three sites, and a significant decline at one site. A new population was introduced in this drainage in 2008 at a site known as St. Paul Ponds.

Coast Fork Willamette River Drainage

In 2008, ODFW estimated the population abundance of Oregon chub at one site in the Coast Fork Willamette drainage (Coast Fork Side Channel; N=130 adults) (Bangs *et al.* 2008). Only three adult Oregon chub were collected at Herman Pond, an introduction site which had an estimated 180 adults in 2007. Chub were introduced to a new site within this drainage known as Sprick Pond in 2008.

Conservation and Recovery Actions

The Oregon Chub Working Group was formed in 1991 and includes Federal and state agency biologists, academics, land managers, and other concerned people who are working to improve the status of the species. The Working Group has been proactive in conserving and restoring habitat for the Oregon chub and raising public awareness of the species since before the Federal listing in 1993.

In 1992, an interagency Conservation Agreement for the Oregon Chub in the Willamette Valley, Oregon was completed and signed by the Service, USFS, BLM, ODFW, and Oregon Parks and Recreation Department (USFWS 1998d). The purpose of the coordinated plan was to facilitate Oregon chub protection and recovery and to serve as a guide for all agencies to follow as they carry out their missions. The management guidelines are to: (1) establish a task force to oversee and coordinate Oregon chub conservation and management actions; (2) protect existing populations; (3) establish new populations; and (4) foster greater public understanding of the Oregon chub, its status, the factors that influence it and the conservation agreement.

In February 1997, a draft habitat conservation plan was prepared by consultants for the City of Salem to protect and enhance the population of Oregon chub located in the drinking water treatment facility at Geren Island in the North Santiam River. In 1996, a no-spray agreement with the Oregon Department of Transportation was formalized to protect Oregon chub sites located in the Middle Fork Willamette River drainage adjacent to Highway 58 in Lane County. The agreement prohibits spraying of herbicides in the vicinity of Oregon chub sites and limits vegetation control to mechanical methods if necessary.

Additional conservation measures implemented to improve the status of Oregon chub include reintroductions of Oregon chub within the historical range, habitat enhancement projects and public education. Also, the Service has completed three individual Safe Harbor Agreements (SHA) for Oregon chub. To streamline the process for landowners to enter into a SHA with the Service in the future, a programmatic SHA is being developed. Under a SHA, property owners can undertake management activities that will benefit listed species on their properties while receiving assurances that they will not incur additional ESA-related liabilities as a result of helping to conserve and recover listed species. SHAs are designed to provide a net benefit for the species over a specified period of time, while allowing landowners to return their enrolled properties to baseline conditions for the covered species in the future if they choose to.

Consulted-on Effects

Consulted-on effects are those effects that have been analyzed through section 7 consultation as reported in a BO. These effects are an important component of characterizing the current condition of the species. To assess consulted-on effects to the Oregon chub, we conducted a general review of all BOs completed at the Oregon Fish and Wildlife Office from January 1993 until March 2009. A total of 48 formal BOs were completed during this time frame.

Our review shows that we consulted on a wide array of actions related to habitat, water, and facility construction/development which had varying level of effects. Some of the other actions included the reintroduction of Oregon chub to suitable habitats in its historic range. No actions that have undergone consultation were found to appreciably reduce the likelihood of survival and recovery (*i.e.,* jeopardy determination) of the Oregon chub.

4.7. Listed Plants and Fender’s Blue Butterfly

The environmental baselines for the listed plants addressed in this consultation (Golden Indian paintbrush, Bradshaw's lomatium, Nelson's checker-mallow, Willamette daisy and Kincaid's lupine) and Fender's blue butterfly are similar, so they are discussed together in this section.

The action area coincides with the entire range of Fender’s blue butterfly and Willamette daisy. Kincaid’s lupine, Bradshaw’s lomatium and Nelson’s checker-mallow primarily occur within Oregon. Extant populations also occur outside of the project area at a few sites in southwestern Washington. Of all of the native prairie species addressed in this consultation, only the golden paintbrush has a large portion of its range outside of Oregon. Since the action area is the entire range, or nearly the entire range, of Fender's blue butterfly, Willamette daisy, Kincaid's lupine, Bradshaw's lomatium and Nelson's checker-mallow, the Status of the Species and Critical Habitat discussed in the previous section essentially constitutes the environmental baseline for the listed prairie species.

Consulted-on Effects

The baseline for consultation includes state, tribal, local and private actions already affecting the species or that will occur contemporaneously with the consultation in progress. Unrelated Federal actions affecting the same species or critical habitat that have completed formal or informal consultation are also part of the environmental baseline, as are Federal and other actions within the action area that may benefit listed species or critical habitat. Other Federal actions affecting Fender's blue butterfly, the listed plants, or their designated critical habitat that required formal section 7 consultation with our office include: habitat management plans for the Army Corps of Engineers' (Corps), BLM, and Service (Baskett Slough Refuge complex), the Service issuance of section 10(a)(1)(A) recovery permits, restoration and species enhancement by the Service, Federal Highway Administration highway and bridge construction, and recreation development by the Corps and BLM. None of the completed section 7 consultations reached a jeopardy finding for Fender's blue butterfly, Willamette daisy, Kincaid's lupine, Bradshaw's lomatium, Nelson's checker-mallow or golden paintbrush nor a finding of adverse modification of designated critical habitat for Fender's blue butterfly, Willamette daisy, or Kincaid's lupine.

5. EFFECTS OF THE ACTION

Effects of the action are defined as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline" (50 CFR 402.02). CREP actions are specifically designed to improve fish and wildlife habitats by restoring and enhancing stream and riparian habitats and associated wetlands and upland wildlife habitats on agricultural lands throughout Oregon. While net benefits are expected, CREP activities will also have some unavoidable adverse effects to the Service's listed species addressed in this consultation. The Service assisted FSA with the development of the effects analyses included in sections 4 and 5 of the BA, and is incorporating the full discussions about the effects of the action by reference. This section provides abbreviated discussions of the effects analyses included in the BA relevant to the species included in this BO. Further analysis and other information relevant to each species are included where appropriate.

5.1. Scope and Assumptions

FSA is not able to precisely document where CREP project sites will be located over the next ten years or describe project site-specific conditions or species effects, whether adversely or beneficially. However, the effects of the covered CREP activities on listed species have been analyzed programmatically considering the nature and scope of the various activities, project habitat types and geographical areas, and listed species needs and threats. Ultimately, all of the covered restoration activities are expected to provide long-term benefits by improving existing conditions for listed species that occur in the vicinity of CREP projects. The duration of the benefits will depend on the specific activity, and any other actions that may occur in the future at a project site after CREP actions have been completed.

CREP projects are currently authorized to take place on up to 100,000 acres during the life of the program, which has an unspecified duration. Projects have already been implemented on approximately 34,800 acres, leaving up to 65,200 acres that can be enrolled in the future (L. Loop, pers. comm. 2009). Based on the average enrollment during the first 9 years of CREP, FSA anticipates 704 more projects covering 18,000 additional acres throughout Oregon during the next five years. We assume this figure will be doubled during the ten year period covered by this BO. The actual number of projects and acreages will depend on landowner interest, project opportunities and the availability of funding and technical staff to work with landowners to enroll in the program and complete practices.

It is assumed that CREP projects will be implemented on eligible lands throughout Oregon. The duration of a restoration activity at a site may last for less than one day to several weeks depending on the extent and complexity of the activity. Activities typically occur on a single property at a time until the work is completed, although actions may sometimes be completed on multiple sites that are concentrated in an area. The Oregon CREP includes incentives that encourage more projects to be concentrated together, rather than having scattered participation by individual landowners, in order to increase program effectiveness in achieving the desired water quality and habitat benefits. This is done by offering cumulative impact incentive payments to landowners in any case where a total of at least 50 percent of the streambank within a 5-mile stream segment is enrolled.

While some negative impacts to the environment and listed species from CREP actions are likely to occur, short- and long-term benefits are also expected. Positive environmental impacts of CREP include reduced sedimentation from tillage and livestock activity, reduced introduction of agricultural chemicals into streams from adjacent croplands and increased bank stability. If grazing or cropping pressure are eliminated from the riparian area or wetland, restoration strategies will be employed based on the climate and soil, the time frame and severity of the damage to the riparian area and the presence of invasive species. A riparian area may recover quickly through natural regeneration or require active restoration to aid with recovery. In some parts of Oregon, invasive weeds may rapidly colonize a riparian area if it is left alone to recover. As native vegetation established through CREP grows and matures, stream shading will increase and stream temperatures will decrease, and habitat for terrestrial wildlife along riparian areas will increase. Riparian functions will be restored, such as providing sources of large woody debris, food and nutrient inputs into stream channels and restoring channel structure, benefiting fish and other aquatic life.

5.2. Biological Effects

5.2.1. Displacement

Short-term displacement or disturbance of threatened and endangered fish and wildlife may occur from CREP activities because of construction noise, human presence, or activities in the area that disturb or displace animals that may be foraging, resting or moving through the area. To avoid or minimize these potential effects to fish and wildlife, the applicable BMPs in sections 1.3 and 1.4 (excerpted from sections 2.4 and 2.5 of the BA) will be followed. The BMPs address ways to avoid or minimize disturbances to and displacement of listed species when accessing sites and implementing projects. It is expected that any adverse affects to listed fish and wildlife species due to disturbance or displacement will be minimal in terms of both intensity and duration.

Listed plants that require open habitat conditions (*e.g.,* prairie species) could be displaced over time due to shading or competition from newly planted or released trees and shrubs. However, technical staff will recommend species for planting that will maintain or restore habitat conditions needed to support listed plants that occur on the project sites. Plants used in revegetation efforts will be selected based on soil type and plant community type and will not grow tall enough to shade out listed shade-intolerant species that occur on site.

5.2.2. Physical Harm

Direct physical harm to fish, invertebrates and plants is not expected from most CREP projects. However, while fish and wildlife are expected to temporarily vacate restoration areas where they could be physically harmed in many cases, ground disturbances and the use of equipment and vehicles could directly affect fish redds, fish in isolated habitats with limited dispersal ability such as springs or ponds, or sites that support Fender's blue butterfly or listed plants that are not able to move away from restoration disturbances.

With the exception of mowing, soil disturbing activities and the use of equipment will not occur in areas with listed plants and Fender's blue butterfly. There are likely to be short-term adverse effects from mowing. However, the long-term effects have been shown to be almost exclusively beneficial. Extensive research has been conducted in the last decade on the effects of various mowing regimes on rare prairie species; these studies have shown that mowing is an important tool for restoring native prairies and increasing populations of associated sensitive prairie species (USFWS 2008a).

Potential physical impacts to fish could occur on projects where water is diverted and pumped for livestock watering facilities or irrigation of revegetated areas. Unscreened (versus screened) water diversions are recognized as one of the threats for Lost River, shortnose and Warner suckers and bull trout because, in addition to the diversions impacting fish by altering flows and habitat conditions, fish can be harmed or killed as they are transported into and through the diversions or become stranded in inhospitable areas such as ditches and agricultural fields (USFWS 1985b, 1988a, 1993d, 1998a,c). Water diversions are recognized as a threat to the Oregon chub and Lahontan cutthroat trout, primarily due to changes in water level or flow conditions caused by the diversions rather than the lack of screening or problems with the screens themselves (USFWS 1975, 1993c, 1995 and 1998d). Similarly, water diversions are recognized as a threat to Modoc sucker, primarily due to associated habitat reduction and increased temperatures rather than factors associated with screening (USFWS 1985a, NatureServe 2009).

The threats associated with habitat and flow alterations from water diversions under this programmatic consultation are addressed by the CREP program BMPs. All pumps must be sized to only use water amounts that fall within the allowances of the landowners' documented or estimated historic water use and legal water right(s). Only minor diversions of up to 0.5 cfs are allowed in areas where listed suckers or Oregon chub may occur to reduce the risk of adversely affecting these species. In addition, for all CREP projects involving water diversions, a BMP is in place to ensure that water withdrawals will not dewater habitats, or cause or exacerbate low stream flow conditions that could impact listed fish.

To address the threat of fish entering the diversions, pumps must be screened to meet NOAA Fisheries' fish screen criteria, be self-cleaning or regularly maintained (by removing debris buildup), and a responsible party must be designated to ensure proper operation (*i.e.,* regular inspection and as-needed maintenance to ensure pumps and screens are properly functioning) on all water diversions covered under this programmatic consultation. The screening criteria consider the swimming ability of fish, based on the needs of fry-sized anadromous salmonids of less than 60.0 mm fork length. If pumps are used to temporarily divert a stream, an acceptable fish screen must be used to prevent entrainment or impingement of small fish per the criteria. Design criteria specify that approach velocities are not to exceed 0.40 feet per second (fps) for screens used on active pump intakes, or 0.2 feet per second for passive pump intakes. The criteria also specify sweeping velocities, which are flow velocities that are parallel and adjacent to the screen face, so that fish do not become impinged on the screens (NMFS 2008). The fish screening criteria are designed to fully protect even the smallest salmonids if they have been installed and are operating correctly (A. Ritchey, pers. comm. 2009).

Screening all diversions associated with CREP projects will avoid and greatly reduce the potential for adverse affects on all listed fish species, and efforts are being made throughout the state to screen unscreened diversions that are impacting all species of listed fish. However, because the NOAA Fisheries screening criteria were designed for anadromous salmonids, the swimming abilities and other factors related to other fish species have not been specifically considered, and the criteria may not fully address their needs. Some entrainment could still occur through screened diversions, and it is possible that some fish could become impinged on screens that meet the criteria.

Larval suckers and Oregon chub may be especially susceptible to entrainment due to the small size of these fish compared with Pacific salmon, bull trout and Lahontan cutthroat trout. The mean length of fry for several Pacific salmon species has been found to range from approximately 25 to 40 mm (Groot *et al.* 1995, Groot and Margolis 1991). Newly emerged bull trout have been found to range between 23-28 mm (Shepard *et al.* 1984a, Fraley et. al 1989). The total length of newly emerged sea-run cutthroat trout fry is about 25 mm (Trotter 1997); the Lahontan cutthroat trout fry is the largest cutthroat trout species (Western Native Trout Initiative 2009) and the fry are assumed to be larger.

The sucker and chub larvae tend to be much smaller. Lost River and shortnose sucker larvae have a typical standard length of 11 mm upon hatching (Cooperman and Markle 2003). Postlarval Warner suckers have been found to range from 11 to 17 mm total length. Very little information is available about the size of Modoc sucker larvae, but fish as small as 10-15 mm in length have been detected (Moyle, pers. comm. 1975 as cited in Conservation Management Institute 1996). Oregon chub are smaller still, with larvae found to be 6.2 to 16 mm in length. The size of adult Oregon chub is comparable to salmonid juveniles, ranging from 27-58 mm in studies of Willamette and Umpqua Oregon chub (Pearsons 1989). The largest Oregon chub on record measures 89 mm (Scheerer *et al.* 1995). As far as swimming performance, suckers are considered to be fairly active, strong swimmers (McGinnis 2006), which may help keep them from being entrained through or impinged on fish screens. Oregon chub are relatively weak swimmers (P. Scheerer, pers. comm. 2009) and could be more susceptible to entrainment or impingement, although they are not likely to be found in areas used for water diversions due to their preference for habitats with slack water and vegetative cover. Warner, Modoc, Lost River and shortnose sucker larvae are also found in shallow backwater pools or along stream margins where there is little to no current, often among or near vegetation. These habitats are not ideal locations for installing water diversions, which reduces the risk of CREP project-related diversions being located in areas that may cause adverse affects to Oregon chub or sucker larvae. In addition, all species will be at least somewhat protected by measures in the screening design criteria that are intended to keep fish away from the diversions (*e.g.,* intake placement; approach and sweeping velocities).

It is worth stating that water diversions under the CREP program are only proposed where needed to achieve restoration goals (*i.e.,* to provide temporary irrigation to native riparian plantings until they are established, or to fill watering facilities designed to move livestock away from sensitive resource areas). Risks will be minimized by the minor amount of water to be diverted (*i.e.,* no more than 0.5 cfs where listed suckers and Oregon chub occur) and the screening requirement for CREP project-related diversions under this programmatic consultation which will benefit all listed fish. The threat of entrainment through the screens is limited to the larval stages of the Oregon chub and the sucker species, and impingement is not expected to be an issue with the minor diversions proposed and the NOAA Fisheries design criteria that will be met. Any loss of fish is expected to be minimal. Threats that are being addressed by the CREP program, such as poor water quality and degraded habitat conditions, are recognized as ongoing and significant factors affecting the survival and abundance of all of the listed fish (ISRP 2005, USFWS 1995, 1998c & d, 1999a, 2007c & d, 2008a). Overall, CREP actions that improve habitat and water quality are expected to benefit all listed fish species and contribute toward their recovery.

5.3. Mechanical Effects

5.3.1. Terrestrial Habitats

Mechanical activities in terrestrial habitats are generally associated with the removal of invasive and non-native vegetation by disking, tilling or grubbing. Planting, mowing, creating vernal pools, breaking tile, and installing livestock fencing, crossings and watering facilities may also involve mechanical equipment and activities that result in ground disturbance. Most of the project sites will be in areas that have been degraded due to past and present agricultural activity that has reduced or eliminated habitat suitability for many species that depend on them.

Terrestrial habitats could be directly affected by any of the restoration activities that restore or enhance riparian, upland, wetland and estuarine areas. These activities will help to restore the composition and structural diversity of native plant communities and hydrological functions. Habitat modifications will be restricted to immediate project vicinities. Soil disturbance and compaction, or removal of some desirable woody and herbaceous vegetation, may occur on project sites requiring the use of heavy equipment. Important habitat features and native vegetation will be maintained to the extent possible during construction activities, although some may be impacted. Disturbed areas will be restricted to the minimum necessary to complete the restoration activities and the effects are expected to be short-term, or avoided altogether, because of the implementation of BMPs. Dispersal and travel corridors for wildlife will be improved as project sites are stabilized and native vegetation recovers over time.

5.3.2. Aquatic Habitats

Mechanical activities may cause temporary adverse affects to aquatic habitat. It is possible that some construction-related sediments may enter a water body due to soil disturbance and use of heavy equipment, particularly during in-water work activities. These sediments may appear as localized increases in turbidity due to fine sediment movement during the implementation of an activity. Sediment could also be carried by surface runoff when erosion control structures are removed. The time duration for turbidity increases is dependent on several factors, including:

- the type of erosion control structures installed at the project site;
- ability to remove sediments from behind work isolation structures before removal;
- amount of area that was originally disturbed and the local topography of the area;
- distance between the structure or activity and the water source, including the amount and type of filter materials in the buffer area; and
- time duration between the completion of the activity and onset of high flows or heavy rains.

There is the potential for short-term shade reduction from removal of riparian weeds, which could slightly affect stream temperatures or dissolved oxygen levels. This could cause short-term stress to fish adults, juveniles and eggs. There is also a slight potential for riparian restoration activities to initially affect aquatic and terrestrial insect populations, which would possibly reduce food availability for juveniles and adults.

Short-term positive environmental impacts of CREP include reduced sedimentation by reducing tillage for agriculture and livestock activity in sensitive areas, reduced introduction of agricultural chemicals into streams from adjacent croplands and increased bank stability.

The long-term effects of CREP projects to aquatic habitats are highly beneficial. Exclusion of livestock from streams will reduce bank erosion and sediment delivery and reduce the potential for fish spawning site destruction or egg trampling. Reestablishment of riparian vegetation will increase shade, lowering stream temperatures and allowing for higher dissolved oxygen levels. Riparian vegetation will also provide bank stability, and in some areas, encourage large woody debris, food and nutrient inputs to streams, all of which will enhance aquatic habitat.

Many BMPs that are designed to minimize short-term impacts to aquatic habitats and maximize long-term benefits are included as part of the action, as listed in sections 1.3 and 1.4. Several related to aquatic habitats are as follows:

- Whenever possible, livestock will be excluded from streams and riparian areas altogether.
- If livestock crossings are needed, livestock fords will only be constructed on the smallest streams, generally 10 feet or less in width at mean high water level. Fords will not be placed on the mid- to downstream end of gravel point bars. Fords will generally be 30 feet or less in width. Fords will be appropriately rocked to stabilize soils/slopes and prevent erosion. Fords will be placed on bedrock or stable substrates whenever possible.
- Off-channel livestock watering facilities will not be located in areas where compaction and/or damage could occur to sensitive soils, slopes, or vegetation due to congregating livestock.
- Sedimentation and erosion controls will be implemented on all project sites where the implementation of restoration activities has the potential to deposit sediment into a stream or waterbody. Structures/techniques must be placed and/or anchored appropriately to prevent

adverse impacts to down slope habitats. Control structures/techniques may include, but are not limited to, silt fences, straw bale structures, seeding by hand and hydro-seeding, jute mats, and coconut logs. Grading and shaping will generally restore natural topography and hydrology.

5.4. Chemical Effects

Long-term water quality effects from CREP projects are expected to be highly positive. The quality of water resources should improve over time because of the reduction or elimination of chronic sediment sources, control of point and nonpoint source pollutants, increased dissolved oxygen, and temperature abatement. However, the adverse effects discussed below are possible.

5.4.1 Restoration-related Chemicals

Possible adverse effects to terrestrial or aquatic species could occur from contact with chemicals from equipment leaks or fuel spills. Possible adverse effects to aquatic species include runoff of eroded sediment and adsorbed chemicals to streams. However, BMPs have been included as part of the action that greatly reduce the risks of potential adverse effects associated with chemicals. Several BMPs specifically address potential impacts from pollutants. Examples include ensuring that equipment staging and refueling areas are located at least 150 feet away from aquatic habitats, equipment is cleaned and inspected daily for leaks, appropriate materials and supplies are available on-site to clean up any accidental spills, etc. (see section 1.3.4 for BMPs specifically related to chemicals other than herbicides). With the BMPs in place, the risks of adverse affects to listed species from restoration-related chemicals are minimal.

5.4.2. Herbicide Applications

On many CREP projects, landowners or contractors apply herbicides to plants or soil (1) before planting trees, shrubs and other vegetation to reduce competing vegetation; (2) after planting to reduce competing vegetation and get the plantings to a “free-to-grow” condition; and (3) periodically throughout the life of the CREP contract to control noxious weeds and invasive plants. The decision of whether or not to use herbicides to control vegetation competing with CREP plantings over other control methods is based on integrated weed management principles. Decisions are made based on which methods or combinations of methods are known to be effective. In most cases, if an herbicide is selected, it is used in combination with other methods. For example, initial treatment on an invasive species may involve use of an herbicide, but then manual or mechanical methods are implemented as maintenance treatments over the long-term.

Herbicides interfere with plant metabolic processes, stopping growth and usually killing the plant. They may control all types of vegetation (non-selective herbicides), or they selectively control either some broadleaf plants or grasses while not affecting others (selective). Some herbicides may control only actively growing vegetation at the time of application, or they may provide invasive plant control through root uptake from the soil (short-term to over a few years). Those differences in selectivity are the basis for developing herbicide recommendations in CREP planting plans that strive to minimize adverse effects and facilitate success of the CREP plantings. The choice of herbicide is based on the target competing species, how it reproduces, its seed viability, the size of its population, site conditions, known effectiveness of treatments under similar site conditions and the ability to mitigate effects on non-target species.

Physical forms of herbicides vary. Some are oil- or water-soluble molecules dissolved in liquids, or attached to granules for dry application to soil surface. Each herbicide is sold as one or more commercial products, called formulations. In any case, product labels for each herbicide formulation provides legally binding directions on its use, including safe handling practices, application rates, and practices to protect human health and the environment. Label application restrictions can also limit the specific herbicides available to control any site-specific invasive plant infestations.

Herbicides may be applied with a variety of equipment and techniques. The techniques vary in effectiveness, environmental effects and costs. Herbicides may be spot sprayed with backpack sprayers, applied in granular form around seedlings planted through CREP, or sprayed via ground vehicles with hose sprayers or booms using an array of spray nozzles. Some application equipment is most often used for selective treatment and/or to minimize non-target effects. Backpack sprayers are most frequently used to spray the foliage, stem, and/or surrounding soil of target invasive plants. Other equipment includes herbicide-soaked wicks or paintbrushes for wiping target vegetation, and lances, hatches or syringes for injection of herbicide onto stems of target plants. Granular herbicides may be applied using hand-held seeders or other specialized dispensing devices.

Herbicides may move from their location of application through leaching (dissolved in water as it moves through soil), dissolution in surface runoff, volatilization (moving through air as a dissolved gas), spray drift and erosion (adsorbed by molecular electrical charges to soil particles that are moved by wind or water). In soil and water, herbicides may persist or be decomposed by sunlight, microorganisms, hydrolysis or other factors.

Generally, active ingredients have been tested on only a limited number of species and mostly under laboratory conditions. While laboratory experiments can be used to determine acute toxicity and effects to reproduction, cancer rates, birth defect rates, and other effects to fish and wildlife, laboratory experiments do not typically account for species in their natural environments and little data is available from studies focused specifically on the listed species in this BO. This leads to uncertainty in risk assessment analyses. Environmental stressors can increase the adverse effects of contaminants, but the degree to which these effects may occur for various herbicides is largely unknown. Lethal effects are possible, and sub-lethal adverse effects to fish and wildlife can occur that affect their ability to compete for food, locate and/or capture food, avoid or fight off predators or reproduce.

The potential effects of the CREP herbicide applications to various representative groups of species have been evaluated for each proposed herbicide, as presented in section 4.3.1 of the BA (incorporated by reference). The effects of herbicide applications using spot spray, hand/select, and broadcast spray methods were evaluated under several exposure scenarios, which were: (1) runoff from riparian (above high water mark) application along streams, lakes and ponds, (2) runoff from treated ditches and dry intermittent streams, and (3) application within perennial streams (dry areas within channel and emergent plants). The potential for herbicide movement from broadcast drift was also evaluated. Risks associated with the potential for exposure and associated affects were also evaluated for terrestrial species.

The risk of adverse effects to fish and wildlife and their habitats was evaluated in terms of hazard quotient (HQ) values and "no observable effect concentration" (NOEC) levels. Hazard quotients are calculated by dividing the expected environmental concentration by the effects threshold concentration. If this value is >1, then adverse effects are considered likely to occur.

In the effects analyses for listed fish and their critical habitats, hazard quotient values were calculated for fish, aquatic invertebrates, algae, and aquatic macrophytes. Adverse effect threshold values for each species group were defined as either 1/20th of the LC_{50} value for listed salmonids, 1/10th of the LC_{50} value for non-listed aquatic species, or the lowest acute or chronic NOEC, whichever was lower, found in available literature. Generally, effect threshold values for listed salmonids were lower than values for other fish species groups, so values for salmonids were also used to evaluate potential effects to other listed fish. In the case of sulfometuron methyl, threshold values for fathead minnow were lower than salmonid values, so threshold values for minnow were used to evaluate effects to listed fish.

Significant adverse effects to fish, and the aquatic invertebrate, algal, and aquatic macrophyte habitat elements, are likely to occur from herbicide use for CREP projects. However, the magnitude and areal extent of adverse effects to listed fish and critical habitat are likely to be low. Herbicides and application scenarios likely to adversely affect listed fish and associated species groups or habitat elements are summarized in Table 4, which was presented and discussed in section 4.3.1.4 of the BA. These findings are based on the detailed affects analyses included in section 4.3.1 and Appendix E of the BA (incorporated by reference), which were researched and written in large part by Rick Golden at NOAA Fisheries and are similar to affects analyses that have been completed recently for other Service and NOAA Fisheries consultations with the USFS in the Pacific Northwest (*e.g.,* formal consultation on the Invasive Plant Project with the Umatilla and Wallowa-Whitman National Forests completed in 2009).

Table 4. Herbicide treatments likely to adversely affect fish and associated species groups.

	Proposed Treatment Categories			
Species Group	Riparian Areas (above high water mark)	Ditches and Intermittent Channels	Perennial Channel Instream (dry areas within channel and emergent plants)	Broadcast Drift
Fish	glyphosate, picloram, triclopyr	glyphosate, dicamba, picloram, triclopyr	glyphosate, triclopyr	glyphosate, picloram, triclopyr
Aquatic Invertebrates	---	dicamba	---	---
Algae	chlorsulfuron, glyphosate, imazapyr, hexazinone, triclopyr, 2,4-D	glyphosate, imazapyr, dicamba, picloram, hexazinone, triclopyr,	---	dicamba, hexazinone, imazapyr, metsulfuron, sulfometuron, triclopyr, 2,4-D
Aquatic Macrophytes	chlorsulfuron, imazapyr, metsulfuron, sulfometuron, hexazinone, picloram, triclopyr, 2,4-D	imazapic, imazapyr, dicamba, picloram, hexazinone, triclopyr	---	chlorsulfuron, hexazinone, imazapic, imazapyr, metsulfuron, sulfometuron, triclopyr, 2,4-D

The following has been excerpted from section 4.3.1.4 of the BA to describe the effects of the proposed herbicide use and provide a narrative summary of the information presented in Table 4:

> *"Significant adverse effects to listed fish are likely to result from glyphosate and triclopyr application in all four treatment categories (riparian, ditch/dry intermittent channels, perennial streams, and broadcast drift), from picloram in three treatment categories (riparian, ditch/intermittent channels, and broadcast drift), and dicamba in one treatment category (ditches/intermittent channels). Significant adverse effects to listed fish from short-term exposures to low (i.e. single digit) HQ exceedences are reasonably likely to occur – for example, increased respiration, reduced feeding success, impaired olfactory function, and subtle behavioral changes that can increase predation risk. When treatments occur that utilize two or more herbicides in close proximity, exposures to mixtures may occur.*
>
> *Exposures to estimated maximum concentrations of chlorsulfuron, aminopyralid, clopyralid, imazapyr, imazapic, sulfometuron, metsulfuron, hexazinone, 2,4-D, and sethoxydim are not likely to result in adverse effects to listed fish. However, simultaneous exposure to these herbicides may increase the level of adverse effects from glyphosate, triclopyr, picloram, or dicamba exposure. Additional adverse effects from co-exposure are most likely to manifest as an additive, and not synergistic, response in fish. Dose addition is considered most appropriate for mixtures with components that affect the same endpoint by the same mode of action, and are believed to behave similarly with respect to uptake, metabolism, distribution, and elimination (Choudhury et al. 2000). The precise toxic mechanisms in fish are not clearly documented for the 14 herbicides contained in the activity description, but effects to the kidney and liver are typical endpoints in terrestrial wildlife. In addition, it is known that the proposed herbicides are relatively soluble and have bioconcentration factors that fall within a range that does not indicate bioconcentration risk (all bioconcentration factors <32). Thus, it is believed that the assumption of similar uptake, metabolism, distribution, and elimination is adequately met in fish for dose-addition analysis at low concentrations.*
>
> *Significant adverse effects to aquatic invertebrates are only likely to occur from dicamba exposure resulting from application in ditches/intermittent channels approaching the maximum labeled rate.*
>
> *As summarized in Table 17* [Table 4 above], *adverse effects to algae and aquatic macrophytes are likely to result from herbicide application in riparian areas, ditches/intermittent channels, and from broadcast drift. Adverse effects to algae and aquatic macrophytes that translate to significant indirect adverse effects (via alteration in food supply, cover, etc.) to listed fish may not result from brief exposures to herbicide concentrations causing lower (single digit) HQ exceedences. The highest risk to aquatic macrophytes is from intensive application to ditches where the HQ values for ditch effluent at stream channel confluences can potentially be greater than 10 (imazapic and triclopyr) or 100 (dicamba, hexazinone, and imazapyr).*
>
> *The chronic exposure analysis determined that adverse effects to aquatic macrophytes are likely for chlorsulfuron when 10 or more streamside acres are treated at application rates greater than about 0.08 pounds a.i./acre (0.056 pounds a.i./acre is the typical rate,*

and 0.25 pounds a.i./acre is the maximum rate). No other chronic effect risks were identified.

Since the herbicides included in the activity description target four different plant metabolic pathways, additive and synergistic effects to aquatic macrophytes may occur when co-exposure to multiple herbicides results from treatments utilizing two or more herbicides in close proximity."

The use of herbicides inherently poses significant potential risks to listed plants. In the effects analyses for listed plants, and host plants for the Fender's blue butterfly, risks associated with the proposed herbicides were evaluated by considering the soil half-life, foliar half-life, movement rating, mode of uptake and estimates of drift from broadcast and hand applications. It is also possible that the Fender's blue butterfly could be harmed by coming into contact with herbicides. BMPs were developed that place limitations on herbicide use and application methods and include protective measures that will greatly reduce the potential for exposure that could result in harm to the butterfly and listed plants.

Abbreviated herbicide effect analyses that are relevant to the Service's listed species are included in the discussions by species below in section 5.5.

5.5. Summary of Effects to Listed Species and Critical Habitats

The Service worked closely with FSA to incorporate BMPs into the proposed action that are designed to avoid and minimize adverse effects to listed species that could occur from restoration activities, although some short-term or minor adverse effects are not completely avoidable and are still reasonably certain to occur. The Service also worked with FSA to develop the effect analyses that are included in the BA for the listed species in this consultation, and used the discussions from the BA in developing the sections on the effects to listed species below. NOAA Fisheries staff assisted FSA extensively with the effects analyses and the interpretation and use of the best available information (*e.g.,* SERA risk assessments) related to the proposed herbicide use. The Service's evaluation of herbicides relies on the findings from the herbicide effects analyses presented in the BA, with acknowledgement that there are inherent uncertainties with regards to the risk of exposure and effects of herbicides on listed species.

5.5.1. Inland Fish

The types of restoration activities implemented under the Oregon CREP are identified as needed recovery actions in the draft and final recovery plans for the Warner sucker, Lost River sucker, shortnose sucker, Oregon chub, Lahontan cutthroat trout and bull trout, and are expected to contribute towards the recovery of listed fish species over the long-term. Some short-term adverse affects are likely to occur during project construction and as project sites are becoming established. Minor long-term adverse affects are possible at some sites due to the permanent footprint needed for facilities such as livestock crossings or watering troughs that may require the removal of a small amount of native vegetation, or for ongoing minor water diversions to maintain water in off-channel livestock watering facilities. However, the potential for adverse affects to listed species will be avoided or greatly minimized by the BMPs, and net benefits are expected as the overall purpose of each CREP project is to improve fish and wildlife habitat and water quality. More detailed discussions about the effects to specific listed fish species are discussed below in sections 5.5.1.1 through 5.5.1.6.

5.5.1.1. Bull trout

The potential effects of CREP projects on bull trout and their critical habitats are comparable within the two interim recovery units that occur in the action area (*i.e.,* Columbia River and Klamath River), and therefore the effects discussions apply to both areas. Bull trout require streams with high channel complexity, clean substrate and cold water. They are vulnerable to many of the same threats that have reduced salmon populations. Due to their need for very cold waters and a long incubation time, bull trout are more sensitive to increased water temperatures, poor water quality and degraded stream habitat than many other salmonids.

CREP activities could result in adverse effects to bull trout and some of the PCEs of designated bull trout critical habitat. Most adverse effects are expected to be short-term in duration, although some fairly small scale long-term adverse effects may occur in situations where a net long-term benefit to habitat or water quality is expected (*e.g.,* loss of native vegetation within the immediate vicinity of a livestock crossing). Specifically, the potential adverse effects to fish may result from a loss of vegetation, shade reduction, water withdrawals, sedimentation, turbidity, soil compaction, impacts from herbicides and other chemicals and direct disturbance to fish during project construction. PCEs involving water temperature, suitable substrate and an abundant food base may be adversely affected over the short-term. While negative impacts are possible, design criteria and BMPs are in place to avoid and minimize the potential risks to listed species, as discussed below.

Loss of vegetation and shade

Reduced shade over streams due to construction activities or after weeds are removed and before native vegetation becomes established could slightly increase water temperatures over the short-term. Consequently, it is possible that the optimal temperature range for bull trout in streams where bull trout occur and in designated critical habitats could be exceeded or result in reduced oxygen levels that could cause stress to bull trout or their prey in the short-term. However, shade loss that significantly affects water temperature is likely to be rare, occurring primarily from treating large-scale streamside monocultures (*e.g.,* knotweed and blackberry), and possibly from cutting streamside woody species (*e.g.,* tree of heaven, scotch broom, etc.).

The loss of shade would persist until native vegetation reaches and surpasses the height of the invasive plants that were removed. Shade recovery may take one to several years, depending on the success of invasive plant treatment and revegetation, stream size and location, topography, growing conditions for the replacement plants, and the density and height of the invasive plants when treated. Some possible long-term negative impacts to fish are possible due to vegetation and shade reduction associated with livestock watering devices and stream crossings. Vegetation removal to create livestock crossings could reduce overhead cover and shade at some sites, but this impact would be very small-scale and riparian vegetation improvements along the remainder of the stream are expected to more than compensate for this loss and significantly improve upon degraded riparian areas. In addition, a BMP is in place that limits the removal of any native vegetation to the amount that is necessary to complete a construction activity.

Water withdrawals

Water withdrawals from streams for CREP project site irrigation (*i.e.,* watering native plantings as they are becoming established) or to maintain water in livestock watering facilities could potentially reduce stream flows during low flow periods. However, the amount of water to be diverted to irrigate or fill watering facilities is not expected to be significant, will not exceed existing water rights, and a BMP is in place to avoid creating or exacerbating low flow conditions that could impact listed fish. In addition, irrigated areas will typically be riparian zones that drain back toward the stream; water loss from transpiration and evaporation is not expected to exceed natural riparian conditions.

If water is pumped from streams in areas with listed fish, including bull trout, fish screens that meet NOAA Fisheries screening criteria (NMFS 2008) will be used with a requirement that they be kept clean and in properly functioning condition. The NOAA Fisheries screening criteria are expected to address the needs of bull trout and Lahontan cutthroat trout (the salmonids addressed in this consultation) due to their similarities with the anadromous salmonids upon which the criteria are based. The Service currently encourages the use of the NOAA Fisheries criteria in areas where listed species occur. While the criteria may not fully address the needs of all fish species, the Service believes that diversions such as those proposed in the CREP program that are screened in accordance with the criteria are not likely to result in take of bull trout (USFWS 1999c).

Sedimentation and turbidity

Sediment delivery could occur that results in short-term water quality impacts or increased substrate embeddedness due to site preparation activities that could cause erosion, such as tillage and invasive species removal. Driving vehicles in the riparian area could increase soil compaction, reducing infiltration and increasing the risk of erosion or making vegetation establishment more difficult. Sediment could be stirred up in the stream or erode from the banks during construction of livestock crossings, watering facilities or re-shaped banks to improve bank slopes for planting. Hand pulling of emergent vegetation is likely to result in localized turbidity increases and mobilization of fine sediments, with the degree of effect proportionate to the extent of the infestation treated, type of substrate in which the plants are rooted, rooting depth, and whether or not hand tools are required (such as a weed wrench, shovel, etc.).

Increased turbidity can disturb or harm listed fish. Localized turbidity increases are likely to cause some juveniles and adults to seek alternative habitat, which could contain suboptimal cover and forage and cause increases in behavioral stress (*e.g.,* avoidance and displacement), and sub-lethal responses (*e.g.,* increased respiration, reduced feeding success, and reduced growth rates). Turbidity and sediment can also reduce embryo survival and juvenile bull trout rearing densities. Fine sediments can clog gravel interstices, reducing water flow over the eggs and limiting oxygen delivery, removal of metabolic wastes, and the ability of fry to emerge. Excessive sediment can clog the gills of juvenile fish, reduce prey availability, and reduce juvenile success in catching prey.

While sedimentation and turbidity could increase in the stream from CREP projects over the short-term, CREP program BMPs are in place to control erosion with the aim of preventing sediment from entering the stream from adjacent areas. In addition, the size, area, locations and construction timing of instream and streambank projects is limited to avoid and minimize impacts to fish. For instance, Oregon guidelines for the timing of in-water work will be followed or modified by ODFW if needed to better protect resident listed fish. Stream crossings will not be placed within 300 feet upstream of known or suspected spawning areas. Streambank shaping will only be implemented where streambank stability is extremely poor or where necessary to restore riparian functions, and will not exceed 30 linear feet of streambank on an individual CREP site under this programmatic consultation. Livestock stream crossings will only be constructed on small streams (generally 10 feet wide or less), and will be appropriately rocked to stabilize soils/slopes and prevent erosion. See sections 1.3 and 1.4.1 for a complete listing of the BMPs that will be followed in areas that may be occupied by bull trout.

Chemicals from mechanical equipment

There is some potential for adverse affects to fish due to exposure to chemicals from mechanized equipment used during construction and tillage, and the use of fuel to run water pumps for irrigation or livestock watering due to fuel spills or leaks in riparian areas or streams. However, BMPs are in place to prevent and minimize the risk of fish becoming exposed to chemicals. For instance, equipment staging and refueling areas will be located at least 150 feet from any stream or other water body, and any stationary equipment within 150 feet of aquatic habitat must be diapered to prevent leaks and/or enclosed in a containment device (*e.g.,* non-permeable drip pan) of adequate capacity to retain equipment fluids (*e.g.,* gasoline, diesel fuel, and oil) if a leak occurs. All equipment will be cleaned and inspected daily for fuel leaks. All detected leaks must be repaired in the staging area before the equipment resumes operation.

Herbicides

The use of herbicides poses risks to bull trout. Herbicides applied to control invasive and competing vegetation on CREP revegetation sites may enter streams through drift, spillage, or overspray; be dissolved and travel to streams in surface runoff; or be attached to sediment particles that run into streams. The herbicide-related BMPs outlined in sections 1.3.3 and 1.4 will be followed, and the proposed herbicides, application methods and use zones are limited as discussed in section 2.3.2.1 of the BA (incorporated by reference), but herbicides could still reach areas where bull trout and their critical habitats occur and cause adverse affects. Herbicide delivery to surface water can result in mortality to fish during incubation, or lead to altered development of embryos. Mortality or sub-lethal effects such as reduced growth and development, decreased predator avoidance, or modified behavior could occur. Herbicides can also impact the food base for bull trout and other fish, which includes terrestrial organisms of riparian origin, aquatic macroinvertebrates and forage fish.

Forage and water quality are related to the PCEs of critical habitat for bull trout. Herbicides can kill or affect growth of fish prey items or affect the growth of aquatic plants that fish or their prey species consume, decreasing food availability. In addition, reduction in cover due to killing non-target vegetation increases the vulnerability of fish to predation. The effects of herbicide applications to other critical habitat PCEs should be minimal. Herbicides may temporarily reduce cover along streams, but the vegetation removed will generally be non-native vegetation and restoration of native species will result in long-term benefits to critical habitat. See additional discussion related to the effects of herbicide applications in section 5.4.2.

Benefits

CREP projects will benefit bull trout and their critical habitat, and support many of the actions identified in the draft bull trout recovery plan (USFWS 2002b, USFWS 2004c). Over the long-term, it is anticipated that streams will become more complex with habitat features such as woody debris, pools and undercut banks as riparian areas are improved. If projects affect stream hydrographs, they are likely to more closely resemble natural conditions due to improved wetland, riparian and floodplain functions and the leasing of instream water rights to maintain or restore stream flows needed for spawning, egg survival, larval development and migration. Wetland restoration such as breaking tiles and restoring native plant communities increases water storage in wetlands and floodplains, creating additional fish habitat and enhancing subsurface flow into streams during the summer. Some wetland restoration projects may also benefit estuarine areas, which are critical to migrating salmonids as they transition between fresh water and saltwater. Springs used for livestock watering facilities are likely to continue to contribute to stream flows. The purpose of watering facilities is to address water quality concerns by removing livestock from sensitive areas and using erosion control measures that address sedimentation problems.

Exclusion of livestock from riparian areas and streams should lessen physical disturbance to fish immediately, and reduced sediment delivery is expected to result in more suitable spawning sites, better water quality and increased egg-to-fry survival. Establishment of native trees, shrubs, grasses and forbs along streams will increase shade, increase dissolved oxygen levels, and promote instream habitat complexity. Tillage and deep ripping to facilitate tree planting will reduce soil compaction, increasing infiltration and soil storage capacity and enhancing the health and growth of riparian plant communities. Increased riparian vegetation and instream cover should increase aquatic insect populations, enhancing food availability for fish.

Overall effects to bull trout critical habitat are expected to be highly beneficial by reducing trampling and sedimentation in spawning areas, improving water quality, increasing shade, reducing stream temperatures, increasing overhanging banks and other refugia, increasing food availability and increasing large woody debris. Projects that improve wetlands and floodplains can help protect and restore habitat by controlling erosion, recycling organic and inorganic nutrients, maintaining or improving water quality, and increasing natural water storage capacity and release that can improve stream flows.

In summary, while CREP projects in areas with bull trout are expected to benefit the species and its critical habitat over the long-term, and BMPs will be followed that will avoid and minimize many potential impacts of CREP activities, we agree that some CREP activities may affect, and are likely to adversely affect bull trout and their critical habitat, mostly over the short-term. Adverse affects may result from increases in turbidity, fine-sediment deposition, disturbance of individuals during instream work, exposure to herbicides, and adverse effects to algae, aquatic macrophytes and aquatic macroinvertebrates from herbicides and sedimentation.

5.5.1.2. Lahontan Cutthroat Trout

The potential effects to Lahontan cutthroat trout are similar to those described for bull trout (see section 5.5.1.1). However, one difference is that herbicide use for all species under the Service's jurisdiction except for bull trout is limited to chemicals and measures that are expected, based on the combined results of all of the herbicide analyses presented section 4.3.1 and Appendix E of the BA (incorporated by reference), to result in exposures that are below threshold risk levels (HQ values less than 1 or NOAC levels) for fish as well as aquatic invertebrates, algae and aquatic macrophytes. Aquatic invertebrates, algae and macrophytes were evaluated because they are susceptible to adverse affects from herbicides, are related to the PCEs for designated and proposed critical habitats and provide food resources for listed fish. The specific herbicide limitations that apply to listed inland fish are described in section 1.4.1. The BMPs limit the specific herbicides, application rates, rainfall levels and distances from aquatic resources to only those that were found in the analyses to be below the threshold risk levels for all evaluated species groups. Therefore, as proposed with the BMPs, the risk of adverse effects from herbicide use on CREP projects has been greatly reduced and potentially avoided for Lahontan cutthroat trout, Oregon chub and the listed suckers.

Temporary loss of shade after weeds are removed and before native vegetation is established could be of concern for Lahontan cutthroat trout. However, this species is not as susceptible to higher water temperatures as some of the other listed fish. They have been found to be tolerant of high temperatures (>20 C) and large daily fluctuations of up to 20 C (Behnke 1992, LaRivers 1962), although they do require spawning and nursery habitat that is characterized by cool water and relatively silt free rocky substrate in riffle-run areas (USFWS 1995). CREP projects could result in increased stream sediment during project construction and as restoration sites are becoming stable, but this is expected to be minimized with the BMPs in place.

While the potential for adverse affects has been greatly reduced through the BMPs, we agree with FSA's determination that some CREP activities may affect, and are likely to adversely affect the Lahontan cutthroat trout. Adverse effects may include short-term, localized increases in turbidity, fine-sediment deposition and direct disturbance of individuals during instream work periods. Water quality is a key habitat factor for Lahontan cutthroat trout (USFWS 1995). Any loss of shade and increased temperatures that result will be short-term in duration or minimal in scale. Risks associated with exposure to chemicals from equipment are possible, but are low due to the precautions to be taken in accordance with the BMPs. While herbicide use will be limited to chemicals and methods designed to avoid adverse affects to inland fish such as the Lahontan cutthroat trout, there are inherent risks associated with the use of herbicides and uncertainties in the herbicide analyses, and it is possible that herbicide delivery to aquatic habitat could still adversely affect this species or its habitat.

Overall, any CREP projects in areas with Lahontan cutthroat trout are expected to benefit the species over the long-term as habitat and water quality are improved. The CREP program supports actions that have been identified in the recovery plan, such as promoting voluntary partnerships with private landowners to manage and improve Lahontan cutthroat trout habitat (USFWS 1995). CREP projects will address some of the threats to this species, such as habitat loss associated with livestock grazing practices (by fencing, installing crossings and building watering facilities to protect sensitive areas), water diversions (by leasing water rights for instream use) and poor water quality (by restoring riparian areas and wetlands).

5.5.1.3. Warner Sucker

The Warner sucker occurs in streams (including headwaters), lakes and associated marshes. CREP activities may occur on those portions of occupied Warner sucker habitat that are privately owned agricultural lands. Land on the floor of the Warner Valley is primarily in private ownership and used for cattle grazing and crop production. Away from the valley floor, much of the habitat used by the Warner sucker is within BLM holdings (USFWS 1995), which are not eligible for CREP.

The potential effects to the Warner sucker are similar to those described for the previously discussed listed fish (see discussions in sections 5.5.1.1 and 5.5.1.2), with the herbicide use limitation as described in the Lahontan cutthroat trout section above (see section 5.5.1.2). However, one difference is that the larvae of the Oregon chub and sucker species addressed in this consultation are assumed to be more susceptible to entrainment due to their small size and differences in swimming performance compared to Pacific salmon, bull trout and Lahontan cutthroat trout fry (see discussion in section 5.2.2). To address this issue, on CREP projects where listed suckers or Oregon chub may be affected, pumps may only be installed under this programmatic consultation if water delivery will be under 0.5 cfs (minor volume diversions) and the number of operational water diversions covered under this consultation will be limited per the terms and conditions (see section 8.4). CREP projects involving the installation of pumps for water diversions over 0.5 cfs in habitat for the Oregon chub or listed suckers will be evaluated under separate consultations on an as-needed basis so that fish screens and other site-specific design criteria can be developed to further minimize potential adverse affects to the species.

In any case, eligible pumps associated with CREP projects must be screened to meet NOAA Fisheries' fish screen criteria, be self-cleaning or regularly maintained (by removing debris buildup), and a responsible party must be designated to ensure proper operation (*i.e.,* regular inspection and as-needed maintenance to ensure pumps and screens are properly functioning). While some entrainment or impingement of suckers is possible, the screens and minor amount of water to be diverted for projects under this programmatic consultation will greatly reduce potential losses. Adults will be large enough to be kept out by the screens, and the diversions will be small with relatively low currents, further reducing the risk of entrainment or impingement. The larval stage is the primary stage that will be vulnerable. Sucker larvae are produced in large numbers and suffer very high rates of natural mortality, thus their loss due to entrainment is generally not currently considered to be a substantial threat at the population level for Lost River and shortnose suckers (ISRP 2005, USFWS 2007c,d) and presumably Warner and Modoc suckers as well. A BMP for water diversions is also in place to avoid creating or exacerbating low flow conditions that could adversely affect listed fish.

Sedimentation and turbidity caused by CREP activities could impact the silt-free, gravel bottomed flowing sections of creeks used by the Warner sucker for spawning. However, this is not expected to be a great concern with the limited activities proposed and the BMPs in place. Installation of livestock crossings and installation of offstream livestock watering facilities are the only instream activities covered by this programmatic consultation. Up to 30 linear feet of streambank at a site may be re-shaped for the installation of livestock crossings, where bank stability is extremely poor or where necessary to restore riparian functions. The goal of these types of projects is to reduce erosion and water quality problems in sensitive areas and improve riparian vegetation. Instream crossings will not be placed in areas used for spawning or within 300 feet upstream of spawning areas, and the Oregon guidelines for the timing of in-water work will be followed unless otherwise allowed to better meet the needs of resident listed fish.

As with the other listed fish species, habitat complexity is important to the Warner sucker. Shallow backwater pools, stream margins where there is no current, deep still pools and faster-flowing areas near the heads of pools are all important at various periods in the life history of the Warner sucker. Adults occupy stretches of stream where the gradient is low enough to allow the formation of long pools. These pools tend to have undercut banks, large beds of aquatic plants, root wads or boulders, a vertical temperature differential of at least 2 degrees Celsius, a maximum depth of 1.5 meters, and overhanging vegetation.

While weed removal may temporarily reduce shade and overhanging vegetation, replacement with native species is likely to improve habitat complexity and features such as pools and undercut banks over the long-term. During project construction instream or elsewhere, there is potential for erosion and sediment delivery to streams, but this will be minimized by the BMPs. Once established, revegetated and restored areas are expected to help retain soils as well as provide other ecological functions that will improve instream, riparian and floodplain habitats.

Critical habitat for the Warner sucker includes 50 feet on either side of the stream banks of designated streams. PCEs of Warner sucker critical habitat include streams 15 feet to 60 feet wide with gravel-bottom shoal and riffle areas and intervening pools. Streams should have clean, unpolluted flowing water and a stable riparian zone. The streams should support a variety of aquatic insects, crustaceans, and other small invertebrates for food. Activities that could adversely affect the Warner sucker or adversely modify its critical habitat include application of herbicide in or near streams or lakes inhabited by the Warner sucker, which could be toxic to this species or its food, pollution of stream or lake habitat by silt or other pollutants, and removal of natural vegetation within or along streams (USFWS 1985a).

Generally, any CREP projects that occur in areas with Warner sucker are expected to benefit the species and its critical habitat over the long-term as stream and riparian habitats are improved. CREP projects will address some of the threats to this species by fencing livestock away from streams, improving riparian and stream conditions and leasing water rights for instream flows. BMPs will be followed that will avoid and minimize many of the potential adverse impacts of CREP activities. BMPs that limit, but still allow some herbicide use in areas where this species may occur will greatly reduce the potential for adverse effects to the species while restoration projects move forward under this programmatic consultation.

In summary, while the potential for adverse affects has been greatly reduced through the BMPs, the Service agrees with FSA's determination that some CREP activities may affect, and are likely to adversely affect the Warner sucker and its critical habitat. Adverse effects may result from short-term increases in turbidity, fine-sediment deposition and direct disturbance of individuals during instream work and due to the potential entrainment of larval suckers. Any loss of shade and increased temperatures that result will be short-term in duration or minimal in scale. Risks associated with exposure to chemicals from equipment are possible, but are low due to the precautions to be taken in accordance with the BMPs. While herbicide use will be limited to chemicals and methods designed to avoid adverse affects to inland fish, there are inherent risks associated with the use of herbicides and uncertainties in the herbicide analyses, and it is possible that herbicide delivery to aquatic habitat could still adversely affect this species or its habitat.

CREP projects that occur in areas that support this species are expected to benefit the species and its critical habitat over the long-term and contribute to its recovery by improving habitat conditions on non-federal lands. The recovery plan calls for the actions that are implemented through the CREP program, such as working with landowners to make land management changes that will maintain or improve Warner sucker habitat while still providing for the social and economic value of those lands, improving poor quality habitat conditions, developing livestock watering facilities to protect and restore high quality habitats, improving stream flows (*e.g.,* by leasing water rights for in-stream use) and providing funding assistance to implement these and other recovery actions on non-Federal lands (USFWS 1998c).

5.5.1.4. Shortnose and Lost River Suckers

The potential effects to shortnose and Lost River suckers and their proposed critical habitats are similar to those described for the other listed fish discussed above (see sections 5.5.1.1, 5.5.1.2 and 5.5.1.3).

The shortnose and Lost River suckers are found in the deeper water of lakes and streams. Springs or streams are used for spawning, preferably in areas with gravel or cobble and a fairly shallow shoreline with an abundance of aquatic vegetation. Shoreline vegetation in both lake and stream habitats is important for the rearing of larval and juvenile suckers. PCEs of proposed critical habitats for these species include water that is of sufficient quantity and quality (*i.e.,* temperature, dissolved oxygen, flow rate, pH, nutrients, lack of contaminants, turbidity, etc.) to provide conditions required during the various life stages of each species; physical habitats for use as refugia, spawning, nursery, feeding, corridor or rearing areas; and a biological environment with an adequate food supply and a natural scheme of predation, parasitism, and competition.

Some of the factors that have contributed to the decline of the shortnose and Lost River suckers and their habitats include loss of aquatic and riparian vegetation which has lead to increases in stream temperatures, high levels of nutrients, reduction in food resources, unnaturally high levels of predation and competition, and serious sedimentation and turbidity problems in streams. Such water quality problems have reduced the availability of suitable sucker habitat and have resulted in major fish mortality. Other factors affecting the decline of these species include pollution from pesticides, herbicides and other chemicals and altered stream flows (USFWS 1988a).

Proposed critical habitat for the Lost River and shortnose suckers includes designated streams as well as the area needed provide long-term stream function, which has been described as the associated 100-year FEMA floodplains, or 300-foot wide setbacks if floodplains are not mapped (USFWS 1994). CREP activities will primarily take place within these streamside areas. Generally, any CREP projects that may occur in areas with shortnose or Lost River sucker are expected to improve current conditions for these species as habitat is improved. The CREP program is designed to address some of the threats to these species through activities such as fencing portions of streams to reduce cattle-caused erosion, restoring native vegetation to riparian areas, improving water quality by altering agricultural practices and leasing water rights for instream use. Projects that improve wetlands and floodplains can help protect and restore sucker habitat by controlling erosion, recycling organic and inorganic nutrients, maintaining or improving water quality, and increasing natural water storage capacity and release that can improve stream flows.

At the time of listing, loss of juvenile and adult shortnose and Lost River suckers in unscreened irrigation diversions was identified as a significant risk factor for these species. Since that time, significant efforts have been made to address this threat by screening diversions. Some of the most problematic diversions have now been addressed, and at this time, most remaining unscreened small diversions are not believed to pose a serious threat to listed sucker populations. Part of the reason for this is that suckers that are most susceptible to entrainment by small diversions are larvae, which are produced in large numbers and suffer very high rates of natural mortality (ISRP 2005).

Requiring that all CREP project-related diversions be screened will minimize the risks to suckers, and the number of operational water diversions covered under this consultation will be limited per the terms and conditions (see section 8.4). Very few diversions are anticipated; from 1998 through 2009, only three stream diversions for off-site water facilities have been installed in Klamath County (L. Loop, pers. comm. 2009). While some entrainment or impingement of suckers is possible, the screens will greatly reduce potential losses. Adults will be large enough to be kept out by the screens, and the diversions will be small with relatively low currents, further reducing the risk of entrainment or impingement. The larval stage is the primary stage that will be vulnerable, but as stated earlier, sucker larvae are produced in large numbers and suffer very high rates of natural mortality, thus their loss due to entrainment is not currently considered to be a substantial threat at the population level (ISRP 2005, USFWS 2007c,d).

BMPs will be followed that will avoid and minimize many of the potential impacts of CREP activities. CREP projects involving the installation of pumps for water diversions over 0.5 cfs in habitat for this species will be evaluated under separate consultations on an as-needed basis so that fish screens and other site-specific design criteria can be developed to minimize potential adverse affects to the species. A BMP is in place to avoid creating or exacerbating low flow conditions that could adversely affect listed fish. The BMPs that limit, but still allow some herbicide use in areas where these species may occur, greatly reduce the potential for adverse effects to the species while restoration projects move forward under this programmatic consultation.

While the potential for adverse affects to these species has been greatly reduced through the BMPs, the Service agrees with FSA's determination that some CREP activities may affect, and are likely to adversely affect the shortnose and Lost River suckers and their proposed critical habitats. Adverse effects may include short-term decreases in aquatic and streamside vegetation, increases in turbidity, fine-sediment deposition and direct disturbance of individuals during instream work and due to the potential entrainment of larval suckers. Any loss of shade and increased temperatures that result will be short-term in duration or minimal in scale. Risks associated with exposure to chemicals from equipment are possible, but are low due to the precautions to be taken in accordance with the BMPs. While herbicide use will be limited to chemicals and methods designed to avoid adverse affects to inland fish, there are inherent risks associated with the use of herbicides and uncertainties in the herbicide analyses, and it is possible that herbicide delivery to aquatic habitat could still adversely affect these species or their habitats.

CREP projects that occur in areas that support this species are expected to benefit the species and their proposed critical habitats over the long-term and contribute toward their recovery. CREP projects will support some of the actions identified in the recovery plan for these species by restoring riparian areas and wetlands and their functions, augmenting base flows, and implementing other actions that will reduce the impacts of grazing and farming and improve habitat and water quality (USFWS 1993d).

5.5.1.5. Modoc Sucker

The potential effects to the listed fish discussed above are similar to those for the Modoc sucker (see sections 5.5.1.1, 5.5.1.2, 5.5.1.3 and 5.5.1.4).

Preferred habitat of the Modoc sucker consists of small streams characterized by large shallow pools with cover, soft sediments, and clear water. Food consists of benthic invertebrates, algae, and detritus. During spring spawning runs, the species ascends creeks or tributaries that may be dry during summer months (*i.e.,* ephemeral and intermittent streams). According to the critical habitat designation for this species, constituent elements of Modoc sucker habitat include intermittent and perennial creeks and surrounding areas (50-feet on either side of streams) that provide vegetation for cover and protection from erosion (USFWS 1985a). No critical habitat for Modoc sucker has been designated in Oregon; the species was only recently rediscovered in the state.

Threats faced by Modoc sucker, and opportunities for CREP projects to address them, are similar to those described for other listed fish. Any CREP projects that may occur in areas with Modoc sucker are expected to improve current conditions for this species as habitat and water quality is improved. CREP activities such as fencing portions of streams to reduce cattle-caused erosion, replanting streambanks with native vegetation, improving agricultural practices, leasing water rights for instream use, and improving wetlands and floodplains can help protect suckers and their habitat by controlling erosion, supporting the food web, providing inputs of woody material, increasing channel complexity, recycling organic and inorganic nutrients and maintaining water quantity and quality.

BMPs will be followed to avoid and minimize many of the potential adverse impacts of CREP activities. CREP projects involving the installation of pumps for water diversions over 0.5 cfs in habitat for this species will be evaluated under separate consultations on an as-needed basis so that fish screens and other site-specific design criteria can be developed to minimize potential adverse affects to the species. Allowing screened diversions for only those projects involving 0.5 cfs or less will minimize the risk of suckers becoming entrained or impinged on the screens due to the minimal flows. In addition, the number of water diversions covered under this consultation that can be operational at any one time is limited per the terms and conditions (see section 8.4), as based on the low number of diversions that have been installed for CREP projects from 1998 through 2009 (L. Loop, pers. comm. 2009). A BMP is also in place to avoid creating or exacerbating low flow conditions that could adversely affect listed fish. The BMPs that limit, but still allow some herbicide use in areas where these species may occur should reduce the potential for adverse effects to the species while restoration projects move forward under this programmatic consultation. BMPs are in place to avoid and reduce the potential for projects to increase sedimentation and turbidity over the short-term as projects are becoming established.

While the potential for adverse affects has been greatly reduced through the BMPs, the Service agrees with FSA’s determination that some CREP activities may affect, and are likely to adversely affect the Modoc sucker. The will be no effect on Modoc sucker critical habitat. Adverse effects to the species involving a small amount of take is likely to result from decreases in aquatic and streamside vegetation, increases in turbidity, fine-sediment deposition and direct disturbance of individuals during instream work and due to the potential entrainment of larval suckers. Any loss of shade and increased temperatures that result will be short-term in duration or minimal in scale. Risks associated with exposure to chemicals from equipment are possible, but are low due to the precautions to be taken in accordance with the BMPs. While herbicide use will be limited to chemicals and methods designed to avoid adverse affects to inland fish, there are inherent risks associated with the use of herbicides and uncertainties in the herbicide analyses, and it is possible that herbicide delivery to aquatic habitat could still adversely affect this species.

CREP projects that occur in areas that support the Modoc sucker are expected to benefit the species over the long-term and contribute toward its recovery.

5.5.1.6. Oregon Chub

The potential effects to the listed fish discussed above are similar to those for the Oregon chub (see sections 5.5.1.1, 5.5.1.2, 5.5.1.3, 5.5.1.4 and 5.5.1.5).

Oregon chub are found in slack water off-channel habitats such as beaver ponds, oxbows, side channels, backwater sloughs, low gradient tributaries, and flooded marshes. Refugia populations also occur in isolated ponds. These habitats usually have little or no water flow, silty and organic substrate, and aquatic vegetation as cover for hiding and spawning. Adults feed on the larvae of aquatic invertebrates, such as mosquitos and other insects. Adult Oregon chub seek dense vegetation for cover and frequently travel in the mid-water column in beaver channels or along the margins of aquatic plant beds. Larval chub congregate in near shore areas in the upper layers of the water column in shallow areas. Juvenile Oregon chub venture farther from shore into deeper areas of the water column. In the winter months, Oregon chub can be found buried in the detritus or concealed in aquatic vegetation.

Some of the factors responsible for the decline of the chub that may be addressed by CREP projects include habitat alteration, runoff from herbicide or pesticide application on farms, desiccation of habitats, water diversions and sedimentation. The types of CREP activities that may remedy these problems include leasing water rights for instream use, restoring native riparian vegetation, and keeping livestock away from sensitive areas.

BMPs will be followed that will avoid and minimize many of the potential impacts of CREP activities. The BMPs that limit, but still allow some herbicide use in areas where these species may occur greatly reduce the potential for adverse effects to the species while restoration projects move forward under this programmatic consultation. CREP projects may involve the installation of pumps for water diversions less than 0.5 cfs in habitat for this species, but those that are over 0.5 cfs will be evaluated under separate consultations on an as-needed basis so that fish screens and other site-specific design criteria can be developed to minimize potential adverse affects to the species. NOAA Fisheries screening criteria will be followed whenever water diversions are installed.

While some entrainment or impingement of Oregon chub is possible, the screens will greatly reduce the risk of potential losses. Adults will be large enough to be kept out by the screens, and the diversions will be small (up to 0.5 cfs) with relatively low currents, further reducing the risk of entrainment or impingement. The larval stage is the primary stage that will be vulnerable because larvae are small enough that they could potentially move through the screens, although the screening design criteria include measures (*e.g.,* intake placement; approach and sweeping velocities) that are intended to keep fish away from the diversions. In addition, few diversions are anticipated in areas where chub may be present and the number that can be operational at any given time under this consultation is limited per the terms and conditions (see section 8.4). From 1998 through 2009, a total of only thirteen stream diversions were installed for off-site water facilities in counties where Oregon chub occur (L. Loop, pers. comm. 2009). The chub is primarily found in slack water off-channel habitats (USFWS 1998d) and areas with vegetative cover (Pearsons 1989), which are generally not as conducive for water diversions and pumping as sites in areas with more open water and flow. The lack of screening and problems associated with screens on diversions are not noted threats for Oregon chub (USFWS 1993c and USFWS 1998d). Any loss of individuals from CREP project-related diversions is expected to be very low.

While the potential for adverse affects to the species has been greatly reduced through the BMPs, the Service agrees with FSA's determination that some CREP activities may affect, and are likely to adversely affect the Oregon chub. The FSA mentioned in its BA that critical habitat had not yet been designated for this species, but was expected to be proposed as soon as March 2009. While the FSA was unable to specifically analyze effects on the proposed critical habitat because the proposal was not available when the BA was completed, the effects analyses in the BA included discussions about Oregon chub habitat in general. Since that time, critical habitat has been proposed, and therefore it has been considered in this BO.

Potential adverse effects to the Oregon chub and its proposed critical habitat include short-term decreases in aquatic and streamside vegetation, increases in turbidity, sedimentation and direct disturbance of individuals during instream work and due to potential entrainment through water diversions. Any loss of shade and increased temperatures that result will be short-term in duration or minimal in scale. The effects to aquatic vegetation and temperature are associated with the PCEs of proposed critical habitat that may be affected. Risks associated with exposure to chemicals from equipment are possible, but are low due to the precautions to be taken in accordance with the BMPs. While herbicide use will be limited to chemicals and methods designed to avoid adverse affects to inland fish, there are inherent risks associated with the use of herbicides and uncertainties in the herbicide analyses, and it is possible that herbicide delivery to aquatic habitat could still adversely affect this species.

CREP projects that occur in areas that support the Oregon chub are expected to benefit the species and contribute toward its recovery over the long-term. CREP projects will support some of the actions identified in the Oregon chub recovery plan, such as maintaining and restoring vegetative cover, addressing erosion and sedimentation problems caused by livestock, and restoring streams and associated riparian, floodplain and wetland habitats (USFWS 1998d).

<u>5.5.2. Fender's blue butterfly</u>

CREP activities on project sites that support Fender's blue butterfly have been limited to minimize potential adverse impacts to the butterfly and its habitat. The BMPs in section 1.4.2 were developed specifically to reduce potential adverse short- and long-term impacts on the butterfly, and will be followed in addition to any BMPs that are applicable from section 1.3.

Shading could negatively affect butterfly habitat, which consists of native prairie. Prairie vegetation is an early seral community that requires natural or human-induced disturbance in order for it to be maintained or restored. The vast majority of the prairies where the butterfly occurs would eventually be forested if left undisturbed. CREP projects that involve the removal of invasive trees and shrubs can help to maintain prairie conditions. Subsequent revegetation with woody species could negatively impact prairie habitat. However, trees and shrubs will only be planted outside of habitats where the butterfly or its critical habitat occurs so that activities will not impact butterfly habitat due to shade, or competition with or displacement by woody species.

Adverse effects to the Fender's blue butterfly could occur from soil disturbance and compaction caused by vehicles and equipment. Soil disturbing activities, such as disking, tillage and fence building may take place on CREP sites that may be occupied. However, soil disturbing activities will not occur when or where the Fender's blue butterfly could be physically harmed. In addition, with the exception of mowers, vehicles and machinery will not be driven on areas where the Fender's blue butterfly could be affected. Foot traffic poses a minor risk of crushing larvae that may be in the duff, or eggs or larvae that may be on host plants.

Mowing may result in short-term adverse affects to the Fender's blue butterfly, but long-term benefits are expected (the discussion on mowing to follow is from an intra-Service consultation on prairie habitat restoration completed in 2008). Mowing in habitat patches with eggs or larvae of Fender's blue butterfly at any time during the year may crush or otherwise kill a small number of individuals of these life stages of the butterfly. However, studies in the southern Willamette Valley have found that both adult and larval Fender's blue butterflies increased in number following mowing to reduce the stature of herbaceous non-native vegetation, (Fitzpatrick 2005, Kaye and Benfield 2005).

A study on the effects of fire and mowing on Fender's blue butterfly and native upland prairie at Baskett Slough National Wildlife Refuge found that Fender's blue butterfly eggs were 10 to 14 times more abundant in plots that were mowed or burned compared to undisturbed, control plots; woody plants were reduced 66 percent with mowing (Wilson and Clark 1997). At the U.S. Army Corps of Engineers' Fern Ridge Reservoir, the Fender's blue butterfly population has increased dramatically since fall mowing of lupine patches has been implemented (Messinger 2006). Fender's blue butterfly population trends have been correlated with lupine vigor; high leaf growth appears to produce larger butterfly populations. The abundance of Fender's blue butterfly eggs was found to be correlated with the abundance of Kincaid's lupine leaves at a number of study sites (Kaye and Cramer 2003); egg abundance increased substantially at sites which had been treated to control non-native weeds (Schultz *et al.* 2003)

The effect of mowing on designated critical habitat for Fender's blue butterfly is a short-term reduction in some PCEs with clear long-term benefits. Spring mowing will temporarily reduce the cover of native prairie species, which would be an adverse effect to that PCE. It will also reduce the cover of larval host plants and reduce the availability of nectar sources for Fender's blue butterfly. Concomitantly, spring mowing will have beneficial effects to critical habitat as it removes competing non-native plant species. Spring mowing will only happen in unoccupied butterfly habitat. Fall mowing is not likely to have any adverse effects to the PCEs. Both spring and fall mowing have clear beneficial effects in the long-term; mowing has been shown to be one of the most effective techniques for increasing native prairie species cover and reducing the dominance of competitive invasive species (Kaye and Benfield 2005, Messinger 2006).

Little is known about the specific impacts of the proposed herbicides on Fender's blue butterfly, but several effects to the butterfly and its critical habitat are possible. Butterfly eggs or larvae, host plants or desirable nectar species may be affected due to exposure to herbicides from drift or spray reaching these non-target species. However, the types of herbicides to be used in butterfly habitats is limited, and herbicide-related BMPs in section 1.4.2 have been developed to minimize the potential for herbicides to come into contact with Fender's blue butterflies and their host plants.

Herbicide may only be used on sites with butterflies when they are in diapause. During this time, larvae are typically located at or near the base of host plants. Host plants (*i.e.,* Kincaid's, sickle-keeled, and spur lupine) will be covered during spraying, even if they have senesced, to protect any butterfly larvae that may be on the plant or on the ground in the immediate vicinity. We cannot calculate the number of larvae that will be killed or injured by incidental exposure to herbicides, but expect the actual effect to very low since larvae should be shielded at the time of application, and they are expected to feed on fresh lupine leaflets that have not been sprayed when they emerge.

The effect of chemical treatments on designated critical habitat for Fender's blue butterfly is a short-term reduction in some PCEs with clear long-term benefits. Herbicide treatment may temporarily reduce the cover of native prairie species. It may also reduce the availability of nectar sources for Fender's blue butterfly. In the long-term, use of chemical treatments to restore prairie habitat for the Fender's blue butterfly will benefit the butterfly and increase the availability of habitat containing PCEs by controlling invasive woody species and non-native plants and providing open areas for native plants and nectar sources for Fender's blue butterfly to become established.

If there are opportunities to support Fender's blue butterfly recovery efforts or improve butterfly critical habitat on CREP project sites, CREP projects may be designed to include actions that will specifically benefit the butterfly species where landowners are interested. In addition, other partners such as the U.S. Fish and Wildlife Service may be invited to participate in CREP projects that could benefit prairie species by providing additional technical and possible financial assistance.

In summary, CREP actions covered by this programmatic consultation may affect, and are likely to adversely affect Fender's blue butterfly and its critical habitat over the short-term due to the risks associated with mowing, foot traffic and herbicide applications. The level of injury and mortality to butterflies and loss of desirable habitat elements are expected to be very low. Risks have been greatly minimized due to the BMPs and limitations on the activities that may occur in Fender's blue butterfly habitats. Some CREP projects may be designed to benefit the butterfly and its proposed critical habitat over the long-term.

5.5.3. Listed Plants

CREP activities may affect Kincaid's lupine, Willamette daisy, Nelson's checker-mallow, Bradshaw's lomatium and golden paintbrush and critical habitat for the Willamette daisy and Kincaid's lupine primarily due to mowing on prairie sites in the Willamette Valley. Soil disturbing activities, such as disking, tillage and fence building may take place on CREP sites that support listed plants. However, soil disturbing activities will not occur where listed plants could be physically harmed (*e.g.,* fence post holes will not be located where listed plants occur). In addition, with the exception of mowers, vehicles and machinery will not be driven on areas where listed plants occur.

There are likely to be some short-term adverse effects to these species from mowing, but ultimately, long-term benefits are expected and that is why mowing has been proposed as part of the action (the discussion on mowing to follow is from an intra-Service consultation on prairie restoration completed in 2008). Spring mowing within patches of listed plants may remove much of the above ground growing parts of the plants, which would reduce growth and reproductive success for that year. Fall mowing is not likely to have any adverse effects to listed plants, as the above ground portions of the listed plants will have senesced. Nelson's checker-mallow may be an exception, as it may not become senescent by the beginning of the fall mowing window; in these cases, loss of some of the above ground growing parts of the plant can be expected.

Research on prairie management techniques has shown that mowing is an effective method for reducing non-native plants, with generally positive effects to native prairie species. Annual fall mowing has significant positive effects, including increased leaf, flower and foliar cover, on Kincaid's lupine (Kaye and Thorpe 2006). A recent study found that Willamette daisy did not respond with increased crown cover in mowed plots, but suggests that the indirect effects (*e.g.*, reduced cover of invasive plants) positively affect the species (Thorpe and Kaye 2006). A two-year study on the effects of mowing and burning on Nelson's checker-mallow found that the species did not respond positively to mowing in the short-term, although the reduction in cover of competing woody plants would likely benefit Nelson's checker-mallow in the long-term (Wilson 2004).

The effect of mowing on designated critical habitat for Kincaid's lupine and Willamette daisy is a short-term reduction in some PCEs, with clear long-term benefits. Spring mowing will temporarily reduce the cover of native prairie species, which would be an adverse effect to that PCE for these species. Concomitantly, spring mowing will have beneficial effects to critical habitat for these species as it removes competing non-native plant species. Fall mowing is not likely to have any adverse effects to the PCEs of designed critical habitat for any of the species. Both spring and fall mowing have clear beneficial effects in the long-term; mowing has been shown to be one of the most effective techniques for increasing native prairie species cover and reducing the dominance of competitive invasive species (Kaye and Benfield 2005, Messinger 2006).

The use of herbicides poses significant risks to listed plants. However, the BMPs developed for herbicide use on sites with listed plants greatly reduce the potential for harm. The BMPs address risks related to the types of herbicides to be used, application methods, proximity to listed plants, and potential exposure, greatly minimizing the potential for listed plants to come into contact with herbicides that could harm them.

For all spray applications, listed plants will be physically shielded (*e.g.,* covered with buckets or some other barrier that will not harm the plants) as needed to protect them from drift, unless they are dormant; plants will be uncovered immediately after spraying has been completed. The potential for exposure from drift will be further addressed by minimizing fine particle size, using the lowest nozzle pressure needed, keeping spray nozzles close to the ground, spraying only when there are no or low breezes, directing spray away from listed plants, and maintaining no-spray buffers for some applications. Even if listed plants are physically shielded, a minimum 10-foot buffer will be maintained between listed plants and the application area for herbicides that have a higher tendency to move through the soil and that could get taken up by the roots. Runoff that could carry herbicides will be minimized by avoiding applications during periods of rain, snow, or melting snow, and by using hand application methods such as wicking, wiping, and hack and squirt where appropriate. (See section 1.4.3 for a complete listing of herbicide-related BMPs for listed plants.)

The effect of chemical treatments on designated critical habitat for the Kincaid's lupine and Willamette daisy is a short-term reduction in some PCEs with clear long-term benefits. Herbicide treatment may temporarily reduce the cover of native prairie species, which would be an adverse effect to a PCE for both species. In the long-term, use of chemical treatments to restore prairie habitat for listed plants will benefit these species and increase the availability of habitat containing PCEs by controlling invasive woody species and non-native plants and providing open areas for native prairie plants to become established.

Shading has the potential to result in adverse affects to listed prairie plants. While many listed plant species could benefit from invasive species removal, reduced grazing pressure and reduced physical disturbance from livestock, some could be shaded out by CREP plantings or outcompeted by other vegetation because of the lack of grazing. Also, increased thatch may reduce successful seed establishment of some species. However, to avoid long-term shading out of shade-intolerant species, technical staff involved in CREP projects will recommend species for planting that will maintain or restore habitat conditions needed to support listed plants and that are appropriate to the site based on soil type and plant community type that will not grow tall enough to shade out the listed species. Therefore, shading is not likely to adversely affect listed plants.

To avoid and minimize harm to threatened and endangered plants from CREP activities, all applicable project BMPs listed in section 1.3 will be followed, as well as those listed in section 1.4.3 for listed plants. CREP activities are likely to adversely affect Kincaid's lupine, Willamette daisy, Nelson's checker-mallow, Bradshaw's lomatium and golden paintbrush and critical habitat for Kincaid's lupine and Willamette daisy during the short-term due to the risks associated with mowing. If any adverse effects occur to listed plants from herbicide applications, they are expected to be minimal due to the BMPs. The level of injury to listed plants and loss of desirable habitat elements are expected to be very low, and risks have been greatly minimized due to the BMPs and limited activities that may occur in listed plant habitats. Some CREP projects may be designed to benefit threatened and endangered plants and their critical habitats over the long-term.

6. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

It is anticipated that existing threats to the species addressed in this BO are reasonably certain to continue. As discussed for each species in section 2, threats include habitat loss and degradation due to invasive non-native plants, pollutants, agricultural and forestry practices, commercial and residential development and other factors.

CREP projects will primarily occur on agricultural lands in riparian areas along streams and rivers, and on associated wetland and upland habitats throughout Oregon. The extent of effects from current and future human activities in the action area is unknown. However, most habitats on lands eligible for CREP funding are likely to continue to be used for agricultural purposes if they are not enrolled in CREP or similar programs, and are therefore not likely to contribute in new ways toward either listed species recovery or declines. Those lands that are enrolled in CREP and other similar conservation programs are expected to contribute to the recovery of listed species over time, especially listed fish since they occur in streams on private agricultural lands in Oregon that are the focus of CREP activities.

7. CONCLUSION

7.1. Inland Fish

After reviewing the status of the listed bull trout, Lahontan cutthroat trout, Warner sucker, shortnose sucker, Lost River sucker, Modoc sucker and Oregon chub, the status of bull trout and Warner sucker designated critical habitats in Oregon, proposed critical habitats for shortnose sucker, Lost River sucker and Oregon chub, the environmental baseline for species that may be affected in the action area, the effects of the proposed actions and cumulative effects, the Service concludes that the proposed actions are not likely to jeopardize the continued existence of these species, nor are they likely to destroy or adversely modify their designated or proposed critical habitats.

The determinations of no jeopardy and no adverse modification of critical habitat are based on the following considerations:

- The listed fish addressed in this BO have declined due to numerous factors. The one factor for decline shared by all of these species is the degradation of aquatic habitats. Agricultural practices, urbanization and other land uses and activities in the Pacific Northwest have caused significant negative changes to aquatic habitat across the range of listed fish. All of the proposed actions addressed by this consultation are intended to improve degraded habitat and water quality, thereby benefiting listed fish species and their critical habitats.
- Generally, lands eligible to be enrolled in CREP have been significantly modified from use as crop or pasture lands. CREP actions will improve these habitats and contribute toward meeting the conservation and recovery needs of the listed fish species by addressing threats

to the species, restoring and enhancing aquatic habitats and their ecological functions, and implementing actions that have been identified for recovering listed fish.

- Some listed fish are likely to experience exposures to various concentrations of herbicides, turbidity, fine sediment deposition, and increased water temperatures that exceed effect thresholds and result in harm. However, these exposures are likely to be minor in magnitude (generally sublethal) and extent (generally on one property at a time, averaging 28 acres in size including about 2.5 stream miles based on past CREP enrollments) and occur infrequently.
- Listed sucker larvae and Oregon chub are susceptible to entrainment through water diversions. However, the number of water diversions where these species occur is expected to be low and the risks have been minimized by the BMPs.
- BMPs designed to avoid and minimize all foreseeable direct and indirect adverse affects to listed species from project activities have been incorporated into the action.
- Due to the low magnitude and extent of effects resulting from implementation of the proposed action, the abundance, productivity, distribution, and connectivity of the listed fish and their critical habitats will not be significantly or permanently affected.

In conclusion, some limited adverse effects will likely result from implementation of CREP project activities to the listed fish species addressed in this BO. However, the overall effect of CREP actions will be to improve aquatic habitat conditions and water quality. Therefore, it is expected that the Oregon CREP will contribute toward the long-term survival and recovery of listed fish, and will improve the function of their designated and proposed critical habitats.

7.2. Fender's blue butterfly and listed plants

After reviewing the current status of Fender's blue butterfly, Willamette daisy, Bradshaw's lomatium, Kincaid's lupine, Nelson's check-mallow and Golden Indian paintbrush, designated critical habitat for Fender's blue butterfly, Kincaid's lupine and Willamette daisy, the current status of the species in the action area, the effects of the proposed action, and the cumulative effects within the action area, it is the Service's conclusion that the action, as proposed, is not likely to jeopardize the continued existence of Fender's blue butterfly or the five listed plants, and is not likely to adversely modify designated critical habitat for Fender's blue butterfly, Willamette daisy or Kincaid's lupine. Although restoration activities are likely to result in short-term adverse effects to these listed species and their critical habitats, best management practices are in place to avoid and minimize adverse effects. While the Oregon CREP is not focused on the restoration of prairie habitats such as those in the Willamette Valley where these listed species occur, some actions designed to benefit prairie species may be incorporated into CREP projects.

The determinations of no jeopardy and no adverse modification of critical habitat are based on the following considerations:

- Soil disturbing activities, such as disking, tillage and fence building will not take place and vehicles and machinery, with the exception of mowers, will not be driven in locations that could cause physical harm to the Fender's blue butterfly or listed plants.
- Trees and shrubs will only be planted outside of habitats where the Fender's blue butterfly or listed prairie plants may occur, and outside of their critical habitats.

- None of the proposed activities are likely to permanently decrease reproduction, numbers, or distribution of Fender's blue butterfly, Willamette daisy, Bradshaw's lomatium, Kincaid's lupine, Nelson's check-mallow or Golden Indian paintbrush.
- BMPs for mowing include seasonal timeframes and buffers to avoid and minimize potential impacts on list plants and Fenders' blue butterfly, thus any adverse impacts from mowing will be very small, and temporary.
- BMPs for herbicide treatments are in place to avoid exposing listed plants, Fender's blue butterfly, and butterfly host plants to herbicides that could harm them.
- Harassment and mortality of butterflies affected by habitat restoration activities are expected to be very low. Recent research indicates that few larvae are killed by mowing, and the population generally rebounds in the year after treatment.
- Management activities that are implemented when plants are growing (*e.g.,* spring mowing, weed treatment including herbicide use) will be done in a manner that minimizes effects to listed plants. Although some plants will be negatively affected, the improved habitat quality and reduction in competition from invasive plants will result in larger, more robust populations of the listed species.
- Mowing can have a beneficial effect on Fender's blue butterfly, Kincaid's lupine and Willamette daisy critical habitat because it can promote new vegetative growth and establishment of Kincaid's lupine, Willamette daisy and other low growing grasses and forbs.
- Techniques used to control invasive species expansions can improve habitat quality for Fender's blue butterfly and listed plants.
- Controlling invasive species can benefit critical habitat for Fender's blue butterfly, Kincaid's lupine and Willamette daisy by reducing dense non-native vegetation that can block sunlight and compete for resources necessary for the growth and reproduction of listed plants as well as host and nectar plants needed for the butterfly, and impede movement of the butterfly.

8. INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of Federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-federal areas in violation of State law or regulations or in the course of any violation of a state criminal trespass law.

The measures described below are non-discretionary, and must be undertaken by the FSA so that they become binding conditions of any grant or permits issued to others conducting the work, as appropriate, for the exemption in section 7(o)(2) to apply. The FSA has a continuing duty to regulate the activity covered by the incidental take statement. If the FSA (1) fails to assume and implement the terms and conditions or (2) fails to require their grantees or permitees to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FSA must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

8.1. Amount or Extent of Take Anticipated

8.1.1. Inland fish

As described in the effects of the action discussion, the Service expects that the action, as proposed by FSA with the BMPs, will minimize incidental take of bull trout, Lahontan cutthroat trout, the listed suckers and Oregon chub. However, the BMPs and other protective measures do not completely eliminate the potential for take and some incidental take associated with herbicide use, increases in turbidity, fine-sediment deposition, shade reduction, disturbance of individuals during instream work, entrainment associated with water diversions, and adverse effects to algae, aquatic macrophytes and aquatic macroinvertebrates from herbicides and sedimentation is likely to occur. While some adverse effects are likely to occur, the frequency, duration, extent and severity of the adverse effects are likely to be low. Any take associated with herbicide use and erosion is expected to be in the form of non-lethal harm, caused by short-term exposures of listed fish to sub-lethal concentrations of herbicides and associated compounds. Sub-lethal effects include short-term impairments (hours) of normal functions and behaviors such as olfaction, respiration, and feeding from chemical exposures that result from herbicide applications (*e.g.,* emergent vegetation treatments, riparian applications, or applications in dry or intermittent streams). These effects are only likely to occur to bull trout. The herbicide use proposed by FSA is not expected to reach streams in concentrations that will adversely affect Lahontan cutthroat trout, the listed suckers or Oregon chub due to the additional herbicide limitations described in the BMPs that apply where these species occur, although some uncertainties about the potential effects to these species are inherent in the herbicide analyses.

The number of significant herbicide exposures to bull trout, and expectedly insignificant exposures to other listed fish (due to the more restrictive BMPs), is likely to vary from year to year, and will depend on the proximity of areas treated with herbicides to occupied habitats, number and nature of the riparian and in-channel sites treated, the types and amounts of herbicides used, the timing of the application, the amount of time elapsed between manual, mechanical, and herbicide treatments and rainfall, and the intensity of rainfall. Potential for juveniles, fry, or eggs to be directly harmed or displaced by workers walking or standing in stream channels or from sediment or turbidity will also vary by location and year.

Entrainment of larval suckers or Oregon chub is possible where CREP projects include water diversions. Entrainment would likely result in mortality. Impingement is highly unlikely because of the minor amount of water that can be diverted in areas with these species under this programmatic consultation. We expect that bull trout and Lahontan cutthroat trout will be fully protected by the requirement that diversions be screened in accordance with NOAA Fisheries screening criteria, which are designed to avoid all take of similar listed species (*i.e.,* anadromous salmonids). The levels of take of the suckers and Oregon chub are expected to be low because only minor diversions are covered and these species will be at least partially protected by the screens. Diversions will typically be located away from areas where Oregon chub and sucker larvae are expected to occur. In addition, water diversions installed to irrigate CREP plantings will be temporary and are expected to cease after plants become established. Diversions used to maintain water in livestock watering facilities will be in use over the long-term, but these will require very little, intermittent flow and pose minimal risk to fish.

Despite the use of best scientific and commercial data available, the Service cannot quantify the specific number of individual fish that will be incidentally taken by this action. The Service anticipates that incidental take of individual listed fish would be difficult to detect or quantify because of the sublethal nature of most of the take and the low likelihood of finding any affected eggs, larvae or fry, juveniles or adults. We expect that the number of individual fish exposed to sublethal concentrations of herbicides or levels of sedimentation or turbidity that could result in harm will be low, and will only be associated with treatments and other work within and adjacent to spawning and rearing habitat. Take associated with the entrainment of larval suckers or Oregon chub through screened water diversions is also expected to be low, and is not likely to affect adult fish.

In the absence of information about specific project locations, potential listed species occurrences on future CREP project sites, and sufficient data to quantify the number of individuals that will be affected by CREP activities, the Service relies on estimates of habitat that may be affected as a reasonable surrogate for describing the extent of take. FSA anticipates that an average of 3,600 acres (ranging from 3,000 to 5,000 acres per year) will be enrolled in CREP annually over the next five years based on past enrollments. They have also stated that landowner interest in the CREP and enrollments in Oregon continue to increase. Lands may continue to be enrolled over a series of years until the approved cap of an additional 65,000 acres is reached. The vast majority of CREP projects will be located along streams. We do not anticipate that listed inland fish will occur in the vicinity of all CREP project sites, but each of the listed species is likely to occur on or within the vicinity of some percentage of the project areas.

We estimated the amount of occupied habitat that may be encountered annually by species based on species distributions in Oregon counties, anticipated CREP enrollments, the average size of CREP projects (28 acres with 2.5 stream miles) and estimates of how often CREP activities may occur within occupied habitats. For simplicity, we assumed that statewide CREP enrollments will average 5,000 acres per year over the next ten years based on FSA's reported and predicted CREP enrollments and trends, and we assumed that CREP project numbers will be evenly distributed in all 36 counties throughout the state, which equates to about 140 acres to be enrolled per county per year on average. We also assumed that CREP projects will occur more often in habitats occupied by listed fish than they would if projects were randomly distributed, since the Oregon CREP is a restoration program and one of its purposes is to benefit listed species. While actual enrollments will vary by area and will be higher in some counties and watersheds than others, we believe our overall estimates of occupied habitats that may be affected are reasonable based on the available information and all of the factors considered.

Bull trout

Bull trout occur in Baker, Crook, Deschutes, Grant, Harney, Hood River, Jefferson, Klamath, Lake, Lane, Linn, Malheur, Umatilla, Union, Wallowa, Wasco and Wheeler counties. Assuming that 140 acres per county will be enrolled in CREP, 2,380 acres will be enrolled in these 17 counties annually. With enrollments averaging 28 acres and about 2.5 stream miles per site, this equates to about 85 projects involving work along an estimated 213 stream miles in these counties annually. If we assume that 30 percent of the CREP sites will occur in occupied areas, it is estimated that take of bull trout may occur in up to 64 stream miles per year on average or 640 stream miles over the 10 year period covered by this programmatic consultation. Any take of bull trout that occurs is expected to be sub-lethal and short-term, with the exception of potential lethal take associated with herbicide use that will occur at some project sites over the short-term.

Lahontan cutthroat trout

Lahontan cutthroat trout occur in Harney and Malheur counties. Assuming that 140 acres per county will be enrolled in CREP, 280 acres will be enrolled in these two counties annually. With enrollments averaging 28 acres and about 2.5 stream miles per site, this equates to about 10 projects involving work along an estimated 25 stream miles in these counties annually. If we assume that 30 percent of the CREP sites will occur in occupied areas, it is estimated that take of Lahontan cutthroat trout may occur in up to 7.5 stream miles per year on average or 75 stream miles over the 10 year period covered by this programmatic consultation. Any take of Lahontan cutthroat trout that occurs is expected to be sub-lethal and short-term.

Shortnose and Lost River suckers

Shortnose and Lost River suckers occur in Klamath County. Assuming that 140 acres per county will be enrolled in CREP, 140 acres will be enrolled in this county annually. With enrollments averaging 28 acres and about 2.5 stream miles per site, this equates to about 5 projects involving work along an estimated 12.5 stream miles in this county annually. If we assume that 50 percent of the CREP sites will occur in these occupied areas, it is estimated that take of shortnose and Lost River suckers may occur in up to 6.25 stream miles per year on average or 62.5 stream miles over the 10 year period covered by this programmatic consultation. Any take of shortnose and Lost River suckers that occurs is expected to be sub-lethal and short-term, with the exception of potential lethal take of larvae associated with entrainment through water diversions if the screening criteria are not fully protective during all life stages.

Warner sucker

Warner sucker occurs in Lake County. Assuming that 140 acres per county will be enrolled in CREP, 140 acres will be enrolled in this county annually. With enrollments averaging 28 acres and about 2.5 stream miles per site, this equates to about 5 projects involving work along an estimated 12.5 stream miles in this county annually. If we assume that 30 percent of the CREP sites will occur in these occupied areas, it is estimated that take of Warner suckers may occur in up to 3.75 stream miles per year on average or 37.5 stream miles over the 10 year period covered by this programmatic consultation. Any take of Warner sucker that occurs is expected to be sub-lethal and short-term, with the exception of potential lethal take of larvae associated with entrainment through water diversions if the screening criteria are not fully protective during all life stages.

Modoc sucker

Modoc sucker occurs in Lake County. Assuming that 140 acres per county will be enrolled in CREP, 140 acres will be enrolled in this county annually. With enrollments averaging 28 acres and about 2.5 stream miles per site, this equates to about 5 projects involving work along an estimated 12.5 stream miles annually. In recent surveys, the Modoc sucker has only been documented in approximately 14.2 miles of stream (Thomas Creek) in Oregon. The known occupied habitat is primarily on land managed by the U.S. Forest Service, which is not eligible for CREP. However, Modoc suckers may extend farther upstream at lower densities, or downstream into areas of Thomas Creek and its tributaries that include private agricultural lands. Considering the very limited distribution of Modoc sucker in Oregon, we estimate that one CREP project will occur in occupied habitat annually, on average. Thus, it is estimated that take of Modoc sucker may occur in up to 2.5 stream miles (the average length of stream affected by CREP projects) each year on average, which equates to 25 stream miles over the 10 year period covered by this programmatic consultation. Any take of Modoc sucker that occurs is expected to be sub-lethal and short-term, with the exception of potential lethal take of larvae associated with entrainment through water diversions if the screening criteria are not fully protective during all life stages.

Oregon chub

Oregon chub occur in Benton, Lane, Linn, Marion and Polk counties. Assuming that 140 acres per county will be enrolled in CREP, 700 acres will be enrolled in these five counties annually. With enrollments averaging 28 acres and about 2.5 stream miles per site, this equates to about 25 projects involving work on the 700 acres and along an estimated 62.5 stream miles in these counties annually. Oregon chub are very limited in distribution, and occur in isolated ponds and wetlands in some cases. If we assume that 10 percent of the CREP projects in these counties will occur on sites with occupied habitats, it is estimated that take of Oregon chub may occur on up to 2.5 projects that may include occupied wetlands or ponds and up to 6.25 stream miles on average per year. This equates to 62.5 stream miles and 25 projects that may include occupied ponds or wetlands over the 10 year period covered by this programmatic consultation. We assume that water diversions will not be installed in ponds or wetlands with Oregon chub, and have included that assumption as a requirement in the terms and conditions section of the incidental take statement. Any take of Oregon chub that occurs is expected to be sub-lethal and short-term, with the exception of potential lethal take associated with entrainment through water diversions installed on streams if Oregon chub may occur near the intakes and the screening criteria are not fully protective during all life stages.

8.1.2. Fender's blue butterfly

The Service anticipates incidental take of Fender's blue butterfly will be difficult to detect because the presence and number of individuals is difficult to determine within a project area and detecting a dead or impaired specimen is highly unlikely. Although the Service anticipates Fender's will be incidentally harassed and harmed (killed or injured) as a result of restoration and maintenance activities, accurately quantifying these effects is difficult. For instance, injured butterflies that fly off to areas well beyond the project corridor before dying or that are consumed by birds, bats or other predators because of injuries, are not likely to be located for estimating take. Additionally, larvae and eggs that are trampled or mowed will be extremely difficult to find in order to quantify incidental take. Therefore, even though take is expected to occur, data are not available and are not sufficient to enable the Service to estimate an exact number of individuals which are incidentally taken for most of the proposed activities. For this reason, we will specify the amount or extent of incidental take associated with mowing, foot traffic and herbicide applications using an estimate of the occupied acres where these activities may occur on an annual basis as a surrogate.

As described in the inland fish section, we assumed that statewide CREP enrollments will average 5,000 acres per year over the next ten years based on FSA's reported and predicted CREP enrollments and trends, and we assumed that CREP project numbers will be evenly distributed in all 36 counties throughout the state, which equates to about 140 acres to be enrolled per county per year on average. The Fender's blue butterfly occurs in Benton, Lane, Linn, Polk and Yamhill counties and may be rediscovered or reintroduced at some point in Marion County. Therefore, an estimated 840 acres per year are expected to be enrolled in these six counties annually.

CREP projects are not expected to occur on sites occupied by the butterfly very frequently. At the time of listing in 2000, the Fender's blue butterfly was known to occupy only 32 sites across 408 acres (165 hectares) (USFWS 2000a). In 2006, 3,010 acres (1,218 hectares) was designated as critical habitat for the butterfly, comprising only 0.07 percent of the land within Benton, Lane, Polk and Yamhill counties (U.S. Census Bureau 2009) of which about 66 percent is private land and the rest is public (USFWS 2006c). The private lands are used for pastures, hayland, cropland, vineyards, nurseries, Christmas tree farms, woodlands, and urban and rural areas managed as open spaces or left as remnant prairies. Only those agricultural lands that have been recently used for cropland or pastureland are eligible for CREP. Generally, the prairie habitat on these lands has been significantly degraded and does not currently support the butterfly. In addition, the butterfly primarily occurs in upland prairies, out of wetlands and often away from streamside habitats where most CREP projects will take place. Over time, CREP projects may increase the amount of potentially suitable habitat.

We assume that CREP activities in Fender's blue butterfly habitat will be infrequent. Based on the limited extent of occupied Fender's blue butterfly habitat and the fact that CREP activities are not specifically focused on upland prairies, we estimate that projects will occur on sites that include occupied habitats up to ten percent of the time in the six counties where the species may be found. This equates to an average of 84 acres or three project sites per year (based on the average size of a CREP enrollment reported by FSA, which is 28 acres). Therefore, it is estimated that take of Fender's blue butterfly may occur on up to thirty projects, estimated to total up to 840 acres, on sites with occupied habitat over the 10 year period covered by this programmatic consultation. On these lands, we anticipate that death or injury of a small percentage of larvae and eggs in the action area may occur due to crushing or soil compaction by mowers, suction by mowers, trampling by foot traffic and from chemical treatment activities.

8.2. Effect of the Take

In the accompanying BO, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of designated or proposed critical habitat when the reasonable and prudent alternatives and terms and conditions in sections 8.3 and 8.4 are implemented.

8.3. Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of the listed species included in this consultation.

> **Reasonable and Prudent Measure 1 (RPM 1)**: FSA is responsible for ensuring that CREP activities subject to this programmatic consultation are carried out in a manner that is consistent with its provisions.
>
> **Reasonable and Prudent Measure 2 (RPM 2):** Water diversions in areas with listed suckers and Oregon chub will be limited.
>
> **Reasonable and Prudent Measure 3 (RPM 3):** FSA will submit an annual report to the Service summarizing CREP activities and listed species encountered.

8.4. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the FSA must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

Terms and Conditions necessary for the implementation of RPM 1:

- FSA shall ensure that its staff and designated responsible parties have a thorough understanding of the requirements and BMPs that must be followed to design, review and implement projects, and to fulfill monitoring and reporting requirements, as relevant to their roles in carrying out CREP activities covered under this consultation.

Terms and Conditions necessary for the implementation of RPM 2:

- It has been assumed that very few water diversions will be installed in areas with listed suckers or Oregon chub based on the low numbers of diversions installed for CREP projects to date, as reported by FSA[5]. No more than five water diversion projects associated with the CREP projects covered under this consultation may be in operation annually in areas that may adversely affect any one species of listed sucker, and no more than fifteen may be installed on streams where Oregon chub may be adversely affected (*i.e.,* no more than the given number of diversions may be operational at a time per species).
- Water diversions will not be installed in ponds or wetlands that support Oregon chub.

[5]The number of stream diversions that have been installed for CREP projects in counties with either listed suckers or Oregon chub for the period from 1998 through 2009: Benton (3), Klamath (3), Lake (unknown), Lane (0), Linn (7), Polk (3) and Marion (0) (L. Loop, pers. comm. 2009).

Terms and Conditions necessary for the implementation of RPM 3:

- FSA shall submit an annual report to the Service at the end of each fiscal year that summarizes the following for the covered time period: (1) the total number of projects and total acreage enrolled in the Oregon CREP by county, (2) the number and sizes (*i.e.,* acreages and stream miles) of projects that were implemented where listed species and/or proposed or designated critical habitats occur, and the CP(s) and practice components (including whether or not herbicides were used) that were implemented, summarized by species, (3) any BMPs and other conservation measures that were used to avoid take, and (4) the cumulative total amounts of take for each listed fish species and Fender's blue butterfly, based on the measures of habitat used to describe the amount or extent of take anticipated in section 8.1.

8.5. Reporting and Review Requirements

8.5.1. Reporting Sick, Injured or Dead Individuals

Upon locating dead, injured, or sick listed species individuals during the time when herbicide application or other activities are occurring on CREP sites, initial notification must be made to the Service's Division of Law Enforcement at 9025 SW Hillman Court, Suite 3134 in Wilsonville, Oregon; phone: 503-682-6131. Instructions for proper handling and disposition of such specimens will be issued by the Division of Law Enforcement. Care must be taken in handling sick or injured fish or butterflies to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured individuals or the preservation of biological materials from dead fish or butterflies, FSA has the responsibility to ensure that information relative to the date, time, and location of the listed fish or butterfly when found, and possible cause of injury or death of each individual be recorded and provided to the Service.

8.5.2. Review Requirement

The Service believes that take will not exceed the amounts for each species described in section 8.1 as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The FSA must immediately provide an explanation of the causes of the taking and review with the Service the need for and possible modification of the reasonable and prudent measures.

9. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service offers the following conservation recommendations based on opportunities for the CREP to support listed species conservation and recovery goals:

1. Encourage CREP technicians and program enrollees to become familiar with the conservation and recovery needs of listed and at-risk species they might encounter.
2. Document any new occurrences of listed and at-risk species in the action area, and work with landowners to undertake measures that will protect and benefit them.
3. Identify areas that could provide suitable habitat for listed and at-risk species in the future, and work with willing landowners to undertake measures that would support recovery efforts.
4. Contact the Service to evaluate opportunities to conserve listed species, implement recovery actions in partnership with CREP program enrollees, and to provide assurances to landowners that additional ESA liabilities will not be incurred due to their efforts to conserve listed and sensitive species (*i.e.,* through Safe Harbor or Candidate Conservation Agreements), where landowners may be agreeable.
5. Use manual and mechanical methods rather than herbicides to treat invasive species where listed species occur, or use herbicide formulations with the least toxicity to listed species and other organisms, whenever possible.
6. Monitor the effects of CREP actions on listed species and their habitats.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

10. REINITIATION – CLOSING STATEMENT

This concludes the formal programmatic consultation on CREP activities that may occur on up to 65,000 acres of agricultural land in Oregon. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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APPENDIX H
NATIONAL MARINE FISHERIES SERVICE AGREEMENT LETTER AND NATIONAL MARINE FISHERIES SERVICE /U.S. FISH AND WILDLIFE SERVICE 1999 BIOLOGICAL OPINION

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
3502 Highway 30
LA GRANDE, OREGON 97850

Refer to NMFS No.:
2008/07679

August 14, 2009

Donald Howard
Acting State Executive Director
Farm Service Agency, Oregon State Office
7620 SW Mohawk Street
Tualatin, OR 97062-8121

Dear Mr. Howard:

Thank you for your letter of July 29, 2009 notifying me of your decision to continue implementing the Oregon Conservation Reserve Enhancement Program (CREP) pursuant to section 7(d) of the Endangered Species Act. My staff and I are working diligently to complete your ongoing consultation (P/NWR/2008/07679) regarding the expanded CREP in as timely a fashion as possible.

In view of the fact that the previous biological opinion (P/NWR/1998/01584) has no sunset date, and that the Oregon CREP is a program which has important habitat conservation benefits for NMFS' trust species, I believe you have made the right decision to not delay CREP implementation while we work to complete this important consultation.

Please feel free to contact myself or my staff biologist, Walt Wilson assigned to this consultation at 541-975-1835 should you have questions regarding this issue.

Sincerely,

S Hovekamp

Spencer Hovekamp
Eastern Oregon Branch Chief

bcc: Walt Wilson, NMFS
Spencer Hovekamp, NMFS
File NMFS Eastern Oregon Branch Office

File Number: P/NWR/2008/07679

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

Refer to:
OSB1999-0079

June 2, 1999

Michael Linsenbigler
U.S. Department of Agriculture
Farm Services Agency
Environmental Activities Branch
1400 Independence Avenue, SW
Stop 0513
Washington, D.C. 20250-0513

Subject: Biological Opinion on the Oregon Conservation Reserve Enhancement Program (NMFS Log #6112, USFWS Log #1-7-99-F-117)

Dear Mr. Linsenbigler:

Enclosed is a biological opinion prepared by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) (jointly, the Services) pursuant to section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.)(Act) on the Oregon Conservation Reserve Enhancement Program (CREP). The Services conclude in this opinion the impact of the Oregon CREP is not likely to jeopardize the continued existence of species identified below as threatened or endangered, or proposed for listing as threatened or endangered, under the Act, nor is it likely to adversely modify designated critical habitat.

The opinion was prepared by the Services in response to an October 15, 1998, request from the Farm Services Agency (FSA) for formal consultation regarding the potential effects of funding the installation and maintenance of the Oregon CREP on salmonid species listed or proposed for listing under the Act. When fully carried out, the Oregon CREP will give farmers and ranchers the opportunity voluntarily to enter 10 to 15 year contracts with U. S. Department of Agriculture (USDA) to restore wetlands and to plant grasses, shrubs and trees on riparian lands they own or manage along salmon and trout streams. Oregon CREP also includes a set of best management practices (BMPs) designed to reduce incidental take and adverse effects that may occur during CREP installation and maintenance. Applications from all eligible producers will be accepted into the program on a first-come, first-served basis up to a maximum enrollment of 100,000 acres.

The Services believe that full achievement of the Oregon CREP is likely to make a very substantial contribution to the survival and recovery of those species and habitats covered by this opinion. Nonetheless, the Services also believe certain site-specific actions associated with establishment and maintenance of the Oregon CREP may result in a small and temporary amount of incidental take of listed species and designated critical habitats. Accordingly, the Services provided a set of nondiscretionary "reasonable and prudent measures" in the accompanying opinion they believe are necessary to minimize the likelihood of that incidental take. The opinion also includes a set of "conservation recommendations" based on discretionary actions the Services believe FSA and USDA can carry out that will increase the effectiveness of CREP. Those recommendations include actions to expand the function and viability of the Oregon CREP, to develop information and technical assistance regarding alternative conservation systems for agriculture, and to continue and expand efforts to make adoption of those systems more cost-effective for agricultural producers.

Species addressed by this opinion include Snake River sockeye salmon (*Oncorhynchus nerka*), Snake River fall chinook salmon (*Oncorhynchus tshawytscha*), Snake River spring/summer chinook salmon (*Oncorhynchus tshawytscha*), Upper Columbia River spring-run chinook salmon (*Oncorhynchus tshawytscha*), Lower Columbia River chinook salmon, all runs (*Oncorhynchus tshawytscha*), Upper Willamette River spring-run chinook salmon (*Oncorhynchus tshawytscha*), Southern Oregon and California Coastal spring and fall chinook salmon (*Oncorhynchus tshawytscha*), Oregon Coast coho salmon (*Oncorhynchus kisutch*), Southern Oregon / Northern California coho salmon (*Oncorhynchus kisutch*), Chum salmon (*Oncorhynchus keta*), Snake River Basin steelhead (*Oncorhynchus mykiss*), Upper Columbia River Basin steelhead (*Oncorhynchus mykiss*), Middle Columbia Basin steelhead (*Oncorhynchus mykiss*), Lower Columbia Basin steelhead (*Oncorhynchus mykiss*), Upper Willamette River steelhead (*Oncorhynchus mykiss*), Southwestern Washington / Columbia River cutthroat trout (*Oncorhynchus clarki clarki*), Umpqua River cutthroat trout (*Oncorhynchus clarki clarki*), Bull trout (*Salvelinus confluentus*), Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*), Oregon chub (*Oregonichthys crameri*), Lost River sucker (*Deltistes luxatus*), Shortnose sucker (*Chasmistes brevirostris*), Aleutian Canada goose (*Branta canadensis leucopareia*), Bald eagle (*Haliaeetus leucocephalus*), Columbian white-tailed deer (*Odocoileus virginianus leucurus*), Nelson's checkermallow (*Sidalcea nelsoniana*), Bradshaw's lomatium (*Lomatium bradshawi*), Howell's spectacular thelopody (*Thelypodium howellii* ssp. *spectabilis*), Rough popcornflower (*Plagiobothrys hirtus*), and

Willamette daisy (*Erigeron decumbens* var. *decumbens*). This opinion constitutes formal consultation for those species that are listed and a formal conference for those proposed for listing.

We appreciate the cooperation of your staff in completing this consultation and look forward to working with them further as you carry out other programs for the conservation of endangered species and threatened species.

Sincerely,

Rick Applegate Assistant Administrator for Habitat Conservation National Marine Fisheries Service Northwest Region	Russell D. Peterson State Supervisor U.S. Fish and Wildlife Service Oregon State Office

Enclosure

cc: Steve Hodapp- FSA, Washington, D.C.
Fred Ringer - FSA, Portland, Oregon
Bob Graham - NRCS, Portland, Oregon
Oregon Governor John Kitzhaber
Ken Bierly - Governor's Watershed Enhancement Board, Salem, Oregon
Phil Ward - Oregon Departement of Agriculture, Salem, Oregon
Jim Brown - Oregon Department of Forestry, Salem, Oregon
Jim Greer - Oregon Department of Fish and Wildlife, Portland, Oregon
Bill Braunworth - Oregon Extension Service
Donald Sampson - Columbia River Intertribal Fish Commission, Portland, Oregon

Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

NMFS Log #6112
USFWS Log #1-7-99-F-117

Oregon Conservation Reserve Enhancement Program

Agency: U.S. Department of Agriculture, Farm Services Agency, Washington, D.C.

Consultation Conducted By: National Marine Fisheries Service, Northwest Region
U.S. Fish and Wildlife Service, Oregon State Office

Date Issued: June 2, 1999

Refer to: OSB1999-0079

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EXECUTIVE SUMMARY

This biological opinion concludes that funding by the Farm Services Agency (FSA) of a program to install and maintain those conservation practices referred to in the Oregon Conservation Reserve Enhancement Program (CREP) biological assessment over the duration of a 10 to 15-year contract period will not jeopardize the continued existence of species named below as listed or proposed for listing as threatened or endangered under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.)(Act). The Opinion was prepared by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (jointly, the Services) in response to FSA's written request to the Services for formal consultation dated October 15, 1998.

The Oregon CREP proposal is designed to address water quality degradation that is a direct or indirect result of agricultural activities on private lands along freshwater streams. On a statewide basis, about 20 percent of the freshwater salmon streams on private lands in Oregon pass through agricultural land use areas. Farming and ranching activities on these lands have led to removal or elimination of native riparian vegetation with resultant increases in water temperature, rates of sedimentation, and changes in channel morphology. The eligible practices under this program are riparian forest buffer (Conservation Practice 22), wetland restoration (Conservation Practice 23), and grass filter strip (Conservation Practice 21). A new conservation practice, the Herbaceous Riparian Cover practice, will also be eligible for Oregon CREP if approved by the U.S. Department of Agriculture (USDA) for inclusion in the Conservation Reserve Program (CRP).

The six objectives of the Oregon CREP are directly related to improvement of riparian and aquatic ecosystems that provide key habitats for salmonids. These six objectives are:

- Restore 100 percent of the area enrolled for the riparian forest practice to a properly functioning condition for distribution and growth of woody plant species.
- Reduce sediment and nutrient pollution from agricultural lands next to the riparian buffers by more than 50 percent.
- Establish adequate vegetation on enrolled riparian areas to stabilize 90 percent of stream banks under normal (non-flood) water conditions.
- Reduce the rate of stream water heating to ambient levels by planting adequate vegetation on all riparian buffer lands.
- Help farmers and ranchers to meet the water quality requirements established under Federal law and Oregon's agricultural water quality laws.

! Provide adequate riparian buffers on 2,000 stream miles to permit natural restoration of stream hydraulic and geomorphic characteristics that meet the habitat requirements of salmon and trout.

Oregon CREP includes a set of best management practices (BMPs) designed to reduce adverse environmental impacts. These BMPs will be followed on all CREP activities and will be provided to all farmers and ranchers who enroll in the program. The Services regard these BMPs as integral components of the Oregon CREP and consider them to be part of the action.

The Services believe that this programmatic consultation on the Oregon CREP removes the requirement for most project level consultation. Consequently, unless otherwise identified within the BO, activities performed within the Oregon CREP that are consistent with the BMPs described in the BA and RPMs and Terms and Conditions described in the BO do not necessitate further consultation. However, the Services have identified certain activities which have a greater likelihood of adverse impacts to salmonids and their habitat which will require site-specific consultation. These activities are identified within the BO and include, but are not limited to, actions such as, bankshaping that exceeds 30 linear feet; all wetland restoration that involves construction, removal, or breaching of dikes, berms, levies, etc.; and, any activities that are not consistent with the CREP BA (BMPs inclusive) and this BO (Reasonable and Prudent Measures and Terms and Conditions inclusive). Other activities that would deviate from guidelines provided within the CREP BA (BMPs inclusive) and from the RMPs or are specifically identified within the BO will require additional site-specific consultation with the Services.

The Services further believe that full achievement of the Oregon CREP is likely to make a very substantial contribution to the survival and recovery of those target aquatic species covered by this opinion. Nonetheless, the Services also believe certain site-specific actions associated with CREP may still result in a small and temporary amount of take. Accordingly, the Services provided a set of nondiscretionary “reasonable and prudent measures” in the accompanying incidental take statement which they believe are necessary to minimize the likelihood that Oregon CREP will result in taking of listed species and designated critical habitats, if any. The opinion also provides a set of “conservation recommendations” based on discretionary actions the Services believe FSA and USDA can carry out for the conservation of endangered species and threatened species.

Species addressed by this opinion include Snake River sockeye salmon (*Oncorhynchus nerka*), Snake River fall chinook salmon (*Oncorhynchus tshawytscha*), Snake River spring/summer chinook salmon (*Oncorhynchus tshawytscha*), Upper Columbia River spring-run chinook salmon (*Oncorhynchus tshawytscha*), Lower Columbia River chinook salmon, all runs (*Oncorhynchus tshawytscha*), Upper Willamette River spring-run chinook salmon (*Oncorhynchus tshawytscha*), Southern Oregon and California Coastal spring and fall chinook salmon (*Oncorhynchus tshawytscha*), Oregon Coast coho salmon (*Oncorhynchus kisutch*), Southern Oregon / Northern California coho salmon (*Oncorhynchus kisutch*), Chum salmon (*Oncorhynchus keta*), Snake River Basin steelhead (*Oncorhynchus mykiss*), Upper Columbia River Basin steelhead (*Oncorhynchus mykiss*), Middle Columbia Basin steelhead (*Oncorhynchus mykiss*), Lower Columbia Basin steelhead (*Oncorhynchus mykiss*), Upper Willamette River steelhead (*Oncorhynchus mykiss*), Southwestern Washington / Columbia River cutthroat trout (*Oncorhynchus clarki clarki*), Umpqua River cutthroat trout (*Oncorhynchus clarki clarki*), Bull trout (*Salvelinus confluentus*), Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*), Oregon chub (*Oregonichthys crameri*), Lost River sucker (*Deltistes luxatus*), Shortnose sucker (*Chasmistes brevirostris*), Aleutian Canada goose (*Branta canadensis leucopareia*), Bald eagle (*Haliaeetus leucocephalus*), Columbian white-tailed deer (*Odocoileus virginianus leucurus*), Nelson's checkermallow (*Sidalcea nelsoniana*), Bradshaw's lomatium (*Lomatium bradshawi*), Howell's spectacular thelopody (*Thelypodium howellii* ssp. *spectabilis*), Rough popcornflower (*Plagiobothrys hirtus*), and Willamette daisy (*Erigeron decumbens* var. *decumbens*).

BIOLOGICAL OPINION

Consultation History

This Biological Opinion is based on information provided in the FSA's BA, dated December 22, 1998; documentation of subsequent discussions among USFWS, NMFS and FSA staff; and FSA's letter, dated March 25, 1999, amending the original BA. Other sources of information used in this opinion include the *Cooperative Agreement between the U.S. Department of Agriculture Commodity Credit Corporation and the State of Oregon Concerning the Implementation of a Conservation Reserve Enhancement Program*, dated October 17, 1998 (CREP Co-op Agreement), *Oregon's Riparian Enhancement Initiative*, dated September 1998 (Oregon's CREP application), the FSA's CREP Manual, file materials, the Services' Biological Opinions on the USFWS Partners for Fish and Wildlife program, all relevant approved recovery plans, and the Federal Register notices of proposed and final listing rules for species covered in this opinion (Table 1). This programmatic consultation covers the Oregon CREP through the year 2014.

Description of the Proposed Action

Overview

The following description of the CREP program is taken largely from the CREP BA and from correspondence among the Services and FSA. The CREP BA was modified by a letter dated March 25, 1999, to incorporate a number of recommendations made by the USFWS regarding the proposed action and to clarify questions raised in the USFWS' March 5, 1999, letter to FSA. Copies of these letters are appended (Appendices A & B). The CREP program is based on the CRP authorized under the provisions of the Food Security Act of 1985, as amended (16 U.S.C. 3830 *et seq*.) and the regulations at 7 CFR Part 1410. As a result, conservation practices referred to in the CREP BA and other supporting documents are defined according to CRP rules and regulations. The proposed action is limited to the installation and maintenance of those conservation practices referred to in the CREP BA. Activities that differ from those described in the BA will require additional site-specific consultation with the Services.

The CREP project area includes private agricultural lands along all streams in Oregon which provide current or historical habitat for 19 species or Evolutionarily Significant Units (ESU) of salmon and trout which are listed under the Act. Up to 100,000 acres of private cropland and grazing land will be eligible for inclusion in this program. Up to 95,000 acres will be planted to riparian buffers and up to 5,000 acres of wetlands will be restored. A total of up to 4,000 miles of important freshwater streams will be enhanced or restored under this program.

Table 1. Species covered in the Biological Opinion for the Oregon Conservation Reserve Enhancement Program.

GROUP	SPECIES	STATUS	LEAD AGENCY
Fishes	Snake River sockeye salmon (*Oncorhynchus nerka*)	E, CH	NMFS
	Snake River fall chinook salmon (*Oncorhynchus tshawytscha*)	T, CH	NMFS
	Snake River spring/summer chinook salmon (*Oncorhynchus tshawytscha*)	T, CH	NMFS
	Upper Columbia River spring-run chinook salmon (*Oncorhynchus tshawytscha*)	E, CH	NMFS
	Lower Columbia River chinook salmon, all runs (*Oncorhynchus tshawytscha*)	T, CH	NMFS
	Upper Willamette River spring-run chinook salmon (*Oncorhynchus tshawytscha*)	T, CH	NMFS
	Southern Oregon and California Coastal spring and fall chinook salmon (*Oncorhynchus tshawytscha*)	PT	NMFS
	Oregon Coast coho salmon (*Oncorhynchus kisutch*)	T	NMFS
	Southern Oregon / Northern California coho salmon (*Oncorhynchus kisutch*)	T, PCH	NMFS
	Chum salmon (*Oncorhynchus keta*)	T, CH	NMFS
	Snake River Basin steelhead (*Oncorhynchus mykiss*)	T, PCH	NMFS
	Upper Columbia River Basin steelhead (*Oncorhynchus mykiss*)	E	NMFS
	Middle Columbia Basin steelhead (*Oncorhynchus mykiss*)	T	NMFS
	Lower Columbia Basin steelhead (*Oncorhynchus mykiss*)	T	NMFS
	Upper Willamette River steelhead (*Oncorhynchus mykiss*)	T	NMFS
	Southwestern Washington / Columbia River cutthroat trout (*Oncorhynchus clarki clarki*)	PT	NMFS

GROUP	SPECIES	STATUS	LEAD AGENCY
Fishes	Umpqua River cutthroat trout (*Oncorhynchus clarki clarki*)	E, CH (proposed for delisting)	NMFS
	Bull trout (*Salvelinus confluentus*)	T	USFWS
	Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*)	T	USFWS
	Oregon chub (*Oregonichthys crameri*)	E	USFWS
	Lost River sucker (*Deltistes luxatus*)	E, PCH	USFWS
	Shortnose sucker (*Chasmistes brevirostris*)	E, PCH	USFWS
Birds	Aleutian Canada goose (*Branta canadensis leucopareia*)	T	USFWS
	Bald eagle (*Haliaeetus leucocephalus*)	T	USFWS
Mammals	Columbian white-tailed deer (*Odocoileus virginianus leucurus*)	E	USFWS
Plants	Nelson's checkermallow (*Sidalcea nelsoniana*)	T	USFWS
	Bradshaw's lomatium (*Lomatium bradshawi*)	E	USFWS
	Howell's spectacular thelopody (*Thelypodium howellii* ssp. *spectabilis*)	PT	USFWS
	Rough popcornflower (*Plagiobothrys hirtus*)	PE	USFWS
	Willamette daisy (*Erigeron decumbens* var. *decumbens*)	PE	USFWS

E = Endangered, T = Threatened, PE = Proposed Endangered, PT = Proposed Threatened, CH = Critical Habitat, PCH = Proposed Critical Habitat

This CREP proposal is designed to address water quality degradation which is a direct or indirect result of agricultural activities on private lands along freshwater streams. On a statewide basis, about 20 percent of the freshwater salmon streams on private lands pass through agricultural land use areas. Farming and ranching activities on these lands have led to removal or elimination of native riparian vegetation with resultant increases in water temperature, rates of sedimentation, and changes in channel morphology.

Under this program, farmers and ranchers who voluntarily participate will enter into contracts with the Federal government for 10 to 15 years, agreeing to remove portions of their land from agricultural production and plant it to grass, shrubs and trees. These producers will be eligible to receive rental payments and other financial assistance in return for removal of their lands from agricultural production. For non-irrigated land, farmers and ranchers will be paid the federally-established dry land soil rental rates. Where land is irrigated, an irrigated soil rental rate will be paid when farmers and ranchers agree to lease the appurtenant water right to the State for instream use.

The eligible practices under this program are riparian forest buffer (CP 22), wetland restoration (CP 23), and grass filter strip (CP 21). A new conservation practice, the Herbaceous Riparian Cover practice, has also been approved by Natural Resource Conservation Service (NRCS) and is awaiting USDA clearance before it may be used in the Oregon CREP program. If approved as proposed, it will be eligible for inclusion in the program.

Farmers and ranchers will receive incentive payments for participation in this program which will be 25 percent above the normal annual rental rate for grass filter strips, and 35 percent and 50 percent above the normal annual rental rate for installation of riparian buffers and wetlands, respectively. Where at least 50 percent of the land along a five mile stretch of stream is enrolled under the program prior to January 1, 2002, producers will receive an additional incentive equal to four times the base annual rental rate. A total of 75 percent of the installation cost of conservation practices will be paid via a combination of State and Federal funds. The total cost of the CREP project is estimated to be $251,000,000 over 15 years.

<u>Objectives of the Oregon CREP</u>

The six objectives of the Oregon CREP are directly related to improvement of freshwater stream systems which provide key habitat for salmonids. These objectives are:

1. Restoration of 100 percent of the area enrolled for the riparian forest practice to a properly functioning condition in terms of distribution and growth of woody plant species.

2. Reduction of sediment and nutrient pollution from agricultural lands adjacent to the riparian buffers by more than 50 percent.

3. Establishment of adequate vegetation on enrolled riparian areas to stabilize 90 percent of stream banks under normal (non-flood) water conditions.

4. Reduction of the rate of stream water heating to ambient levels by planting adequate vegetation on all riparian buffer lands.

5. Provision of a contributing mechanism for farmers and ranchers to meet the water quality requirements established under Federal law and Oregon's agricultural water quality laws.

6. Provision of adequate riparian buffers on 2,000 stream miles to permit natural restoration of stream hydraulic and geomorphic characteristics which meet the habitat requirements of salmon and trout.

<u>Description of the Oregon CREP</u>

The Oregon CREP is a comprehensive, state-wide program designed to reduce and mitigate agriculture-related impacts on streams that provide current or historical habitat for salmon and trout listed pursuant to the Act. In addition to the CREP BA, details of the Oregon CREP program are set forth in the CREP Co-op Agreement (Appendix C), and in FSA's CREP Manual.

The primary mechanism to accomplish this program will be through the establishment of forested riparian buffers. Farmers and ranchers will be afforded the opportunity to voluntarily enter into 10 to 15 year contracts with USDA to plant grasses, shrubs and/or trees on riparian lands they own or manage along salmon and trout streams. Applications from all eligible producers will be accepted into the program on a first-come, first-served basis up to a maximum enrollment of 100,000 acres.

The program will provide for enrollment of 100,000 acres of agricultural land, of which 95,000 acres will be established as riparian buffers and 5,000 acres will be reserved for wetland restoration. Under this program, riparian buffers averaging 100 feet in width will be installed along approximately 4,000 miles of streams. Based on preliminary GIS analyses, it is estimated that there are approximately 1,750 miles of salmon streams which cross private agricultural lands within the State. Therefore, this proposal should be adequate to address all such streams. In addition, riparian areas along streams providing habitat for trout species listed under the Act will also be eligible for enrollment. It is estimated that there are several hundred miles of streams which provide habitat for the listed trout species. Figure 1 of the BA depicts the areas eligible for enrollment under this program, and is herein incorporated by reference. Of the 5,000 acres of wetlands, not less than 25 percent are to be located in coastal estuaries. Upland riparian buffers may be established adjacent to any wetlands established at a ratio of up to 6:1 (i.e., six acres of wetland to one of buffer).

Forest riparian buffers (practice code CP 22) will be the primary conservation practice installed under this program. Grass filter strips (practice code CP 21) and herbaceous riparian cover (if approved as proposed) will only be used on cropland where analysis of available records (historical accounts and photographs) indicates that no trees or shrubs, including willow (*Salix* spp.), existed on the site within historic times. Additionally, if the herbaceous riparian cover practice is approved as proposed, the grass filter strip practice will only be used upslope of the herbaceous riparian cover practice.

These conservation practices shall be installed in accord with all applicable CRP statutes (16 U.S.C. 3831 *et seq.*), regulations (7 CFR Part 1410) and the CREP Manual. In addition, the practices shall be consistent with the specifications outlined in the applicable NRCS Field Office Technical Guides. Appendices 2 and 3 of the BA consist of a current copy of the CRP practices from the FSA national policy handbook (2-CRP) and copies of the current NRCS Oregon Practice Standards and Specifications (incorporated herein by reference).

The State of Oregon, NRCS, USFWS, NMFS, and the Environmental Protection Agency (EPA) have signed an April 1998 Memorandum of Understanding (NRCS MOU) which provides for enhancement of the NRCS Field Office Technical Guides as appropriate to better meet endangered species and water quality issues. The CREP Co-op Agreement between the State of Oregon, the Commodity Credit Corporation and FSA, signed October 17, 1998, recognizes that future modifications to the current Field Office Technical Guides may be implemented, and it provides for the modified Field Office Technical Guides to be implemented within the context of the CREP. The Services fully expect these ongoing modifications will provide greater protection to the listed species targeted under this program.

The riparian buffer will be the most common practice installed under this CREP. It is estimated that riparian buffers will be installed on 90 percent of the lands enrolled under the CREP. The width of the buffers, in accord with the NRCS Riparian Forest Buffer Standard and Specification (391A), will typically range from 35 to 150 feet. However, the maximum width of the riparian buffer may exceed 150 feet in order to accommodate particular resource objectives on a site-specific basis.

Under this program, funds may only be used to install and maintain conservation practices on eligible cropland and marginal pastureland. No instream work (i.e., work within the "streambank width") will be undertaken except for the installation of offstream livestock watering facilities and livestock crossings across small streams. The definition of the term "streambank width" as used in the BA, CREP Co-op Agreement, and CREP Manual is the width of the stream at "bankfull discharge" as defined here:

> *Bankfull discharge:* The discharge that controls the shape of the stream channel; the discharge which is most efficient, transporting the most sediment and water with the least amount of energy. The level of the active floodplain (Leopold 1994).

It is estimated that nearly 60 percent of the land which will be enrolled under this program is pasture or range land. Pursuant to existing law (16 U.S.C. 3831(b)(3)), marginal pastureland can only be enrolled in the Conservation Reserve Program, and thus in CREP, if planted to trees in or near riparian areas. Therefore, all marginal pastureland will be planted to trees.

In any case where USDA pays the irrigated cropland rental rates to a participating farmer, that portion of the existing water right appurtenant to the enrolled acreage shall be dedicated for instream flow pursuant to the laws of the State of Oregon for the duration of the CREP contract. Under State law, these leases can only be for two years duration and therefore will have to be renewed biennially for the duration of the CREP contract. At the end of the CREP contract, water right holders will have several options: resume the right for the authorized purpose on all lands to which it is appurtenant, continue leasing the water for instream use, transfer the instream right to the State, transfer the right to other lands, or abandon the water right. Based on the average statewide agricultural irrigation water usage of three acre feet for each acre of agricultural land, as cited in the BA, CREP is projected to restore up to 60,000 acre feet of water per year to salmon and trout streams.

The Oregon CREP proposes a cumulative impact incentive which is designed to encourage adjacent farmers and ranchers to enter the program to concentrate the use of restoration practices, thereby increasing the effectiveness of those practices. Under this incentive system, USDA will make a one-time payment to all enrollees when a sufficient number of landowners agree to participate along a particular stream. This incentive payment would be made in any case where a total of at least 50 percent of the streambank within a five-mile stream segment is enrolled under the program. The incentive will be four times the base annual rental rate (without inclusion of any other incentives) for each acre enrolled. Enrollees would be eligible for this incentive only through the end of calendar year 2002, which will encourage producers to enroll soon after the program is established. Under this CREP agreement, farmers and ranchers will be eligible to enroll in contracts of 10 to 15 years duration, but administering agencies intend to encourage enrollment in longer contracts.

The State and USDA will jointly administer this CREP. The primary responsibilities of the various Federal and State agencies involved in the implementation of this CREP are as follows.

The FSA County Committee will:

- develop recommendations for soil rental rates;
- work with Oregon Department of Fish and Wildlife (ODFW), NMFS and USFWS to determine streams eligible for inclusion in the program;
- determine eligibility for the cumulative impact payments; and
- approve CREP contracts.

The NRCS will:

- determine acreage eligible and suitable for enrollment;
- participate in development and approval of all conservation plans;
- develop specifications, provide oversight during installation, certify completion of filter strips and wetland restoration practices; and
- complete required status reviews.

The Oregon Department of Forestry will:

- develop tree planting specifications, provide oversight during installation and certify the completion of all installations of forested riparian buffers.

The Conservation District employees, funded by the State of Oregon, will:

- provide outreach on the program and assist landowners in the development of conservation plans.

The Oregon Department of Water Resources will:

- perfect the leasing of landowner water rights for instream use.

The Governor's Watershed Enhancement Board will:

- coordinate the overall monitoring effort by the various State agencies.

Monitoring

The State of Oregon is developing a uniform system of reporting watershed restoration projects and monitoring salmon recovery and has dedicated staff resources to ensure that projects are reported systematically. The Oregon CREP monitoring program will build on existing monitoring programs of the Oregon Department of Environmental Quality, Oregon Department of Forestry, ODFW, and the Oregon Department of Water Resources. Where available, this program will utilize existing data from other Federal and citizen monitoring programs.

As a condition for funding, landowners must agree to allow access to sites for monitoring purposes including pre-treatment baseline data collection. Landowners will be informed that effectiveness monitoring sites will be selected randomly. Landowners will be informed that data will be collected to assess the effectiveness of the program in reaching water quality and aquatic habitat goals and not for enforcement purposes. If potential violations are discovered, the appropriate agency will work cooperatively with the landowner to achieve compliance.

The near-term focus of the CREP monitoring program will be on project documentation, plant growth and survival, and the effects of riparian treatments on instream water quality conditions. The extended response time associated with riparian forest growth and recovery necessitates a commitment to long-term monitoring. Mid-term monitoring will incorporate stream shading, temperature monitoring and channel morphology. Large woody debris recruitment is a long-term component of the CREP.

The Oregon Plan Watershed Restoration Inventory currently collects data on riparian enhancement activities throughout Oregon using a written survey method. This inventory will be expanded to address specific monitoring questions for the CREP. Additional parameters may include age, source, method, density, species, height, soil type and predation control. All CREP projects will be documented because completion of the Oregon Plan watershed restoration reporting form will be required for all CREP participants.

Effectiveness monitoring questions for the CREP will focus on the specific project objectives and will be addressed using field-based methods. All monitoring data collected will be in accordance with existing protocols. Water quality baseline data (pre-treatment or if not available, upstream monitoring) will be established. A subset of completed CREP projects will be randomly selected to evaluate the effectiveness of the CREP program. Where feasible, monitoring will include both treated and reference sites.

Water quality parameters will be monitored using Department of Environmental Quality protocols. The parameters measured will include stream temperature, sediment deposition, and agriculture chemical concentrations. Water quality monitoring sites will be established at upstream and downstream locations from treated reaches, as well as upstream and downstream locations from potential upstream sources of sediment and nutrient inputs to the stream. Monitoring will attempt to distinguish between road-related and agricultural sources of sediment.

Bank stability and stream channel morphology will be evaluated at selected project sites using ODFW's Aquatic Habitat Inventory protocol. Riparian tree growth and survival will be assessed using Oregon Department of Forestry's riparian conditions monitoring protocol, and will include assessment of woody and herbaceous browsing. Fish populations will be sampled to determine if treated reaches provide favorable habitat for juvenile rearing or adult spawners using ODFW's Juvenile Rearing and Adult Salmonid Inventory Project methods.

Outreach

The overall success of this voluntary program will be directly correlated to the level of enrollment by farmers and ranchers. A critical aspect of securing enrollment is distribution of program information and education of producers. Research has shown that one-on-one discussions of agricultural programs between producers and key individuals (USDA representatives, Extension agents, and other producers) is the most effective way to secure producer participation. Therefore, broad public outreach by Federal and State employees is proposed as a major component of this program.

In addition, the State will develop public outreach material in cooperation with the USDA agencies (FSA, NRCS, Oregon State University Extension). Information will address native fish and water quality issues. Local community groups (watershed councils, local FSA committees, and Soil and Water Conservation Districts) will identify interested landowners and develop cooperative landowner outreach efforts. A joint USDA/Oregon Communication Plan has been developed. This plan identifies priority target audiences, desired response, targeted messages and tactics for outreach about the Oregon CREP.

Best Management Practices

Best management practices (BMPs) are designed to reduce adverse environmental impacts resulting from the installation of CREP practices. The Services consider these BMPs to be part of the CREP action and assume that they will be binding requirements within each contract. Consequently, the following BMPs will be included as conditions in all CREP contracts and will be provided to all farmers and ranchers who enroll in the program.

1. All terms and conditions in regulatory permits and other official project authorizations to eliminate or reduce adverse impacts to any endangered or threatened species or their critical habitats will be followed.

2. Restoration activities at individual project sites will be completed in an expeditious manner. In addition, proper scheduling will be used to reduce disturbance and/or displacement of fish and wildlife species in the immediate project area.

3. Vehicular access ways to project sites will provide for minimizing impacts on riparian corridors.

4. Minimize to the extent practicable, the use of heavy equipment and techniques that will result in soil disturbance or compaction of soils, especially on steep or unstable slopes.

5. Vehicles will not enter or cross streams except in cases where no alternative exists. Where stream crossings are required, the number of crossings will be minimized. Vehicles and machinery will cross streams at right angles to the main channel whenever

possible. Any stream crossings will be consistent with ODFW and Oregon Department of Forestry instream use guidelines.[1]

6. Staging and refueling areas will be properly located to prevent potential contamination of any waterbody.

7. There will be no instream work except for installation of livestock crossings and installation of offstream livestock watering facilities. Bank shaping will be done from the top of the bank.

8. Vegetative planting techniques must not cause major disturbances to soils and slopes. Hand planting is the preferred technique for all plantings, except for filter strips. Plantings will occur during the appropriate seasonal period for the respective plant species involved.

9. The evaluation of herbicide, pesticide, and fertilizer use will include the accuracy of applications, effects on target and non-target species, and the potential impacts to aquatic and terrestrial ecosystems. All chemical applications will follow label instructions. Projects specifications, to be developed by qualified agency personnel, will fully address timing, rate of application and application methodology.

10. Sedimentation and erosion controls will be implemented on all project sites where the implementation of restoration activities has the potential to deposit sediment into a stream or waterbody. Structures/techniques must be placed and/or anchored appropriately to prevent adverse impacts to down slope habitats. Control structures/techniques may include, but are not limited to, silt fences, straw bale structures, seeding by hand and hydro-seeding, jutte mats, and coconut logs. Grading and shaping will generally restore natural topography and hydrology.

11. Streambank shaping will only be implemented where streambank stability is extremely poor or where necessary to restore riparian functions. Streambank modification for planting purposes will be thoroughly documented, and on each CREP contract where more than 30 linear feet of streambank is shaped by mechanical equipment, USDA will consult with the Services. Design of all streambank modification projects will recognize the important wildlife values provided along naturally eroding outside meander curves. Any soil control structures will be bio-engineered to the extent possible. No rip rap will

[1]The Services assume this BMP refers to the ODFW in-water timing and road crossing guidelines (ODFW 1997a,b) as well as the appropriate guidelines allowed by the Oregon Department of Forestry (Oregon Department of Forestry 1995).

be used under this program for streambank stabilization. No streambank stabilization activity will reduce natural stream functions or floodplain connection.

12. Qualified agency personnel will develop plant specifications detailing types of seeds, sources for seed, handling of plant material and planting techniques. Seedling competition will be reduced by controlling grasses, forbs, and woody shrubs from around each seedling for an appropriate distance. Proper methods to protect seedlings from animal, insect, and environmental damage will be employed.

13. Fence designs (e.g., wire type and wire spacing) will be in accord with NRCS standards.

14. Off-channel livestock watering facilities will not be located in areas where compaction and/or damage could occur to sensitive soils, slopes, or vegetation due to congregating livestock. Livestock stream crossings will only be constructed on the smallest streams, generally 10 feet or less in width at mean high water level. Crossings will not be placed on the mid- to downstream end of gravel point bars. Crossings will generally be 30 feet or less in width. Any culverts constructed for livestock crossing purposes will meet NMFS guidelines. Livestock fords across streams will be appropriately rocked to stabilize soils/slopes and prevent erosion. Fords will be placed on bedrock or stable substrates whenever possible.

15. Native vegetation will be used under this project. Where use of native vegetation is not feasible, similar species which are functional equivalents and known not to be aggressive colonizers may be substituted.

16. For any project within ¼ mile non-line-of-sight or ½ mile line-of-sight of an eagle nest identified by ODFW, no activities producing noise above ambient levels will occur at the site from January 1 to August 31. If a proposed activity is near a bald eagle nest and must occur during this restricted period, site-specific consultation with USFWS will be initiated to evaluate the potential for adverse effects.

17. Survey data from USFWS and Oregon Natural Heritage Inventory will be used to identify potential locations where five listed and proposed plant species (see Table 2) may be located along stream corridors within the project area. Where required, surveys by trained personnel will be conducted for the presence of these species. Any locations of these plants identified in a survey will be avoided through redesign of the project as necessary.

18. Where project sites are located within ¼ mile of active resting and foraging sites for the Aleutian Canada Goose as identified by USFWS in the coastal areas of Tillamook,

Coos and Curry Counties, work activities producing noise above ambient levels will not occur during the birds' normal wintering and migration period from October 1 to April 30. In addition, all CREP projects proposed in the area of the New River bottoms (southern Coos and northern Curry counties) within Township 30 South, Range 15 West, Sections 14, 15, 27, 28, 33, 34 and in Township 31 South, Range 15 West, Sections 3, 4, 8, 9, 16,
17, or near the Nestucca River near Pacific City within Township 4 South, Range 10 West, Section 19, Willamette Meridian, will not proceed without site-specific consultation with USFWS to evaluate the potential for local adverse effects to the Aleutian Canada goose.

Table 2. Soil type associations of listed and proposed plants that may be affected by the Oregon Conservation Reserve Enhancement Program.

Species	**Location**	**Habitat**	**NRCS Mapped Soil Unit**	**Soil Series**
Howell's Spectacular Thelypody (*Thelypodium howellii* var. *spectabilis*)	Union and Baker Counties	Moist meadows	STATSGO[2] 179	Wingville, Baldock, and Haines
Rough Popcornflower (*Plagiobothrys hirtus*)	Umpqua River Valley, Douglas County	Moist valley bottoms	SSURGO[3] 44A	Conser Silty Clay Loam
Willamette Daisy (*Erigeron decumbens* var. *decumbens*)	Willamette Valley	Bottomland and upland prairie	STATSGO 81	Wapto, Bashaw and Mcalpin
Nelson's Checkermallow (*Sidalcea nelsoniana*)	Willamette Valley and Washington, Tillamook and Yamhill Counties in the Coast Range	Wetlands and riparian areas	STATSGO 81 and STATSGO 91	Wapto, Bashaw, Mcalpin; and, Malabon, Coburg, Salem
Bradshaw's Lomatium (*Lomatium bradshawii*)	Southern Willamette Valley	Wet prairies	STATSGO 81	Wapto, Bashaw, Mcalpin

Note: The USFWS has been able to further refine the soils data provided during informal consultation and development of the FSA's biological assessment. However, additional refinement of the soil types or series on which all CREP projects will require botanical surveys cannot be completed until additional data are made available on the NRCS SSURGO database. Once the relevant data are made available, the USFWS will work with FSA and NRCS to further reduce the required level of survey effort by developing more refined plant/soil associations.

[2]STATSGO refers to the NRCS State Soils Geographic database.

[3]SSURGO refers to the NRCS Soil Survey Geographic Database. Mapped SSURGO soil units offer higher resolution than mapped STATSGO units, and would thus require lower survey effort.

Environmental Baseline

Regulations implementing section 7 of the Act (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. The environmental baseline also includes the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation, and the impacts of State and private actions that are contemporaneous with the consultation in progress.

The action area is defined in 50 CFR 402.02 to mean "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the purposes of this consultation, the action area includes all lands where CREP projects may be implemented within the State of Oregon, and all areas downstream from these sites.

The following Environmental Baseline discussion focuses primarily on the baseline conditions of streams inhabited by the 19 listed salmonid fishes that are the target species for the Oregon CREP program, and three non-target listed fish species: the Oregon chub, Lost River sucker, and shortnose sucker. All of these aquatic species, though variable in their biological and life history traits, would experience the impacts of agricultural practices in similar ways, though to varying degrees. The environmental baseline for non-target terrestrial species is addressed near the end of this section of the Biological Opinion.

The current population status of the proposed, listed and candidate species addressed in this Biological Opinion is described below. For some species, adequate population data are lacking, and habitat conditions provide a means of evaluating the status of the species.

Status of Aquatic Species within the Action Area

Snake River Sockeye Salmon
The Snake River sockeye salmon was listed as endangered in 1991 (56 FR 58519). The following summary information is from 56 FR 58519.

Adult Migration and Spawning Snake River sockeye salmon enter the Columbia River primarily during June and July. Arrival at Redfish Lake, Idaho, which now supports the only remaining run of Snake River sockeye salmon, peaks in August and spawning occurs primarily in October. Eggs hatch in the spring between 80 and 140 days after spawning. Fry remain in the gravel for three to five weeks, emerge in April through May, and move immediately into the lake where juveniles feed on plankton for one to three years before migrating to the ocean. Migrants leave Redfish Lake from late April through May, and smolts migrate almost 900 miles to the Pacific Ocean.

The critical habitat for the Snake River sockeye salmon was designated in December 1993 (58 FR 68543). The designated habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, Alturas Lake Creek, Valley Creek, and Stanley, Redfish, Yellow Belly, Pettit, and Alturas Lakes (including their inlet and outlet creeks).

Juvenile Outmigration/Smolts Passage at Lower Granite Dam (the first dam on the Snake River downstream from the Salmon River) ranges from late April to July, with peak passage from May to late June. Once in the ocean, the smolts remain inshore or within the Columbia River influence during the early summer months. Later, they migrate through the northeast Pacific Ocean. Snake River sockeye salmon usually spend two to three years in the Pacific Ocean and return in their fourth or fifth year of life. Historically, the largest numbers of Snake River sockeye salmon returned to headwaters of the Payette River, where 75,000 were taken one year by a single fishing operation in Big Payette Lake. During the early 1880s, returns of Snake River sockeye salmon to the headwaters of the Grande Ronde river in Oregon (Walleye Lake) were estimated between 24,000 and 30,000 at a minimum. During the 1950s and 1960s, adult returns to Redfish Lake numbered more than 4,000 fish.

Snake River sockeye salmon returns to Redfish Lake since at least 1985, when the Idaho Department of Fish and Game began operating a temporary weir below the lake, have been extremely small (one to 29 adults counted per year). Snake River sockeye salmon have a very limited distribution relative to critical spawning and rearing habitat. Redfish Lake represents only one of the five Stanley Basin lakes historically occupied by Snake River sockeye salmon and is designated as critical habitat for the species.

Chinook Salmon

The following summary of general life history and ecology is taken from 63 FR 11481. Chinook salmon are easily distinguished from other *Oncorhynchus* species by their large size. Adults weighing over 120 pounds have been caught in North American waters. Chinook salmon are very similar to coho salmon in appearance while at sea (blue-green back with silver flanks), except for their large size, small black spots on both lobes of the tail, and black pigment along the base of the teeth. Chinook salmon are anadromous and semelparous. This means that as adults, they migrate from a marine environment into the freshwater streams and rivers of their birth (anadromous) where they spawn and die (semelparous). Adult female chinook will prepare a spawning bed, called a redd, in a stream area with suitable gravel composition, water depth and velocity. Redds will vary widely in size and in location within the stream or river. The adult female chinook may deposit eggs in four to five "nesting pockets" within a single redd. After laying eggs in a redd, adult chinook will guard the redd from four to 25 days before dying. Chinook salmon eggs will hatch, depending upon water temperatures, between 90 to 150 days after deposition. Stream flow, gravel quality, and silt load all significantly influence the survival of developing chinook salmon eggs. Juvenile chinook may spend from three months to two years in freshwater after emergence and before migrating to estuarine areas as smolts, and then into the ocean to feed and mature.

Among chinook salmon two distinct races have evolved. One race, described as a "stream-type" chinook, is found most commonly in headwater streams. Steam-type chinook salmon have a longer freshwater residency, and perform extensive offshore migrations before returning to their natal streams in the spring or summer months. The second race is called the "ocean-type" chinook, which is commonly found in coastal steams in North America. Ocean-type chinook typically migrate to sea within the first three months of emergence, but they may spend up to a year in freshwater prior to emigration. They also spend their ocean life in coastal waters. Ocean-type chinook salmon return to their natal streams or rivers as spring, winter, fall, summer, and late-fall runs, but summer and fall runs predominate. The difference between these life history types is also physical, with both genetic and morphological foundations.

Juvenile steam- and ocean-type chinook salmon have adapted to different ecological niches. Ocean-type chinook salmon tend to utilize estuaries and coastal areas more extensively for juvenile rearing. The brackish water areas in estuaries also moderate physiological stress during parr-smolt transition. The development of the ocean-type life history strategy may have been a response to the limited carrying capacity of smaller stream systems and glacially scoured, unproductive, watersheds, or a means of avoiding the impact of seasonal floods in the lower portion of many watersheds.

Stream-type juveniles are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. A stream-type life history may be adapted to those watersheds, or parts of watersheds, that are more consistently productive and less susceptible to dramatic changes in water flow, or which have environmental conditions that would severely limit the success of subyearling smolts. At the time of saltwater entry, stream-type (yearling) smolts are much larger, averaging 73-134 mm depending on the river system, than their ocean-type (subyearling) counterparts and are, therefore, able to move offshore relatively quickly.

Coast wide, chinook salmon remain at sea for one to six years (more common, two to four years), with the exception of a small proportion of yearling males, called jack salmon, which mature in freshwater or return after two or three months in salt water. Ocean- and steam-type chinook salmon are recovered differentially in coastal and mid-ocean fisheries, indicating divergent migratory routes. Ocean-type chinook salmon tend to migrate along the coast, while stream-type chinook salmon are found far from the coast in the central North Pacific. Differences in the ocean distribution of specific stocks may be indicative of resource partitioning and may be important to the success of the species as a whole.

There is a significant genetic influence to the freshwater component of the returning adult migratory process. A number of studies show that chinook salmon return to their natal streams with a high degree of fidelity. Salmon may have evolved this trait as a method of ensuring an adequate incubation and rearing habitat. It also provides a mechanism for reproductive isolation and local adaptation. Conversely, returning to a stream other than that of one's origin is important in colonizing new areas and responding to unfavorable or perturbed conditions at the natal steam.

Chinook salmon stocks exhibit considerable variability in size and age of maturation, and at least some portion of this variation is genetically determined. The relationship between size and length of migration may also reflect the earlier timing of river entry and the cessation of feeding for chinook salmon stocks that migrate to the upper reaches of river systems. Body size, which is correlated with age, may be an important factor in migration and redd construction success. Under high density conditions on the spawning ground, natural selection may produce stocks with exceptionally large-sized returning adults.

Early researchers recorded the existence of different temporal "runs" or modes in the migration of chinook salmon from the ocean to freshwater. Freshwater entry and spawning timing are believed to be related to local temperature and water flow regimes. Seasonal "runs" (i.e., spring, summer, fall, or winter) have been identified on the basis of when adult chinook salmon enter freshwater to begin their spawning migration. However, distinct runs also differ in the degree of maturation at the time of river entry, the thermal regime and flow characteristics of their spawning site, and their actual time of spawning. Egg deposition must occur at a time to ensure that fry emerge during the following spring when the river or estuary productivity is sufficient for juvenile survival and growth.

Pathogen resistance is another locally adapted trait. Chinook salmon from the Columbia River drainage were less susceptible to *Ceratomyxa shasta*, an endemic pathogen, then stocks from coastal rivers where the disease is not know to occur. Alaskan and Columbia River stocks of chinook salmon exhibit different levels of susceptibility to the infectious hematopoietic necrosis virus (IHNV). Variability in temperature tolerance between populations is likely due to selection for local conditions; however, there is little information on the genetic basis of this trait.

Physical and chemical habitat characteristics for chinook salmon, in general are as follows:

- Temperatures for optimal egg incubation are 5.0-14.4 ^{o}C.
- Upper lethal limit is 25.1 ^{o}C, but may be lower depending on other water quality factors.
- Dissolved oxygen for successful egg development in redds is $\geq$ 5.0 mg/l, and water temperatures of 4-14 ^{o}C.
- Freshwater juveniles avoid water with $\leq$ 4.5 mg/l dissolved oxygen at 20 ^{o}C.
- Migrating adults will pass through water with dissolved oxygen levels as low as 3.5-4.0 mg/l. Excessive silt loads (>4,000 mg/l) may halt chinook salmon movements or migrations. Silt can also hinder fry emergence, and limit benthic invertebrate

production. Low pH decreases egg and alevin (larval stage dependent on yolk sac as food) survival.

Snake River Fall Chinook Salmon

Snake River fall chinook salmon was listed as threatened in 1992 (59 FR 66786). An Emergency Rule (59 FR 54840) proposing to reclassify Snake River chinook from threatened to endangered, was published in November 1994, but expired on May 1995. Critical habitat for the Snake River fall chinook salmon was designated in December 1993 (58 FR 68543) and modified in March 1998 (63 FR 11515) to include the Deschutes River. The following summary is taken from information in these Federal Register notices.

A 1995 status review found that the Deschutes River fall-run chinook salmon population should be considered part of the Snake River fall-run ESU. Populations from Deschutes River and the Marion Drain (tributary of the Yakima River) show a greater genetic affinity to Snake River ESU fall chinook than to the Upper Columbia River summer/fall-run chinook (63 FR 11490). The designated critical habitat (63 FR 11515) includes all river reaches assessable to chinook salmon in the Columbia River from The Dalles Dam upstream to the confluence with the Snake River in Washington (inclusive). Critical habitat in the Snake River includes its tributaries in Idaho, Oregon, and Washington (exclusive of the upper Grande Ronde River and the Wallowa River in Oregon, the Clearwater River above its confluence with Lolo Creek in Idaho, and the Salmon River upstream of its confluence with French Creek in Idaho). Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to The Dalles Dam. Excluded are areas above specific dams identified in Table 17 of the Federal Register Notice (see 63 FR 11519) or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years).

ESU Status Almost all historical Snake River fall-run chinook salmon spawning habitat in the Snake River Basin was blocked by the Hells Canyon Dam complex; other habitat blockages have also occurred in Columbia River tributaries. The ESU's range has also been affected by agricultural water withdrawals, grazing, and vegetation management. The continued straying by non-native hatchery fish into natural production areas is an additional source of risk. Assessing extinction risk to the newly-configured ESU is difficult because of the geographic discontinuity and the disparity in the status of the two remaining populations. The relatively recent extirpation of fall-run chinook in the John Day, Umatilla, and Walla Walla Rivers is also a factor in assessing the risk to the overall ESU. Long-term trends in abundance for specific tributary systems are mixed. NMFS concluded that the ESU as a whole is likely to become an endangered species within the foreseeable future, in spite of the relative health of the Deschutes River population.

See the third paragraph under Snake River spring/summer chinook salmon for life history comparisons between fall and spring/summer chinook salmon. Adult Snake River fall chinook salmon enter the Columbia River in July and migrate into the Snake River from August through October. Fall chinook salmon natural spawning is primarily limited to the Snake River below Hells Canyon Dam, and the lower reaches of the Clearwater, Grand Ronde, Imnaha, Salmon and Tucannon Rivers. Fall chinook salmon generally spawn from October through November and fry emerge from March through April.

Downstream migration generally begins within several weeks of emergence with juveniles rearing in backwaters and shallow water areas through mid-summer prior to smolting and migration. Peak migration in the Brownlee-Oxbow Dam reach of the Snake River occurs from April through the middle of May. Juveniles will spend one to four years in the Pacific Ocean before beginning their spawning migration. Chinook salmon fry tend to linger in the lower Columbia River and may spend a considerable portion of their first year in the estuary. For detailed information on the Snake River fall chinook salmon see 56 FR 29542.

Elevated water temperatures are thought to preclude returning of fall chinook salmon in the Snake River after early to mid-July. The preferred temperature range for chinook salmon has been variously described as 12.2-13.9 °C, 10-15.6 °C, or 13-18 °C.. Summer temperatures in the Snake River substantially exceed the upper limits of this range.

No reliable historic estimates of abundance are available for Snake River fall chinook salmon. Estimated returns of Snake River fall chinook salmon declined from 72,000 annually between 1938 and 1949, to 29,000 from 1950 through. Estimated returns of naturally produced adults form 1985 through 1993 range from 114 to 742 fish.

<u>Snake River Spring/Summer Chinook Salmon</u>

The Snake River spring/summer chinook salmon was listed as threatened in 1994 (59 FR 66786) The following summary information is from this Federal Register notice.

This Evolutionarily Significant Unit (ESU) was listed as threatened in April 1992 and was “downgraded” to a proposed endangered status in December 1994. The November 1994 Emergency Rule (59 FR 54840), reclassifying Snake River chinook from threatened to endangered, expired in May 1995. The critical habitat for the Snake River spring/summer chinook salmon was designated in December 1993 (58 FR 68543). The designated habitat consists of river reaches of the Columbia, Snake, and Salmon Rivers, and all tributaries of the Snake and Salmon Rivers (except the Clearwater River) presently or historically accessible to Snake River spring/summer chinook salmon (except reaches above impassable natural falls and Hells Canyon Dam).

ESU status This information is taken from 56 FR 29544. Historically, it is estimated that 44 percent of the combined Columbia River spring/summer chinook salmon returning adults entered the Salmon River. Since the 1960s, counts at Snake River dams have declined considerably. Snake River redd counts in index areas provide the best indicator of trends and status of the wild spring/summer chinook population. The abundance of wild Snake River spring/summer chinook has declined more at the mouth of the Columbia River than the redd trends indicate. Although pre-1991 data suggest several thousand wild spring/summer chinook salmon return to the Snake River each year, these fish are thinly spread over a large and complex river system.

In general, the habitats utilized for spawning and early juvenile rearing are different among the three chinook salmon forms (spring, summer, and fall). In both the Columbia and Snake Rivers, spring chinook salmon tend to use small, higher elevation streams (headwaters), and fall chinook salmon tend to use large, lower elevation streams or mainstem areas. Summer chinook are more variable in their spawning habitats; in the Snake river, they inhabit small, high elevation tributaries typical of spring chinook salmon habitat, whereas in the upper Columbia River they spawn in the larger lower elevation streams characteristic of fall chinook salmon habitat. Differences are also evident in juvenile out-migration behavior. In both rivers, spring chinook salmon migrate swiftly to sea as yearling smolts, and fall chinook salmon move seaward slowly as subyearlings. Summer chinook salmon in the Snake River resemble spring-run fish in migrating as yearlings, but migrate as subyearlings in the upper Columbia River. Early researchers categorized the two behavioral types as "ocean-type" chinook for seaward migrating subyearlings and as "stream-type" chinook for the yearling migrants.

Life history information clearly indicates a strong affinity between summer- and fall-run fish in the upper Columbia River, and between spring- and summer-run fish in the Snake River. Genetic data support the hypothesis that these affinities correspond to ancestral relationships. The relationship between Snake River spring and summer chinook salmon is more complex and is not discussed here.

The present range of spawning and rearing habitat for naturally-spawned Snake River spring/summer chinook salmon is primarily limited to the Salmon, Grande Ronde, Imnaha, and Tucannon sub-basins. Most Snake River spring/summer chinook salmon enter individual sub-basins from May through September. Juvenile Snake River spring/summer chinook salmon emerge from spawning gravels from February through June. Typically, after rearing in their nursery streams for about one year, smolts begin migrating seaward in April through May. After reaching the mouth of the Columbia River, spring/summer chinook salmon probably inhabit near shore areas before beginning their northeast Pacific Ocean migration, which lasts two to three years. For detailed information on the life history and stock status of Snake River spring/summer chinook salmon, see 56 FR 29542.

The number of wild adult Snake River spring/summer chinook salmon in the late 1800s was estimated to be more than 1.5 million fish annually. By the 1950s, the population had declined to an estimated 125,000 adults. Escapement estimates indicate that the population continued to decline through the 1970s. Redd count data also show that the populations continued to decline through about 1980.

The Snake River spring/summer chinook salmon ESU, the distinct population segment listed under the Act , consists of 39 local spawning populations (sub-populations) spread over a large geographic area. The number of fish returning to a given subpopulation would, therefore, be much less than the total run size.

Based on recent trends in redd counts in major tributaries of the Snake River, many sub-populations could be at critically low levels. Sub-populations in the Grande Ronde River, Middle Fork Salmon River, and Upper Salmon River basins are at particularly high risk. Both demographic and genetic risks would be of concern for such sub-populations, and in some cases, habitat may be so sparsely populated that adults have difficulty finding mates.

<u>Upper Columbia River Spring-Run Chinook Salmon</u>

The Upper Columbia River spring-run chinook salmon was listed as endangered in March 1999 (64 FR 14308). The following life history information is taken from 63 FR 11489.

NMFS listed several chinook salmon ESUs under the Act in March 1999 (64 FR 14308). The Upper Columbia River spring-run chinook ESU is listed endangered. This ESU includes stream-type chinook salmon spawning above Rock Island Dam - that is, those in the Wenatchee, Entiat, and Methow Rivers. All chinook salmon in the Okanogan River are apparently ocean-type and are considered part of the Upper Columbia River summer- and fall-run ESU. Critical habitat designation is found on page 11515 of 63 FR. Designated habitat includes all river reaches accessible to chinook salmon in Columbia River tributaries upstream of the Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to Chief Joseph Dam in Washington. Excluded are areas above specific dams identified in Table 16 of 63 FR 11481 or above longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years).

This ESU was first identified as the Mid-Columbia River summer/fall chinook salmon ESU but a later determinations concluded this ESU's boundaries do not extend downstream from the Snake River. The ESU status of the Marion Drain population from the Yakima River is still unresolved.

ESU status Access to a substantial portion of historical habitat was blocked by Chief Joseph and Grand Coulee Dams. There are local habitat problems related to irrigation diversions and hydroelectric development, as well as degraded riparian and instream habitat from urbanization and livestock grazing. Mainstem Columbia River hydroelectric development has resulted in a major disruption of migration corridors and affected flow regimes and estuarine habitat. Some populations in this ESU must migrate through nine mainstem dams.

Artificial propagation efforts have had a significant impact on spring-run populations in this ESU, either through hatchery-based enhancement or the extensive trapping and transportation. Harvest rates are low for this ESU, with very low ocean and moderate instream harvest. Previous assessments of stocks within this ESU have identified several as being at risk or of concern. Due to lack of information on chinook salmon stocks that are presumed to be extinct, the relationship of these stocks to existing ESUs is uncertain. Recent total abundance of this ESU is quite low, and escapements in 1994-1996 were the lowest in at least 60 years. At least six populations of spring chinook salmon in this ESU have become extinct, and almost all remaining naturally-spawning populations have fewer than 100 spawners. In addition to extremely small population sizes, both recent and long-term trends in abundance are downward, some extremely so. NMFS concluded that chinook salmon in this ESU are in danger of extinction.

Chinook salmon from this ESU primarily emigrate to the ocean as subyearlings but mature at an older age than ocean-type chinook salmon in the Lower Columbia and Snake Rivers. Furthermore, a greater proportion of tag recoveries for this ESU occur in the Alaskan coastal fishery than is the case for Snake River fish. The status review for Snake River fall chinook salmon also identified genetic and environmental differences between the Columbia and Snake rivers. Substantial life history and genetic differences distinguish fish in this ESU from stream-type spring chinook salmon from the upper-Columbia River.

The ESU boundaries fall within part of the Columbia Basin Ecoregion. The areas is generally dry and relies on Cascade Range snowmelt for peak spring flows. Historically, this ESU likely extended farther upstream; spawning habitat was compressed down-river following construction of Grand Coulee Dam.

<u>Lower Columbia River Chinook Salmon, All Runs</u>:

In March 1999, NMFS listed several chinook salmon ESUs in the Lower Columbia River as threatened under the Act (64 FR 14308). The following life history information is taken from 63 FR 11488.

The Lower Columbia River spring-run chinook ESU is listed as threatened. This ESU includes all naturally spawned chinook populations from the mouth of the Columbia river to the crest of the Cascade Range, excluding populations above Willamette Falls. Designated critical habitat can be found in 63 FR, page 11515. The designation is designed to include all river reaches accessible to chinook salmon in Columbia River tributaries between the Grays and White Salmon Rivers in Washington and the Willamette and Hood Rivers in Oregon, inclusive. Also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to The Dalles Dam; with the usual exclusions.

ESU status Apart form the relatively large and apparently healthy fall-run population in the Lewis River, production in this ESU appears to be predominantly hatchery-driven with few identifiable naturally spawned populations. All basins are affected (to varying degrees) by habitat degradation. Hatchery programs have had a negative effect on the native ESU. Efforts to enhance chinook salmon fisheries abundance in the lower Columbia River began in the 1870s. Available evidence indicates a pervasive influence of hatchery fish on natural populations throughout this ESU, including both spring- and fall-run populations. The large number of hatchery fish in this ESU make it difficult to determine the proportion of naturally produced fish. The loss of fitness and diversity within the ESU is an important concern.

Harvest rates on fall-run stocks are moderately high, with an average total exploitation rate of 65 percent. Harvest rates are somewhat lower for spring-run stocks, with estimates for the Lewis River totaling 50 percent. Previous assessments of stocks within this ESU have identified several stocks as being at risk or of concern. There have been at least six documented extinctions of populations in the ESU, and it is possible that extirpation of other native population has occurred but has been masked by the presence of naturally spawning hatchery fish. NMFS concludes that chinook salmon in this ESU are not presently in danger of extinction but are likely to become endangered in the foreseeable future.

<u>Upper Willamette River Spring-Run Chinook Salmon</u>

The Upper Willamette River spring-run chinook salmon was listed as threatened in March 1999 (64 FR 14308). The following life history information is taken from 63 FR 11489.

This ESU includes naturally spawned spring-run chinook salmon populations above Willamette Falls. Fall chinook above Willamette Falls are introduced and although they are naturally spawning, they are not considered a population for purposes of defining this ESU. Critical habitat is designated in 63 FR, page 11515. In addition to the area of the Willamette River and its tributaries above the Falls, also included are river reaches and estuarine areas in the Columbia River from a straight line connecting the west end of the Clatsop jetty (south jetty, Oregon side) and the west end of the Peacock jetty (north jetty, Washington side) upstream to and including the Willamette River in Oregon, with the usual exclusions regarding specific dams and longstanding natural barriers.

ESU status While the abundance of Willamette River spring chinook salmon has been relatively stable over the long term, and there is evidence of some natural production, it is apparent that at present natural production and harvest levels the natural population is not replacing itself. With natural production accounting for only one-third of the natural spawning escapement, it is questionable whether natural spawners would be capable of replacing themselves even in the absence of fisheries. The introduction of fall-run chinook into the basin and laddering of Willamette Falls have increased the potential for genetic introgression between wild spring- and hatchery fall-run chinook. Habitat blockage and degradation are significant problems in this ESU. Another concern for this ESU is that commercial and recreational harvests are high relative to the apparent productivity of natural populations. Recent escapement is less than 5,000 fish and been declining sharply. NMFS concludes that chinook salmon in this ESU are not presently in danger of extinction but are likely to become endangered in the foreseeable future.

Historic, naturally spawned populations in this ESU have an unusual life history that shares features of both the stream and ocean types. Scale analysis of returning fish indicate a predominantly yearling smolt life-history and maturity at four years of age, but these data are primarily from hatchery fish and may not accurately reflect patterns for the natural fish. Young-of-year smolts have been found to contribute to the returning three year-old year class. The ocean distribution is consistent with an ocean-type life history, and tag recoveries occur in considerable numbers in the Alaskan and British Columbian coastal fisheries. Intra-basin transfers have contributed to the homogenization of Willamette River spring chinook stocks; however, Willamette River spring chinook remain one of the most genetically distinctive groups of chinook salmon in the Columbia River Basin.

The geography and ecology of the Willamette Valley is considerably different from surrounding areas. Historically, the Willamette Falls offered a narrow temporal window for upriver migration, which may have promoted isolation from other Columbia River stocks.

<u>Southern Oregon and California Coastal Spring and Fall Chinook Salmon</u>

The Southern Oregon and California Coastal spring and fall chinook salmon were proposed as threatened in March 1998 (63 FR 11481). The following life history information is taken from 63 FR 11487.

The area of concern for Oregon in this ESU are the very southern coastal watersheds. Critical habitat is designated in 63 FR, page 1515 and includes all river reaches and estuarine areas accessible to chinook salmon from the southern Oregon border to Cape Blanco (Elk River).

Excluded are the Klamath and Trinity Rivers upstream of their confluence; these stocks are genetically and ecologically distinguishable from those in this ESU.

ESU status Chinook salmon spawning abundance in this ESU is highly variable among populations. There is a general pattern of downward trends in abundance in most populations for which data are available, with declines being especially pronounced in spring-run populations. Habitat loss and/or degradation is widespread throughout the range of the ESU. The Rogue River Basin in particular has been affected by mining activities and unscreened irrigation diversions in addition to the problems resulting from logging and dam construction. Artificial propagation program contribution to overall abundance is relatively low except for the Rogue River spring run. NMFS concludes that the extremely depressed status of almost all coastal populations south of the Klamath River is an important source of risk to the ESU and that chinook salmon in this ESU are likely to become endangered in the foreseeable future.

Chinook salmon in this ESU exhibit an ocean-type life history; ocean distribution (based on tag recoveries) is predominantly off of the California and Oregon coasts. Life history information on smaller populations, especially in the southern portion of the ESU, is extremely limited. Data show some divergence between chinook populations north and south of the Klamath River, but the available information is incomplete to describe chinook salmon south of the Klamath River as a separate ESU. Life history differences also exist between spring- and fall-run fish in the ESU, but not to the same extent as is observed in larger inland basins.

Ecologically, the majority of the river systems in this ESU are relatively small and heavily influenced by a maritime climate. Low summer flow and high temperature in many rivers result in seasonal physical and thermal barrier bars that block movement by anadromous fish. The Rogue River is the largest river basin in this ESU and extends inland into the Sierra Nevada and Cascades Ecoregions.

<u>Oregon Coast Coho Salmon</u>

The Oregon Coast coho salmon ESU is listed as threatened (63 FR 42587). The following life history information is taken from 60 FR 38011, and 63 FR 42587. This ESU represents naturally spawning coho inhabiting coastal streams draining the coast Range Mountains between Cape Blanco and the Columbia River in Oregon. Critical habitat has not been designated.

ESU status Within the Oregon coast ESU, hatchery populations from the north Oregon coast form a distinctive subgroup. Adult run- and spawn-timing are similar to those along the Washington coast and in the Columbia River, but less variable. While marine conditions off the Oregon and Washington coasts are similar, the Columbia River has greater influence north of its mouth, and the continental shelf becomes broader off the Washington coast. Upwelling off the Oregon coast is much more variable and generally weaker than areas south of Cape Blanco.

Estimated escapement of coho salmon in coastal Oregon was about 1.4 million fish in the early 1900s, with harvest of nearly 400,000 fish. Abundance of wild Oregon coast coho salmon declined during the period from about 1965 to 1975 and has fluctuated at a low level since that time. Production potential (based on stock-recruit models) shows a reduction of nearly 50 percent in habitat capacity. Recent spawning escapement estimates indicate an average spawning escapement of less than 30,000 adults. Current abundance of coho on the Oregon coast may be less than five percent of that in the early part of this century. The Oregon coast coho salmon ESU is not at immediate danger of extinction but may become endangered in the future if present trends continue. For more information on coho salmon life history, and factors contributing to the decline of the species, refer to the discussion under southern Oregon/northern California coast coho ESU.

Spawn timing Most Oregon coast coho salmon enter rivers from late September to mid-October with the onset of autumn freshets. Thus, a delay in fall rains will retard river entry and perhaps spawn timing. Peak spawning occurs from mid-November to early February.

Spawning habitat and temperature Although each native stock appears to have a unique time and temperature for spawning that theoretically maximizes offspring survival, coho salmon generally spawn at water temperatures within the range of 10-12.8 °C. Predominant spawning streams are low gradient fourth- and fifth-order, with clean gravel of pea to orange size.

Hatching and emergence The favorable range for coho salmon egg incubation is 10-12.8 °C. Depending on water temperature, eggs incubate for 35 to 50 days and start emerging from the gravel two to three weeks after hatching.

Parr movement and smoltification Following emergence, fry move into shallow areas near the stream banks. Their territory seems to be related not only to slack water, but to objects which provide points of reference to which the fry can return. Juvenile rearing usually occurs in low gradient tributary streams, although they may move up to streams of 4 or 5 percent gradient. Juveniles have been found in streams as small as one to two meters wide. When the fry are approximately 4 cm in length, they migrate upstream considerable distances to reach lakes or other rearing areas. Rearing requires temperatures of 20 °C or less, preferably 11.7-14.4 °C. Coho salmon fry prefer backwater pools during spring. In the summer, juveniles are more abundant in pools than in glides or riffles. During winter, the fishes predominate in off-channel pools of any type. The ideal food channel for maximum coho smolt production is shallow, fairly swift mid-stream flows with numerous back-eddies, narrow width, copious overhanging mixed vegetation (for stream temperature control and insect habitat), and banks permitting hiding places. Rearing in freshwater may be up to 15 months followed by moving to the sea as smolts between February and June.

Estuary and ocean migration Little is known about residence time or habitat use in estuaries during seaward migration, although the assumption is that coho salmon spend only a short time in the estuary before entering the ocean. Growth is very rapid once the smolts reach the estuary. While living in the ocean, coho salmon remain closer to their river of origin than do chinook salmon. After about 12 months at sea, coho salmon gradually migrate south and along the coast, but some appear to follow a counter-clockwise circuit in the Gulf of Alaska. Coho typically spend two growing seasons in the ocean before returning to their natal streams to spawn as three year-olds. Some precocious males ("jacks") return to spawn after only six months at sea.

Food The early diets of emerging fry include chironomid larvae and pupae. Juveniles are carnivorous opportunists, eating insects. These fish do not appear to pick stationary items off the substratum.

<u>Southern Oregon / Northern California Coast Coho Salmon</u>

The Southern Oregon / Northern California Coast (SONC) coho ESU is listed as threatened . The following life history summary is taken from 62 FR 24588, and 62 FR 6274. In November 1997, NMFS proposed to designate critical habitat for the SONC coho salmon ESU (62 FR 6274) as accessible reaches of all rivers (including estuarine areas and tributaries) between the Mattole River in California and the Elk River (Cape Blanco area) in Oregon, inclusive. NMFS has not proposed to designate critical habitat in marine areas at this time. Excluded areas are above certain dams (Lost Creek Dam on the Rogue River, Applegate Dam on the Applegate, and Iron Gate Dam [in California] on the upper Klamath River) and longstanding, impassable barriers.

ESU status In the 1940s, estimated abundance of coho salmon in this ESU ranged from 150,000 to 400,000 naturally spawning fish. Today, coho populations in this ESU are very depressed, currently numbering approximately 10,000 naturally produced adults. Although the Oregon portion of the SONC coho ESU has declined drastically, the Rogue River Basin increased substantially from 1974-1997. The bulk of current coho salmon production in this ESU consists of stocks from the Rogue River, Klamath River, Trinity River, and Eel River in Oregon.

In contrast to the life history patterns of other anadromous salmonids, coho salmon exhibit a relatively simple three-year life cycle.

In migration and spawning Most SONC coho salmon enter rivers between September and February and spawn from November to January (occasionally into early spring). In migration is influenced by river flow, especially for many small California stream systems that have sandbars at their mouths for much of the year except winter.

Incubation and rearing Coho salmon eggs incubate for 35 to 50 days between November and March, and start emerging from the gravel two to three weeks after hatching. Following emergence, fry move into shallow areas near the stream banks. As the fry grow larger, they disperse up- and downstream to establish and defend a territory. During the summer, fry prefer pools and riffles with adequate cover. Juveniles over-winter in large mainstem pools, backwater areas, and secondary pools with large woody debris, and undercut bank areas. Juveniles primarily eat aquatic and terrestrial insects. After rearing in freshwater for up to 15 months, the smolts enter the ocean between March and June.

Estuary and ocean migration Although coho salmon have been captured several thousand kilometers away from their natal stream, this species usually remains closer to its river of origin than chinook salmon. Coho typically spend two growing seasons in the ocean before returning to spawn as three year-olds; precocious males ("jacks") may return after only six months at sea.

Population trends In Oregon south of Cape Blanco, all but one coho salmon stock is considered to be at "high risk of extinction". South of Cape Blanco, all Oregon coho salmon stocks are considered "depressed".

Threats to naturally-reproducing coho salmon throughout its range are numerous and varied. Habitat factors include: Channel morphology changes, substrate changes, loss of in stream roughness, loss of estuarine habitat, loss of wetlands, loss/degradation of riparian areas, declines in water quality (e.g., elevated water temperatures, reduced dissolved oxygen, altered biological communities, toxics, elevated pH, and altered stream fertility), altered stream flows, fish passage impediments, elimination of habitat, and direct take. The major activities responsible for the decline of coho salmon in Oregon are logging, road building, grazing and mining activities, urbanization, stream channelization, dams, wetland loss, beaver trapping, water withdrawals, and unscreened diversions for irrigation.

Agricultural practices have also contributed to the degradation of salmonid habitat on the west coast through irrigation diversions, overgrazing in riparian areas, and compaction of soils in upland areas by livestock. Urbanization has degraded coho salmon habitat through steam channelization, floodplain drainage, and riparian damage. Forestry has degraded coho habitat through removal and disturbance of natural vegetation, disturbance and compaction of soils, construction of roads, and installation of culverts. Timber harvest activities and erosion from logging roads can result in sediment delivered to streams through mass wasting and surface erosion that can elevate the level of fine sediments in spawning gravels and fill the substrate interstices inhabited by invertebrates.

Depletion of storage of natural flows have drastically altered natural hydrological cycles. Alteration of stream flows has increased juvenile salmonid mortality for a variety of reasons: migration delay resulting from insufficient flows or habitat blockages; loss of usable habitat due to de-watering and blockage; stranding of fish resulting from rapid flow fluctuations; entrainment of juveniles into unscreened or poorly screened diversions; and increased juvenile mortality resulting from increased water temperatures. In addition, reduced flows degrade or diminish fish habitats through increased deposition of fine sediments in spawning gravels, decreased recruitment of new spawning gravels, and encroachment of riparian and nonendemic vegetation into spawning and rearing areas.

Other factors contributing to the decline of SONC coho include overutilization for commercial recreational, scientific, or education purposes. Harvest management practiced by the tribes is conservative and has resulted in limited impact on the coho stock in the Klamath and Trinity Rivers; overfishing in non-tribal fisheries is believed to have been a significant factor in the decline of coho salmon. Marked hatchery coho are allowed to be harvested in the Rogue River. All other recreational coho salmon fisheries in the Oregon portion of this ESU are closed. Collection for scientific research and educational programs is believed to have had little or no impact on coho populations in the ESU.

Relative to other effects, disease and predation are not believed to be major factors contributing to the overall decline of coho salmon in this ESU. However, disease and predation may have substantial impacts in local areas.

Chum Salmon

The Columbia River chum salmon ESU is listed as threatened (64 FR 14508). The following life history information is taken from 63 FR 11773. Critical habitat has been designated (63 FR 16955). The Columbia River chum salmon ESU spawn in tributaries to the lower Columbia River in Washington and Oregon.

Designated critical habitat consists of the water, substrate, and adjacent riparian zone of estuarine and riverine reaches in specific hydrologic units and counties. Accessible reaches are those within the historical range of the ESUs that can still be occupied by any life stage of chum salmon. Columbia River chum salmon critical habitat designation includes all accessible reaches in the Columbia River downstream from Bonneville Dam, excluding Oregon tributaries upstream of Milton Creek at river km 144 near the town of St. Helens.

ESU status Life history information specific to the above ESU is not available. The chum salmon or dog salmon is the third most abundant salmon species in the Pacific Northwest. Spawning for chum salmon adults may take place just at the head of tide waters similar to pink salmon (*O. gorbuscha*), however unlike pinks, chum also migrate upriver to spawn. Spawning occurs from October through December. Most adult females construct their redds near saltwater and are territorially aggressive; therefore, females may "miss out" on male spawners. Because of the location of most redds in lower rivers, an embryo mortality of 70 - 90 percent is possible due to siltation and decreased dissolved oxygen transfer. Chum salmon benefit from high quality habitat conditions in lower rivers and estuaries.

After emergence, fry do not rear in freshwater. Chum salmon fry migrate immediately, at night, to the estuary for rearing. Out-migration is March through June. Juveniles remain near the seashore during July and August. Juveniles spend from just half a year to four years at sea.

Steelhead

The following summary of general life history and ecology is taken from 50 CFR 222, 227, and 63 FR 11797. Steelhead exhibit one of the most complex life histories of any salmonid species. Steelhead may exhibit anadromy or freshwater residency. Resident forms are usually referred to as “rainbow” or “redband” trout, while anadromous life forms are termed “steelhead”.

Steelhead typically migrate to marine waters after spending two years in freshwater. They then reside in marine waters for two to three years prior to returning to their natal stream to spawn as 4- or 5- year-olds. Depending on water temperature, steelhead eggs may incubate in redds for one and one half to four months before hatching as alevins. Following yolk sac absorption, alevins emerge from the gravel as young juveniles (fry) and begin actively feeding. Juveniles rear in freshwater from one to four years, then migrate to the ocean as smolts.

Biologically, steelhead can be divided into two reproductive ecotypes, based on their state of sexual maturity at the time of river entry and the duration of their spawning migration. These two ecotypes are termed “stream maturing” and “ocean maturing”. Stream maturing steelhead return to freshwater in a sexually immature condition and require several months to mature and spawn. Ocean maturing steelhead enter freshwater with well-developed gonads and spawn shortly after river entry. These two reproductive ecotypes are more commonly referred to by their season of freshwater entry as either summer or winter steelhead.

Two major genetic groups or “subspecies” of steelhead occur on the west coast of the United States: a coastal group and an inland group, separated on the Fraser and Columbia River Basins by the Cascade crest. Historically, steelhead likely inhabited most coastal streams in Washington, Oregon, and California, as well as many inland streams in these states and Idaho. However, during this century, over 23 indigenous, naturally-reproducing stocks of steelhead are believed to have been extirpated, and many more are thought to be in decline in numerous coastal and inland streams.

Factors contributing to the decline of specific steelhead ESUs are discussed under each ESU. General information for west coast steelhead is summarized here. Forestry, agriculture, mining, and urbanization have degraded, simplified, and fragmented habitat. Water diversions for agriculture, flood control, domestic, and hydropower purposes have greatly reduced or eliminated historically accessible habitat. Washington and Oregon's wetlands are estimated to have diminished by one-third. Loss of habitat complexity as seen in the decrease of abundance of large, deep pools due to sedimentation and loss of pool-forming structures has also adversely affected west coast steelhead.

Steelhead are not generally targeted in commercial fisheries but do support an important recreational fishery throughout their range. A particular problem occurs in the main stem of the Columbia River where listed steelhead from the Middle Columbia River ESU are subject to the same fisheries as unlisted, hatchery-produced steelhead, chinook and coho salmon. Infectious disease and predation also take their toll on steelhead. Introductions of non-native species and habitat modifications have resulted in increased predator populations in numerous river systems. Federal and state land management practices have not been effective in stemming the decline in west coast steelhead.

Snake River Basin Steelhead

This inland steelhead ESU occupies the Snake River Basin of southeast Washington, northeast Oregon and Idaho. A final listing status of threatened was issued in August 1997 (62 FR 43937) for the spawning range upstream from the confluence with the Columbia River. Critical habitat has been proposed (64 FR 5740). The following information is taken from 50 CFR 222, 227, and 62 FR 43937.

The Snake River flows through terrain that is warmer and drier on an annual basis than the upper Columbia Basin or other drainages to the north. Geologically, the land forms are older and much more eroded than most other steelhead habitat. Collectively, the environmental factors of the Snake River Basin result in a river that is warmer and more turbid, with higher pH and alkalinity, than is found elsewhere in the range of inland steelhead.

ESU status Snake River Basin (SRB) steelhead all defined as "B-run" steelhead. Prior to Ice Harbor Dam completion in 1962, there were no counts of Snake River basin naturally spawned steelhead. From 1949 to 1971 counts averaged about 40,000 steelhead for the Clearwater River. At Ice Harbor Dam, counts averaged approximately 70,000 until 1970. The natural component for steelhead escapements above Lower Granite Dam was about 9400 (2400 B-run) from 1990-1994. SRB steelhead recently suffered severe declines in abundance relative to historical levels. Low run sizes over the last 10 years are most pronounced for naturally produced steelhead. The drop in parr densities characterizes many river basins in this region as being underseeded relative to the carrying capacity of streams. Declines in abundance have been particularly serious for B-run steelhead, increasing the risk that some of the life history diversity may be lost from steelhead in this ESU.

Interactions between hatchery and natural SRB steelhead are of concern because many of the hatcheries use composite stocks that have been domesticated over a long period of time. The primary indicator of risk to the ESU is declining abundance throughout the region.

SRB steelhead are summer steelhead, as are most inland steelhead, and comprise two groups, A-run and B-run, based on migration timing, ocean-age, and adult size. SRB steelhead enter freshwater from June to October and spawn in the following spring from March to May. A-run steelhead are thought to be predominately 1-ocean (one year at sea), while B-run steelhead are thought to be 2-ocean. SRB steelhead usually smolt at age 2- or 3-years.

The steelhead population from Dworshak National Fish Hatchery is the most divergent single population of inland steelhead based on genetic traits determined by protein electrophoresis; these fish are consistently referred to as B-run.

Similar factors to those affecting other salmonids are contributing to the decline of SRB steelhead. Widespread habitat blockage from hydrosystem management and potentially deleterious genetic effects from straying and introgression from hatchery fish. The reduction in habitat capacity resulting from large dams such as the Hells Canyon dam complex and Dworshak Dam is somewhat mitigated by several river basins with fairly good production of natural steelhead runs.

<u>Upper Columbia River Basin Steelhead</u>

This inland steelhead ESU occupies the Columbia River Basin upstream from the Yakima River, Washington, to the U.S./Canada border. The geographic area occupied by the ESU forms part of the larger Columbia Basin Ecoregion. The Upper Columbia River Basin (UCRB) steelhead ESU was listed as endangered in August 1997 (62 FR 43937). Official critical habitat is not designated. The following life history information is taken from 50 CFR 222, 227, and 62 FR 43937.

ESU status NMFS cites a pre-fishery run size estimate in excess of 5000 adults for tributaries above Rock Island Dam. Runs may have already been depressed by lower Columbia River fisheries at the time of the early estimates (1933-1959). Most of the escapement to naturally spawning habitat within the range of this ESU is to the Wenatchee, Methow and Okanogan Rivers. The Entiat River also has a small spawning run. Steelhead in the Upper Columbia river ESU continue to exhibit low abundances, both in absolute numbers and in relation to numbers of hatchery fish throughout the region. Estimates of natural production of steelhead in the ESU are will below replacement (approximately 0.3:1 adult replacement ratios estimated in the Wenatchee and Entiat Rivers). The proportion of hatchery fish is high in these rivers (65-80 percent) with extensive mixing of hatchery and natural stocks.

Life history characteristics for UCRB steelhead are similar to those of other inland steelhead ESUs. However, some of the oldest smolt ages for steelhead, up to 7 years, are reported from this ESU; this may be associated with the cold stream temperatures. Based on limited data available from adult fish, smolt age in this ESU is dominated by 2-year-olds. Steelhead from the Wenatchee and Entiat Rivers return to freshwater after one year in salt water, whereas Methow River steelhead are primarily 2-ocean resident (i.e., two years in salt water).

In an effort to preserve fish runs affected by Grand Coulee Dam, which blocked fish passage in 1939, all anadromous fish migrating upstream were trapped at Rock Island Dam (river km 729) from 1939 through 1943 and either released to spawn in tributaries between Rock Island and Grand Coulee Dams or spawned in hatcheries and the offspring released in that area. Through this process, stocks of all anadromous salmonids, including steelhead, which historically were native to several separate sub-basins above Rock Island Dam, were randomly redistributed among tributaries in the Rock Island-Grand Coulee reach. Exactly how this has affected stock composition of steelhead is unknown.

Habitat degradation, juvenile and adult mortality in the hydrosystem, and unfavorable environmental conditions in both marine and freshwater habitats have contributed to the declines and represent risk factors for the future. Harvest in lower river fisheries and genetic homogenization from composite broodstock collection are other factors that may contribute significant risk to the Upper Columbia River Basin ESU.

<u>Middle Columbia Basin Steelhead</u>

After a comprehensive status review of West Coast steelhead populations in Washington and Oregon, NMFS identified 15 ESUs. In March 1999, the Middle Columbia River steelhead ESU was listed as threatened (64 FR 14517). The middle Columbia area includes tributaries from above (and excluding) the Wind River in Washington and the Hood River in Oregon, upstream to, and including the Yakima River, in Washington. Steelhead of the Snake River Basin are excluded. There is no official critical habitat designation. The following life history information is taken from 63 FR 11797.

ESU status Current population sizes are substantially lower than historic levels, especially in the rivers with the largest steelhead runs in the ESU: the John Day, Deschutes, and Yakima Rivers. At least two extinctions of native steelhead runs in the ESU have occurred (the Crooked and Metolius Rivers, both in the Deschutes River Basin). In addition, NMFS remains concerned about the widespread long- and short-term downward trends in population abundance throughout the ESU.

Genetic differences between inland and coastal steelhead are well established, although some uncertainty remains about the exact geographic boundaries of the two forms in the Columbia

River (63 FR 11801). All steelhead in the Columbia River Basin upstream from The Dalles Dam are summer-run, inland steelhead. Life history information for steelhead of this ESU indicates that most middle Columbia River steelhead smolt at two years and spend one to two years in salt water (i.e., 1-ocean and 2-ocean fish, respectively) prior to re-entering freshwater, where they may remain up to a year before spawning. Within this ESU, the Klickitat River is unusual in that it produces both summer and winter steelhead, and the summer steelhead are dominated by 2-ocean steelhead, whereas most other rivers in this region produce about equal number of both 1- and 2-ocean steelhead.

The recent and dramatic increase in the percentage of hatchery fish in natural escapement in the Deschutes River Basin is a significant risk to natural steelhead in this ESU. Coincident with this increase in the percentage of strays has been a decline in the abundance of native steelhead in the Deschutes River.

Lower Columbia Basin Steelhead

This coastal steelhead ESU occupies tributaries to the Columbia River between the Cowlitz and Wind Rivers in Washington and the Willamette and Hood Rivers in Oregon. Excluded are steelhead in the upper Willamette River Basin above Willamette Falls, and steelhead from the Little and Big White Salmon Rivers in Washington. The Lower Columbia River steelhead ESU is listed as threatened (63 FR 13347). Official critical habitat is not designated. The following life history information is taken from 50 CFR 222, 227, 63 FR 13347 and 63 FR 32996.

The lower Columbia River has extensive intertidal mud and sand flats and differs substantially from estuaries to the north and south. Rivers draining into the Columbia River have their headwaters in increasingly drier areas, moving from west to east. Columbia River tributaries that drain the Cascade mountains have proportionally higher flows in late summer and early fall than rivers on the Oregon coast.

ESU status Steelhead populations are at low abundance relative to historical levels, placing this ESU at risk due to random fluctuations in genetic and demographic parameters that are characteristic of small populations. There have been almost universal, and in many cases dramatic, declines in steelhead abundance since the mid-1980s in both winter- and summer-runs. Genetic mixing with hatchery stocks have greatly diluted the integrity of native steelhead in the ESU. NMFS is unable to identify any natural populations of steelhead in the ESU that could be considered “healthy”.

Steelhead populations in this ESU are of the coastal genetic group, and a number of genetic studies have shown that they are part of a different ancestral lineage than inland steelhead from the Columbia River Basin. Genetic data also show steelhead in this ESU to be distinct from steelhead in the upper Willamette River and coastal streams in Oregon and Washington.

Washington Department of Fish and Wildlife data show genetic affinity between the Kalama, Wind, and Washougal River steelhead. These data show differentiation between the Lower Columbia River ESU and the Southwest Washington and Middle Columbia River Basin ESUs. The Lower Columbia ESU is composed of winter steelhead and summer steelhead.

Habitat loss, hatchery steelhead introgression, and harvest are major contributors to the decline the steelhead in this ESU. Details on factors contributing to the decline of west coast steelhead are discussed above.

<u>Upper Willamette River Steelhead</u>

In March 1999, the Upper Willamette River steelhead ESU was listed as threatened (64 FR 14517). Official critical habitat has not been proposed. The following life history information is taken from 63 FR 11797.

This coastal ESU occupies the Willamette River and its tributaries, upstream from Willamette Falls. The Willamette River Basin is zoogeographically complex. In addition to its connection to the Columbia River, the Willamette River historically has had connections with coastal basins through stream capture and headwater transfer events.

Steelhead from the upper Willamette River are genetically distinct from those in the lower river. Reproductive isolation from lower river populations may have been facilitated by Willamette Falls, which is known to be a migration barrier to some anadromous salmonids. For example, winter steelhead and spring chinook salmon occurred historically above the falls, but summer steelhead, fall chinook salmon, and coho salmon did not.

ESU status Steelhead in the Upper Willamette ESU are distributed in a few, relatively small, natural populations. Over the past several decades, total abundance of natural late-migrating winter steelhead ascending the Willamette Falls fish ladder has fluctuated several times over a range of approximately 5,000-20,000 spawners. However, the last peak occurred in 1988, and this peak has been followed by a steep and continuing decline. Abundance in each of the last five years (to 1998) has been below 4,300 fish, and the run in 1995 was the lowest in 30 years. The low abundance, coupled with potential risks associated with interactions between naturally spawned steelhead and hatchery stocks is of great concern to NMFS.

The native steelhead of this basin are late-migrating winter steelhead, entering freshwater primarily in March and April, whereas most other populations of west coast winter steelhead enter freshwater beginning in November or December. As early as 1885, fish ladders were constructed at Willamette Falls to aid the passage of anadromous fish. As technology improved, the ladders were modified and rebuilt, most recently in 1971. These fishways facilitated successful introduction of Skamania stock summer steelhead and early-migrating Big Creek stock winter steelhead to the upper basin. Another effort to expand the steelhead production in the upper Willamette River was the stocking of native steelhead in tributaries not historically used by that species. Native steelhead primarily used tributaries on the east side of the basin, with cutthroat trout predominating in streams draining the west side of the basin.

Nonanadromous steelhead are known to occupy the Upper Willamette River Basin; however, most of these nonanadromous populations occur above natural and man-made barriers. Historically, spawning by Upper Willamette River steelhead was concentrated in the North and Middle Santiam River Basins. These areas are now largely blocked to fish passage by dams, and steelhead spawning is distributed throughout more of the Upper Willamette River Basin than in the past. Due to introductions of non-native steelhead stocks and transplantation of native stocks within the basin, it is difficult to formulate a clear picture of the present distribution of native Upper Willamette River steelhead, and their relationship to nonanadromous and possibly residualized steelhead within the basin.

<u>Southwest Washington/Lower Columbia River Cutthroat Trout</u>

Southwest Washington/Lower Columbia River cutthroat trout were proposed as endangered in April 1999 (64 FR 16397). The ESU consists of coastal cutthroat trout populations in southwestern Washington and the Columbia River, excluding the Willamette River above Willamette Falls. In this proposed ESU, only naturally spawned cutthroat trout are proposed for listing. Prior to the final listing determination, NMFS and USFWS will examine the relationship between hatchery and naturally spawned populations of cutthroat trout, and populations of cutthroat trout above barriers to assess whether any of these populations warrant listing. This may result in the inclusion of specific hatchery populations or populations above barriers as part of the listed ESU in the final listing determination.

ESU status The southwestern Washington-lower Columbia River region historically supported healthy, highly productive coastal cutthroat trout populations. Coastal cutthroat trout, especially, the freshwater forms, may still be well distributed in most river basins in this geographic region, although probably in lower numbers relative to historical populations sizes. However, severe habitat degradation throughout the lower Columbia River areas has contributed to dramatic declines in anadromous coastal cutthroat trout populations and two near extinctions of anadromous runs in the Hood and Sandy Rivers. The Services remain concerned about the extremely low populations sizes of anadromous coastal cutthroat trout in lower Columbia River streams, indicated by low incidental catch of coastal cutthroat trout in salmon and steelhead recreational fisheries, and by low trap counts in a number of tributaries throughout the region. The general life history forms are similar to those described for the Umpqua Cutthroat trout below.

Population Trends Numbers of anadromous adults and outmigrating smolts in the southwestern Washington portion of this ESU are all declining. Returns of both naturally and hatchery produced anadromous coastal cutthroat trout in almost all lower Columbia River streams have declined markedly over the last 10 to 15 years. Serious declines in the anadromous form have occurred throughout the lower Columbia River, and it has been nearly extirpated in at least two rivers on the Oregon side of the basin. Indeed, the only anadromous coastal cutthroat population in the lower Columbia River to show increased abundance over the last 10 years is the North Fork Toutle River population, which is thought to be recovering from the effects of the Mt. Saint Helens eruption in 1980.

Factors for the decline of this subspecies include: habitat degradation as a result of logging; recreational fishing; predation by marine mammals, birds, and native and non-native fish species; adverse environmental conditions resulting from natural factors such as droughts, floods, and poor ocean conditions; non-point and point pollution source pollution caused by agriculture and urban development; disease outbreaks caused by hatchery introductions and warm water temperatures; mortality resulting from unscreened irrigation inlets; competition in estuaries between native and hatchery cutthroat trout; cumulative loss and alteration of estuarine areas; and loss of habitat caused by the construction of dams.

Umpqua River Cutthroat Trout

Umpqua River (UR) cutthroat trout were listed as endangered in August 1996 (61 FR 41514). However subsequent information indicates that Umpqua River cutthroat trout are part of a larger ESU encompassing the coast of Oregon between the Columbia Rive and Cape Blanco, Oregon, which at this time does not warrant listing. Consequently, NMFS issued a proposed rule to delist this ESU on 5 April, 1999 (64 FR 16397). Critical habitat designation was finalized in 1998 (63 FR 1388) and includes all river reaches accessible to listed Umpqua River cutthroat trout from a straight line connecting the west end of the North Jetty and including all Umpqua River estuarine areas (including the Smith River) and tributaries proceeding upstream from the Pacific Ocean to the confluence of the North and South Umpqua Rivers; the North Umpqua River, including all tributaries, from its confluence with the mainstem Umpqua River to Soda Springs dam; the South Umpqua River, including all tributaries, from its confluence with the mainstem Umpqua River to its headwater (including Cow Creek, tributary to the South Umpqua River). Critical habitat includes all waterways below longstanding, naturally impassable barriers (i.e., natural water falls in existence for over several hundred years). Critical habitat includes the bottom and water of the waterways and adjacent riparian zone. The riparian zone includes those areas within 300 feet (91.4 m) of the normal line of the high water mark of the stream channel or from the shoreline of a standing body of water. NMFS recognized that the Umpqua River estuary is an essential rearing area and migration corridor for listed Umpqua River cutthroat trout, and maintained the designation of the estuary as critical habitat in the final rule. The following life history information is taken from 61 FR 41514 and 63 FR 1388.

ESU status Cutthroat trout evolved to exploit habitats least preferred by other salmonid species. The life history of UR cutthroat trout is probably the most complex and flexible of any Pacific salmonid. Three life history forms are in the Umpqua River basin. The current freshwater distribution of anadromous and potamodromous life forms is thought to be limited primarily to the mainstem, Smith, and North Umpqua Rivers. Resident cutthroat trout appear to remain broadly distributed throughout the Umpqua River basin. Unlike other anadromous salmonids, sea-run forms of the coastal cutthroat trout do not overwinter in the ocean and only rarely make long extended migrations across large bodies of water. They migrate in the nearshore marine habitat and usually remain within 10 km of land.

Anadromous cutthroat trout Unlike other anadromous salmonids, anadromous cutthroat trout do not over-winter in the ocean and only rarely make long extended migrations across large bodies of water. They migrate in the near shore marine habitat and usually remain within 10 km of land. While most anadromous cutthroat trout enter seawater as two- or three-year-old fish, some may remain in fresh water for up to five years before entering the ocean.

Potamodromous cutthroat trout The potamodromous life form undertakes freshwater migrations of varying length without entering the ocean, and are sometimes referred to as "fluvial". Potamodromous cutthroat trout migrate only into rivers and lakes, even when they have access to the ocean. The potamodromous life form is most common in rivers with physical barriers to anadromous fish, but have also been documented below barriers in the Rogue River and the Umpqua River.

Resident cutthroat trout The resident life form does not migrate long distances; instead, the fish remain in upper tributaries near spawning and rearing areas and maintain small home territories throughout their life cycle. Resident cutthroat trout have been observed in the upper Umpqua River drainage. During a radio tagging study in three tributaries of Rock Creek (North Umpqua River drainage), fish smaller than 180 mm moved about an average total distance of 27 meters of stream length during the study. Larger fish explored an average total distance of about 166 meters.

Spawning and rearing Cutthroat trout generally spawn in the tails of pools located in small tributaries at the upper limit of coho salmon and steelhead spawning and rearing sites. Stream conditions are typically low stream gradient. December to May encompasses most spawning times with a peak in February.

Cutthroat trout are iteroparous and may spawn every year for at least five years and some remain in freshwater for at least a year before returning to seawater. Post-spawning mortality is possible. Eggs begin to hatch after one-and-a-half to two months. Alevins remain in the redds for a few more weeks and emerge as fry between March and June.

Parr movements After emergence from redds, cutthroat trout juveniles generally remain in upper tributaries until they are one year of age, then extensive movements in the stream begin. Directed downstream movement by parr can happen during any month but usually begins with the first spring rains. Some parr from the Alsea River drainage entered the estuary and remained there over the summer; these fish did not smolt. Upstream movement of juveniles from estuaries and mainstem to tributaries begins with the onset of winter freshets during November, December, and January; these one year and older fish averaged less than 200 mm in length.

Smoltification Time of initial seawater entry of ocean-bound Umpqua River smolts begins as early as March, peaks in May and June, tapers off by July, with a few stragglers through October. For other "less protected" Oregon coastal areas, cutthroat trout tend to migrate at an older age (age three and four). It is unlikely that Umpqua River cutthroat trout migrate from the upper basin areas to the estuary considering the distance and warm water temperatures (averaging in the mid 20s^{o} C. at Winchester Dam).

Estuary and ocean migration Migratory patterns of sea-run cutthroat trout differ from Pacific salmon in two major ways: few, if any, cutthroat overwinter in the ocean, and; the fish do not usually make long open-ocean migrations. Cutthroat trout, whether initial or seasoned migrants average approximately 90 days at sea.

Adult freshwater migrations For the Umpqua River, cutthroat trout begin upstream migrations in late June and continue through January.

Food In streams, drifting terrestrial and aquatic insects are the cutthroat trouts' food source. Small fish and invertebrates constitute the diet in the marine environment; forage areas are around gravel beaches, off the mouths of small creeks and beach trickles, around oyster beds, and patches of eel grass.

Population Trends Numbers of returning anadromous UR cutthroat adults passing Winchester Dam on the North Umpqua River varied between a few score to nearly 2,000 in the 1940s-1950s. The numbers increased during the 1960s-1970s with the artificial release of smolts to augment the population. From the late 1980s to the present, annual adult counts were generally fewer than 100.

Factors for the decline of this subspecies include: habitat degradation as a result of logging; recreational fishing; predation by marine mammals, birds, and native and non-native fish species; adverse environmental conditions resulting from natural factors such as droughts, floods, and poor ocean conditions; non-point and point pollution source pollution caused by agriculture and urban development; disease outbreaks caused by hatchery introductions and warm water temperatures; mortality resulting from unscreened irrigation inlets; competition in estuaries between native and hatchery cutthroat trout; cumulative loss and alteration of estuarine areas; and loss of habitat caused by the construction of dams.

Bull Trout

Bull trout in the Columbia River and Klamath Basins were listed as threatened without critical habitat in 1998 (63 FR 31674). Juvenile bull trout average 50-70 mm (2-3 in) in length at age 1, 100-120 mm (4-5 in) at age 2, and 150-170 mm (6-7 in) at age 3 (Pratt 1992). Juveniles have a slender body form and exhibit the small scalation typical of char. The back and upper sides are typically olive-green to brown with a white to dusky underside. The dorsal surface and sides are marked with faint pink spots. They lack the worm-like vermiculations and reddish fins commonly seen on brook trout (*Salvelinus fontinalis*). Spawning bull trout, especially males, turn bright red on the ventral surface with a dark olive-brown back and black markings on the head and jaw. The spots become a more vivid orange-red and the pectoral, pelvic, and anal fins are red-black with a white leading edge. The males develop a pronounced hook on the lower jaw. Bull trout have an obvious "notch" on the end of the nose above the tip of the lower jaw.

Bull trout populations are known to exhibit four distinct life history forms: resident, fluvial, adfluvial, and anadromous. Resident bull trout spend their entire life cycle in the same (or nearby) streams in which they were hatched. Fluvial and adfluvial populations spawn in tributary streams where the young rear from one to four years before migrating to either a lake (adfluvial) or a river (fluvial) where they grow to maturity (Fraley and Shepard 1989). Anadromous bull trout spawn in tributary streams, with major growth and maturation occurring in the ocean.

The historic range of the bull trout spanned seven states (Alaska, Montana, Idaho, Washington, Oregon, Nevada, and California) and two Canadian Provinces (British Columbia and Alberta) along the Rocky Mountain and Cascade Mountain ranges (Cavender 1978). In the United States, bull trout occur in rivers and tributaries throughout the Columbia Basin in Montana, Idaho, Washington, Oregon, and Nevada, as well as the Klamath Basin in Oregon, and several cross-boundary drainages in extreme southeast Alaska. In California, bull trout were historically found in only the McCloud River, which represented the southernmost extension of the species' range. Bull trout numbers steadily declined after completion of McCloud and

Shasta Dams (Rode 1990). The last confirmed report of a bull trout in the McCloud River was in 1975, and the original population is now considered to be extirpated (Rode 1990).

Bull trout distribution has been reduced by an estimated 40 to 60 percent since pre-settlement times, due primarily to local extirpations, habitat degradation, and isolating factors. The remaining distribution of bull trout is highly fragmented. Resident bull trout presently exist as isolated remnant populations in the headwaters of rivers that once supported larger, more fecund migratory forms. These remnant populations have a low likelihood of persistence (Reiman and McIntyre 1993). Many populations and life history forms of bull trout have been extirpated entirely.

Highly migratory, fluvial populations have been eliminated from the largest, most productive river systems across the range. Stream habitat alterations restricting or eliminating bull trout include obstructions to migration, degradation of water quality, especially increasing temperatures and increased amounts of fine sediments, alteration of natural stream flow patterns, and structural modification of stream habitat (such as channelization or removal of cover).

In Oregon, bull trout were historically found in the Willamette River and major tributaries on the west side of the Oregon Cascades, the Columbia and Snake Rivers and major tributaries east of the Cascades, and in streams of the Klamath basin (Goetz 1989). Currently, most bull trout populations are confined to headwater areas of tributaries to the Columbia, Snake, and Klamath rivers (Ratliff and Howell 1992). Major tributary basins containing bull trout populations include the Willamette, Hood, Deschutes, John Day, and Umatilla (Columbia River tributaries), and the Owyhee/Malheur, Burnt/Powder, and Grande Ronde/Imnaha Basins (Snake River tributaries). Of these eight major basins, large fluvial migratory bull trout are potentially stable in only one, the Grande Ronde, and virtually eliminated from the remaining seven, including the majority of the mainstem Columbia River. The only known increasing population of bull trout is an adfluvial migrant population located in Lake Billy Chinook, that spawns and rears in the Metolius River and tributaries in the Deschutes Basin. In recognition of the precarious status of Oregon bull trout populations, harvest of bull trout is prohibited in all state waters with the exception of Lake Billy Chinook and Lake Sintustus in the Deschutes River Basin.

Columbia and Klamath River basin bull trout have been isolated from one another for over 10,000 years. Leary *et al.* (1993) demonstrated substantial genetic separation between bull trout in the Klamath and Columbia River basins; these two basin populations constitute "distinct population segments", and were listed as such under the Endangered Species Act.

Bull trout spawn in the fall, primarily in September or October when water temperatures drop below 9°C (48°F). Typically, spawning occurs in gravel, in runs or tails of spring-fed pools.

Adults hold in areas of deep pools and cover and migrate at night (Pratt 1992). After spawning, adfluvial adults return to the lower river and lake.

Bull trout eggs are known to require very cold incubation temperatures for normal embryonic development (McPhail and Murray 1979). In natural conditions, hatching usually takes 100 to 145 days and newly-hatched fry, known as alevins, require 65 to 90 days to absorb their yolk sacs (Pratt 1992). Consequently, fry do not emerge from the gravel and begin feeding for 200 or more days after eggs are deposited (Fraley and Shepard 1989), usually in about mid-April.

Fraley and Shepard (1989) reported that juvenile bull trout were rarely observed in streams with summer maximum temperatures exceeding 15°C (59°F). Fry, and perhaps juveniles, grow faster in cool water (Pratt 1992). Juvenile bull trout are closely associated with the substrate, frequently living on or within the streambed cobble (Pratt 1992). Along the stream bottom, juvenile bull trout use small pockets of slow water near high velocity, food-bearing water. Adult bull trout, like the young, are strongly associated with the bottom, preferring deep pools in cold water rivers, as well as lakes and reservoirs (Thomas 1992).

Juvenile adfluvial fish typically spend one to three years in natal streams before migrating in spring, summer, or fall to a large lake. After traveling downstream to a larger system from their natal streams, subadult bull trout (age 3 to 6) grow rapidly but do not reach sexual maturity for several years. Growth of resident fish is much slower, with smaller adult sizes and older age at maturity.

Juvenile bull trout feed primarily on aquatic insects (Pratt 1992). Subadult bull trout rapidly convert to eating fish and, as the evolution of the head and skull suggest, adults are opportunistic and largely nondiscriminating fish predators. Historically, native sculpins (*Cottus* spp.), suckers (*Catostomus* spp.), and mountain whitefish (*Prosopium williamsoni*) were probably the dominant prey across most of the bull trout range. Today, throughout most of the bull trout's remaining range, introduced species, particularly kokanee (*Oncorhynchus nerka*) and yellow perch (*Perca flavescens*), are often key food items (Pratt 1992).

Bull trout are habitat specialists, especially with regard to preferred conditions for reproduction. While a small fraction of available stream habitat within a drainage or subbasin may be used for spawning and rearing, a much more extensive area may be utilized as foraging habitat, or seasonally as migration corridors to other waters. Structural diversity is a prime component of good bull trout rearing streams (Pratt 1992). Several authors have observed highest juvenile densities in streams with diverse cobble substrate and low percentage of fine sediments (Shepard *et al.* 1984, Pratt 1992).

Persistence of migratory life history forms and maintenance or re-establishment of stream migration corridors is crucial to the viability of bull trout populations (Reiman and McIntyre

1993). Migratory bull trout facilitate the interchange of genetic material between populations, ensuring sufficient variability within populations. Migratory forms also provide a mechanism for reestablishing local populations that have been extirpated. Migratory forms are more fecund and larger than smaller non-native brook trout, potentially reducing the risks associated with hybridization (Reiman and McIntyre 1993). The greater fecundity of these larger fish enhances the ability of a population to persist in the presence of introduced fishes.

Lahontan Cutthroat Trout

The Lahontan cutthroat trout is listed as threatened without critical habitat (35 FR 16047). It is one subspecies of the wide-ranging cutthroat trout that includes at least 14 recognized forms in the western United States. The spotting pattern on the Lahontan cutthroat trout helps distinguish this from other subspecies of cutthroat trout (Behnke 1992). The Lahontan cutthroat trout often exhibit spots on the top and sides of the head, extending to the tip of the snout (other interior species typically lack the spots on the head and ventral region) (USFWS 1994). The coloration is generally dull, but reddish tones may appear on the sides and cheeks; the orange cutthroat slash is typically present to some degree, but yellow slashes also occur (USFWS 1994). The Lahontan cutthroat trout is an obligatory stream spawner. Spawning occurs from April through July over gravel substrate in riffle areas. The eggs hatch in 4 to 6 weeks, and fry emerge 13 to 23 days later (USFWS 1994).

Cutthroat trout have the most extensive range of any inland trout species of western North America (Behnke 1992), and occur in anadromous, non-anadromous, fluvial, and lacustrine populations. Many of the basins in which cutthroat trout occur contain remnants of much more extensive bodies of water which were present during the wetter period of the late Pleistocene epoch (Smith 1978).

Lahontan cutthroat trout historically occurred in most cold waters of the Lahontan Basin of Nevada and California, including the Humboldt, Truckee, Carson, Walker, and Summit Lake/Quinn River drainages. Large alkaline lakes, small mountain streams and lakes, small tributary streams, and major rivers were inhabited, resulting in the current highly variable subspecies. The fish occurred in Tahoe, Pyramid, Summit, Donner, Walker, and Independence Lakes, but has disappeared from Lake Tahoe, Pyramid, Donner and Walker lakes (Behnke 1992). The Pyramid lake population was extirpated primarily due to blockage of spawning tributaries (Behnke 1992). The subspecies has been extirpated from most of the western portion of its range in the Truckee, Carson, and Walker river basins, and from much of its historic range in the Humboldt basin. Only remnant populations remain in a few streams in the Truckee, Carson, and Walker basins out of an estimated 1,640 km (1,020 miles) of historic habitat (Gerstung 1986). Coffin (1988) estimated that only 85 stream populations existed in the Humboldt Basin in a total of 434 km (270 miles) of habitat compared with an estimated historic occurrence in 3556 stream km (2,210 stream miles).

The Lahontan cutthroat trout inhabiting Oregon were originally classified as Willow-Whitehorse cutthroat trout. Genetic and taxonomic investigations led to its re-classification as Lahontan cutthroat trout in 1991 (Williams 1991). Willow-Whitehorse cutthroat were afforded protection and threatened status as Lahontan cutthroat trout in November 1991. The Lahontan cutthroat trout occurs in the following Oregon streams: Willow Creek, Whitehorse Creek, Little Whitehorse Creek, Doolitle Creek, Fifteen Mile Creek (from the Coyote Lake Basin) and Indian, Sage, and Line Canyon Creeks (tributaries of McDermitt Creek in the Quinn River, Nevada basin).

Sources and mechanisms of stream colonization outside of the Lahontan basin by Lahontan cutthroat trout are uncertain, but human transport is suspected. Resident stream populations have been used to stock other Willow-Whitehorse area streams during the 1970's and early 1980's. These transplanted populations are considered threatened unless they are determined to be "experimental populations" released outside of the native range of the species for conservation purposes (USDI 1997).

The severe decline in range and numbers of Lahontan cutthroat trout is attributed to a number of factors, including hybridization and competition with introduced trout species; loss of spawning habitat due to pollution from logging, mining, and urbanization; blockage of streams due to dams; channelization; de-watering due to irrigation and urban demands; and watershed degradation due to overgrazing of domestic livestock (Gerstung 1986; Coffin 1988; Wydoski 1978). Declining Lahontan cutthroat trout populations in the Whitehorse and Trout Creek Mountains are a result of decades of season-long intensive livestock grazing, recreational over-fishing, and more recently drought conditions from 1985 to 1994.

Oregon Department of Fish and Wildlife surveys indicated that Lahontan cutthroat trout populations were reduced from 1985 to 1989 (USDI 1997). Declining numbers of Lahontan cutthroat trout prompted ODFW to close area streams to fishing (by special order) in 1989. This closure remains in effect. Fish surveys of area streams were conducted again in October 1994. Although methods vary between the conducted surveys (1985, 1989 and 1994), fish numbers have increased in general from approximately 8,000 fish in the mid 1980s to approximately 40,000 fish in 1994. However, in many areas stream conditions remain less than favorable for the cutthroat; of the 113 km (70 miles) surveyed less than 32 km (20 miles) supported adequate densities of fish (USDI 1997).

Oregon Chub

The Oregon chub, a small minnow endemic to the Willamette River Basin in western Oregon, was listed as endangered without critical habitat in 1993 (58 FR 53804). The Service published a recovery plan for the Oregon chub in 1998 (USFWS 1998a). The information below is extracted from that document.

The Oregon chub and its sibling Umpqua chub have an olive colored back grading to silver on the sides and white on the belly. Scales are relatively large with fewer than 40 occurring along the lateral line; scales near the back are outlined with dark pigment. The main distinguishing characteristics between Oregon and Umpqua chub are: the greater length of the caudal peduncle in the Oregon chub; the mostly scaled breast on Oregon chub versus three fourths to fully naked breast of Umpqua chub; and the Oregon chub's more terminal mouth position, versus Umpqua chub's subterminal mouth. Several size classes of Oregon chub have been collected. Young of the year are approximately 7 to 32 mm (0.25 to 1.25 in), presumed 1+ year chub are approximately 33 to 46 mm (1.3 to 1.8 in), presumed 2+ year chub are approximately 47-64 mm (1.85 to 2.52 in), and presumed 3+ year fish are >65 mm (2.56 in). The largest Oregon chub collected by researchers was found in the North Santiam River and measured 89 mm (3.5 in) in length.

Oregon chub are endemic to the Willamette River drainage of western Oregon. Typically they occupy off-channel habitats such as beaver ponds, oxbows, side channels, backwater sloughs, low gradient tributaries, and flooded marshes. This species was formerly distributed throughout the Willamette River Valley as far downstream as Oregon City and as far upstream as Oakridge. Historical records report Oregon chub were collected from the Clackamas River, Molalla River, South Santiam River, North Santiam River, Luckiamute River, Long Tom River, McKenzie River, Mary's River, Coast Fork Willamette River, Middle Fork Willamette River, and the mainstem Willamette River.

The current distribution of Oregon chub is limited to 20 naturally occurring populations and four recently reintroduced populations. The naturally occurring populations are found in the Santiam River, Middle Fork Willamette River, Coast Fork Willamette River, and several tributaries to the Mainstem Willamette River downstream of the Coast Fork/Middle Fork confluence. Only seven of these populations exceed 1,000 fish, and 13 populations contain fewer than 100 individuals. Four populations of Oregon chub have been introduced into habitats in the Willamette River drainage at Wicopee Pond, East Ferrin Pond, Fall Creek Spillway Pond, and Dunn Wetland.

Oregon chub habitats usually have little or no water flow, silty and organic substrate, and considerable aquatic vegetation as cover for hiding and spawning (Markle *et al.* 1991; Scheerer and Jones 1997). The average depth of Oregon chub habitats is typically less than 2 m (6 ft) and the summer temperatures typically exceed 16º C (61º F). Adult Oregon chub seek dense vegetation for cover and frequently travel in beaver channels or along the margins of aquatic plant beds. In the early spring, chub are most active in the warmer, shallow areas of the ponds. Larval chub congregate in shallow areas near the shore (Pearsons 1989, Scheerer 1997). Juvenile Oregon chub venture farther from shore into deeper water (Pearsons 1989). In the winter months, Oregon chub are found buried in detritus or concealed in the limited aquatic vegetation (Pearsons 1989). Fish of similar size classes school and feed together.

Oregon chub spawn from April through September. Spawning activity has only been observed at temperatures exceeding 16º C (61º F). Before and after spawning season, chub are social and non-aggressive.

Oregon chub feed throughout the day, mostly on water column fauna, and stop feeding after dusk (Pearsons 1989). The diet for Oregon chub adults collected in a May sample consisted primarily of copepods, cladocerans, and chironomid larvae (Markle *et al.* 1991). The diet of juvenile chub consisted of rotifers, copepods, and cladocerans. (Pearsons 1989).

In the last 80 years, backwater and off-channel habitats typically occupied by the Oregon chub have disappeared because of changes in seasonal flows resulting from the construction of dams throughout the basin, channelization of the Willamette River and its tributaries, removal of snags for river navigation, and agricultural practices. As a result, suitable Oregon chub habitat was reduced, existing Oregon chub populations were isolated, and recolonization of habitat and mixing between populations was virtually eliminated. In addition, a variety of non-native aquatic species were introduced to the Willamette Valley over the same period. The establishment and expansion of these non-native species, in particular, largemouth bass (*Micropterus salmoides*), smallmouth bass *(Micropterus dolomieui*), crappie (*Pomoxis* sp.), bluegill (*Lepomis macrochirus*), western mosquitofish (*Gambusia affinis*) and bullfrog (*Rana catesbiana*), has contributed to the decline of the Oregon chub and limits the species' ability to expand beyond its current range.

Many of the known extant populations of Oregon chub occur near rail, highway, and power transmission corridors and within public park and campground facilities. These populations are threatened by chemical spills from overturned truck or rail tankers; runoff or accidental spills of brush control chemicals; overflow from chemical toilets in campgrounds; siltation of shallow habitats from logging and construction activities; and changes in water level or flow conditions from construction, diversions, or natural desiccation.

<u>Lost River and Shortnose Suckers</u>

The Lost River sucker is a large sucker that may reach over 0.9 m (3 ft). It is characterized by a long, slender head with a subterminal mouth and long, rounded snout. The coloring is dark on the back and sides, fading to white or yellow on the belly. The only species in the genus *Deltistes*, the Lost River sucker is native to Upper Klamath Lake and its tributaries. This sucker also historically inhabited the Lost River watershed, Tule Lake, Lower Klamath Lake, and Sheepy Lake (Moyle 1976), but is not considered native to the Klamath River, although it is now found there, at least downstream to Copco Reservoir (Beak 1987).

The shortnose sucker historically occurred in Upper Klamath Lake and its tributaries (Miller and Smith 1981). Its historic range likely included Lake of the Woods, Oregon, and probably the Lost River system (Scoppettone and Vinyard 1991). The current distribution of the shortnose sucker includes Upper Klamath Lake and its tributaries, Klamath River downstream to Iron Gate Reservoir, Clear Lake Reservoir and its tributaries, Gerber Reservoir and its tributaries, the Lost River, and Tule Lake. Gerber Reservoir represents the only lake habitat with a shortnose sucker population that does not also have a Lost River sucker population.

Both species are primarily lake residents that spawn in associated rivers, streams, or springs. After hatching, larval suckers migrate out of spawning substrates, which are usually gravels or cobbles, and drift downstream into lakes. Vegetated river and lake shoreline habitats are known to be important during larval and juvenile rearing (Klamath Tribe 1991; Markle and Simon 1993). The Lost River and shortnose suckers are omnivorous bottom feeders whose diets include detritus, zooplankton, algae and aquatic insects (Buettner and Scoppettone 1990). Sexual maturity for Lost River suckers sampled in Upper Klamath Lake occurs between the ages of 6 to 14 years with most maturing at age 9. Most shortnose suckers reach sexual maturity at age 6 or 7 (Buettner and Scoppettone 1990).

The Upper Klamath River Basin above Iron Gate Dam (Basin) encompasses a drainage area of approximately 2,120,400 hectares (5,301,000 acres) in Oregon and California (USFWS 1992). The Basin once had over 350,000 acres of wetlands (USFWS 1989a), extensive riparian corridors, and functional floodplains. Early records from the Basin indicate that the Lost River and shortnose suckers were common and abundant. Gilbert (1898) noted that the Lost River sucker was "the most important food-fish of the Klamath Lake region." Several commercial operations processed "enormous amounts" of suckers into oil, dried fish, canned fish, and other products (Andreasen 1975, Howe 1968). Currently, less than 75,000 acres of wetlands remain in the Basin (USFWS 1992).

The historical range of the Lost River and shortnose suckers has been fragmented by construction of dams, instream diversion structures, irrigation canals, and the general development of the U.S. Bureau of Reclamation's Klamath Project and related agricultural processes. Because habitat fragmentation limits or prevents genetic interchange among populations, extinction could result as genetic diversity decreases and populations become more susceptible to environmental change. The combined effects of damming of rivers, instream flow diversions, draining of marshes, dredging of Upper Klamath lake, and other water manipulations has threatened both species with extinction (53 FR 27134). Additionally, water quality degradation in the Upper Klamath Lake watershed has led to large-scale fish kills related to algal bloom cycles in the lake (Kann and Smith 1993). Introduced exotic fishes may reduce recruitment through competition with, or predation upon, suckers (USFWS 1993b, Dunsmoor 1993).

Status of terrestrial species within the action area

As mentioned above, and further detailed in the Description of the Proposed Action section of this Biological Opinion, the Oregon CREP program is targeted to restore aquatic habitats. However, in the process of implementing CREP, it is likely that impacts will occur to a number of listed or proposed terrestrial species that are not the specified target species of this program. As a result, these non-target terrestrial species must be considered in this consultation, and are addressed here. All the non-target species fall under the jurisdiction of the USFWS.

The non-target listed terrestrial species impacted by CREP are described below. These species are affected by agricultural practices such as those discussed above very differently than are aquatic species. In many cases, detailed information such as that provided above may not be available for each species. We therefore have summarized available information (often from species recovery plans) for the baseline status of these species within the action area.

Aleutian Canada Goose

The Aleutian Canada goose is a small, island-nesting subspecies of Canada goose. It is the second smallest goose species in the Pacific Flyway. The adults are easily distinguished by a white ring around the neck. Other characteristics include: an abrupt forehead, cheek patches generally separated by black feathering on the ventral side of the head, and a narrow border of dark features along the bottom of the neck ring. The following information is derived largely from the Aleutian Canada Goose Recovery Plan (USFWS 1991) and a recent status summary (63 FR 17350).

In 1967, the Aleutian Canada goose was federally listed as endangered, without critical habitat (55 FR 433). Fewer than 800 birds of the subspecies remained at that time. Their decline was primarily attributed to predation by introduced Arctic foxes (*Alopex lagopus*) and red foxes (*Vulpes vulpes*) on all but one of the Aleutian Islands. The loss of migration and wintering habitat to agricultural and urban development also contributed to the decline of the Aleutian Canada goose. Chemical pollutants, human disturbance, disease, subsistence hunting by natives on the nesting area, and commercial and sport hunting on the winter grounds contributed further to the reduction of an already endangered bird.

As a result of predator control and management actions on the breeding and wintering grounds, the species rebounded. Rates of increase between 1975 and 1989 ranged from 6 to 35 percent annually, and by winter 1989/1990 the peak winter count reached 6,200 geese. The Service reclassified the Aleutian Canada goose from endangered to threatened in 1990 (55 FR 51106). Surveys during the winter of 1996/1997 estimated the population at over 24,000 birds.

Aleutian Canada geese winter in and use pastures and grain fields along the coasts of Oregon and northern California and in California's Central Valley. Prior to the northward spring migration, almost the entire population stages near Lake Earl in Crescent City, California. They arrive in early February and head north in April. Thousands of birds heading north along the southern coast of Oregon stop to graze in the New River pastures on the Coos/Curry county line. At night, the geese roost on the coastal rocks near Bandon. It is presumed that the geese migrate between the Aleutian Islands and their wintering grounds by flying non-stop over the Pacific Ocean, a distance of nearly 2,000 miles.

A unique population of Aleutian Canada geese breeds in the Semidi Islands, southwest of Kodiak Island, and winters only at Nestucca Bay, near Pacific City, Oregon. This population is small and its status remains tenuous.

Bald Eagle

The bald eagle is listed as threatened without critical habitat in Oregon. The information in this section is taken from the Pacific Bald Eagle Recovery Plan (USFWS 1986) and the 1995 final rule to reclassify the species as threatened rangewide (60 FR 36010). The bald eagle was listed as a result of destruction of habitat, illegal harassment and disturbance, shooting, electrocution, poisoning, a declining food base, and environmental contaminants. Currently the primary threats to bald eagles are habitat degradation and environmental contaminants. The species is doing well in the Pacific Northwest; statewide goals set by the Pacific Bald Eagle Recovery Plan have been met.

In Oregon and Washington, bald eagles typically nest in multi-layered, coniferous stands with old-growth trees located within one mile of lakes, large rivers or marine habitat. Availability of suitable trees for nesting and perching is necessary to maintain bald eagle site fidelity and populations. Perch trees are also needed by eagles for hunting and resting. These trees typically provide an unobstructed view of the surrounding area and are near feeding areas.

Oregon and Washington support approximately 25 percent of the wintering bald eagles in the conterminous United States. Wintering sites are typically in the vicinity of concentrated food sources such as anadromous fish runs, high concentrations of waterfowl or mammalian carrion. Winter roost sites provide protection from inclement weather conditions and are characterized by more favorable microclimate conditions.

Columbian White-Tailed Deer

The Columbian white-tailed deer is listed as endangered without critical habitat (55 FR 433). Information on this species is derived from the recovery plan (USFWS 1983) and other sources as cited below. This deer is medium-sized, with a coat that is tawny in the summer and bluish-gray in winter. Bucks weigh up to 182 kg (400 lb), whereas does are smaller, usually weighing less than 113 kg (250 lb). Female Columbian white-tailed deer typically have one or two fawns every season. Young deer have a reddish-tan coat with small white speckles.

The Columbian white-tailed deer is one of 38 subspecies of white-tailed deer in the Americas. Historically, the subspecies ranged from the southern end of Puget Sound in Washington to the Willamette Valley of Oregon and throughout the river valleys west of the Cascade Mountains. Following European settlement, conversion of land to agriculture pushed the deer into small vestiges of habitat where they are found today. Logging, vehicular fatalities, poaching, and flooding events also have contributed to the decline of this deer. Today, only two populations of the Columbian white-tailed deer exist, one near Roseburg, Oregon, and another on a few small islands and in isolated areas adjacent to the lower Columbia River, near Cathlamet, Washington.

Efforts to save the Columbian white-tailed deer from extinction began in 1972, when the Service established the 4,800-acre Julia Butler Hansen Refuge for the species near Cathlamet, Washington. Total numbers of the deer in the lower Columbia River population have increased in recent years, although the size of the population varies in response to flooding. In recent aerial surveys, biologists estimated a population of 60 deer on the Refuge mainland unit and 100 deer on 2,000-acre Tenasillahe Island in the Columbia River.

A separate population of Columbian white-tailed deer is found along the Umpqua River in Douglas County, Oregon, near Roseburg. In this population, deer are found in riparian woodlands adjacent to the North and South Umpqua Rivers, and in associated upland oak savannahs. This population is estimated at 5,500 deer, and has reached its recovery goal (David Peterson, USFWS, Southwest Oregon Field Office, Roseburg, Oregon, personal communication, 1999).

<u>Nelson's Checkermallow</u>

Nelson's checkermallow is federally listed as threatened without critical habitat (58 FR 8242). A recovery plan was published in 1998 (USFWS 1998b). The following information, unless otherwise attributed, is derived from the recovery plan. The species is a perennial herb in the mallow family (Malvaceae). The majority of sites for the species occur in the Willamette Valley of Oregon; the plant is also found at several sites in the Coast Range of Oregon and at two sites in the Puget Trough of southwestern Washington. Thus the range of the plant extends from southern Benton County, Oregon, north to Cowlitz County, Washington, and from central Linn County, Oregon, west to just west of the crest of the Coast Range. In the Willamette Valley, Nelson's checkermallow occurs on soils in the Wapto, Bashaw and Mcalpin Series (NRCS mapped soil unit STATSGO 81); in Oregon's Coast Range, the plant is found on soils in the Malabon, Coburg and Salem Series (NRCS mapped soil unit STATSGO 91) (Dr. Andrew F.

Robinson, Ph.D., USFWS, Oregon State Office, Portland, Oregon, personal communication, 1999).

Nelson's checkermallow bears tall lavender to deep pink flowers borne in clusters 50-150 cm (1.6-5 ft) tall at the end of short stalks. Inflorescences are usually somewhat spike-like, elongate and somewhat open (Hitchcock 1957). Plants have either perfect flowers (male and female) or pistillate flowers (female). The plant can reproduce vegetatively, by rhizomes, and by producing seeds, which drop near the parent plant. Flowering can occur as early as mid-May and extend into September in the Willamette Valley. Fruits have been observed as early as mid-June and as late as mid-October. Coast Range populations generally flower later and produce seed earlier, probably because of the shorter growing season (CH_2M Hill 1991).

Within the Willamette Valley, Nelson's checkermallow most frequently occurs in ash (*Fraxinus* sp.) swales and meadows with wet depressions, or along streams. The species also grows in wetlands within remnant prairie grasslands. Some sites occur along roadsides at stream crossings where exotics such as blackberry (*Rubus* spp.) and Queen Anne's lace (*Daucus carota)* are also present. Nelson's checkermallow primarily occurs in open areas with little or no shade and will not tolerate encroachment of woody species.

Prior to European colonization of the Willamette Valley, naturally occurring fires and fires set by Native Americans maintained suitable Nelson's checkermallow habitat. Current fire suppression practices allow succession by introduced and native species, which may gradually invade habitat for Nelson's checkermallow (BLM 1985). Remnant prairie patches in the Willamette Valley have been modified by livestock grazing, fire suppression, or agricultural land conversion (Moir and Mika 1972). Stream channel alterations, such as straightening, splash dam installation, and rip-rapping cause accelerated drainage and reduce the amount of water that is diverted naturally into adjacent meadow areas. As a result, areas that would support Nelson's checkermallow are lost. The species is now known to occur in 62 patches within five relict population centers in Oregon, and at two sites in Washington (CH_2M Hill 1991).

<u>Bradshaw's Lomatium</u>

Bradshaw's lomatium is federally listed as endangered without critical habitat (53 FR 38451). The Service published a recovery plan for the species in 1993 (USFWS 1993a); the following information was taken from the recovery plan. Bradshaw's lomatium is a member of the parsley family (Apiaceae), and grows from 20-50 cm (8-20 in) in height, with mature plants having only two to six leaves. Leaves are chiefly basal and are divided into very fine, almost threadlike, linear segments. The yellow flowers are small, measuring about 1 mm (0.05 in) long and 0.5 mm (0.025 in) across, and are grouped into asymmetrical umbels. Each umbel is composed of 5 to 14 umbellets, which are subtended by green bracts divided into sets of three. This bract arrangement differentiates *L. bradshawii* from other lomatiums. Bradshaw's lomatium blooms during April and early May, with fruits appearing in late May and June. Fruits are oblong, about 1.2 cm (0.5 in) long, corky and thick-winged along the margin, and have thread-like ribs on the dorsal surface. This plant reproduces entirely from seed. Insects observed to pollinate this plant include a number of beetles, ants, and some small native bees.

The majority of Bradshaw's lomatium populations occur on seasonally saturated or flooded prairies, adjacent to creeks and small rivers in the southern Willamette Valley. Soils at these sites are dense, heavy clays, with a slowly permeable clay layer located 15-30 cm (6-12 in) below the surface. This clay layer results in a perched water table during winter and spring, and so is critical to the wetland character of these grasslands, known as tufted hair-grass (*Deschampsia cespitosa*) prairies. Bradshaw's lomatium occurs on alluvial soils. The species occurs on soils in the Wapto, Bashaw and Mcalpin Series (NRCS mapped soil unit STATSGO 81)(Dr. A.F. Robinson, Ph.D., personal communication, 1999).

Endemic to and once widespread in the wet, open areas of the Willamette Valley of western Oregon, Bradshaw's lomatium is limited now to a few sites in Lane, Marion, and Benton Counties. The greatest concentrations of remaining sites and plants occur in and adjacent to the Eugene metropolitan area. Most of its habitat has been destroyed by land development for agriculture, industry, and housing. In addition, water diversions and flood control structures have changed historic flooding patterns, which may be critical to seedling establishment. Reductions in natural flooding cycles also permit invasion of trees and shrubs, and eventual conversion of wet prairies to woodlands.

Howell's Spectacular Thelypody

Howell's spectacular thelypody was proposed as threatened without critical habitat in January 1998 (63 FR 1948). The following information on the species is from the proposed rule and Meinke (1982). Howell's spectacular thelypody is a biennial plant (Family: Brassicaceae) that grows to approximately 60 cm (24 in) tall, with branches arising from near the base. Basal leaves are oblanceolate to spatulate and 2-10 cm (0.75-4 in) long. Cauline leaves (leaves borne on stem) are lanceolate to linear lanceolate, entire, and usually sagittate (arrowhead-shaped) at the base, 1-10 cm (0.4-4 in) long. Flowering typically takes place from June through July. Sepals are erect, scarious at the margin, and green, purple or lavender in color. The four petals per flower are mostly spatulate, occasionally oblanceolate, and lavender to purple in color. Its petal shape and paired free filaments distinguish *T. howellii* ssp. *spectabilis* from *T. howellii* ssp. *howellii*.

This plant occurs in moist, moderately well-drained, somewhat alkaline meadow habitats, typically growing with salt tolerant species such as greasewood (*Sarcobatus vermiculatus*), giant wild rye (*Elymus cinereus*), and goosefoot (*Chenopodium* spp.). *Thelypodium howellii* ssp. *spectabilis* appears to be dependent on periodic flooding because it rapidly colonizes areas adjacent to streams that have flooded. It occurs at 18 sites in the Baker-Powder River Valley located near the communities of North Powder, Haines, and Baker in Union and Baker Counties on soils in the Wingville, Baldock and Haines Series (NRCS mapped soil unit STATSGO 179)(Dr. A.F. Robinson, Ph.D., personal communication, 1999). The plant has been extirpated from about one-third of known historic sites, including the type locality in Malheur county.

Threats to the taxon include 1) habitat loss due to urban and agricultural development; 2) habitat degradation due to livestock grazing and hydrological modification; 3) consumption by livestock; 4) use of herbicides or mowing during the growing season; and 5) competition with exotic species such as teasel (*Dipsacus sylvestris*), bull thistle (*Cirsium vulgare*), Canada thistle (*C. canadensis*), and yellow sweet clover (*Melilotus officinalis*).

<u>Rough Popcornflower</u>

An annual herb in the Borage family (Boraginaceae), the rough popcornflower was proposed as endangered without critical habitat in November 1997 (63 FR 61953). Information in this section is from the proposed rule, except where otherwise cited. The rough popcornflower has stout stems, erect or reclining, that grow to 30-60 cm (12-24 in) long. The leaves are linear, the lower paired and the upper alternate, 10-25 cm (4-10 in) in length. The flowers are white with yellow centers, 5-petaled, radially symmetrical, up to 2 cm (0.75 in) across, and are arranged in curled racemes typical of the borage family. The nutlets (seeds) are ovate, 2 mm (0.1 in) long, with a prominent dorsal keel. It can be distinguished from other sympatric *Plagiobothrys* species by its distinctive, wide-spreading hairs, in contrast to the appressed hairs of the other species. The species is an annual, or creeping perennial with rooting stems, a unique trait for the genus.

The rough popcornflower has a narrow range historically, and currently occurs at only four known sites in Oregon's Umpqua Valley, near Sutherlin, in Douglas County. The plant occurs on soils in the Conser Silty Clay Loam Series (NRCS mapped soil unit SSURGO 44A) (Dr. A.F. Robinson, Ph.D., personal communication, 1999). The sites are all located within 8 km (5 miles) of one another and total under 4 hectares (10 acres) in area. Fewer than 3,000 plants are known to exist. The species occurs in moist, open areas on poorly drained silty clay soils in flat valley bottoms. Its habitat is maintained by the seasonal ponding of water.

The rough popcornflower is highly threatened by development, ditching, road building and maintenance, grazing, and competition with non-native weeds. One population occurs within the town of Sutherlin, on a vacant lot surrounded by residential areas. Another population occurs along the shoulder of Interstate 5, at the Sutherlin exit. The third population is transversed by a series of drainage ditches, with seasonal pool areas leveled with fill dirt, which has introduced non-native weeds to the site. The fourth site has a history of sheep grazing, and is presently grazed by cattle (Gamon and Kagan 1985).

Willamette Daisy

The Willamette daisy was proposed as endangered without critical habitat in January 1998 (63 FR 3863). The following information is extracted from the proposed rule, unless otherwise attributed. A member of the sunflower family (Asteraceae), this plant is a perennial herb, 15-62 cm (6-24 in) tall. Basal leaves are 5-18 cm (2-7 in) long and less than 1.2 cm (0.5 in) wide, becoming gradually shorter along the stem. The flowering stems, which are taller than the vegetative stems, produce 2 to 5 flower heads in June and July. The flowers are daisy-like, with yellow centers and 25 to 50 pinkish to blue rays, often fading to white with age.

The Willamette Daisy is endemic to Oregon's Willamette Valley. Historically, this plant was likely widespread throughout the Valley. Currently, 18 sites are known, distributed over an area of some 700,000 hectares (1.7 million acres), between Grand Ronde and Goshen, Oregon. The species occurs on alluvial soils. The Willamette daisy occurs on soils in the Wapto, Bashaw and Mcalpin Series (NRCS mapped soil unit STATSGO 81)(Dr. A.F. Robinson, Ph.D., personal communication, 1999). The plant is known to have been extirpated from an additional 19 historic locations (Clark *et al*. 1993).

Willamette daisy populations are known from both bottomland and upland prairie remnants. Prior to European settlement, these prairies were maintained by fire, which prevented the establishment of woody species. Prairie remnants are considered to be among the rarest habitats in western Oregon and are threatened by fragmentation, agriculture and urban growth. Most sites are small and privately owned. Only four sites are in protective ownership (Clark *et al*. 1993).

Factors Affecting Species Environments Within the Action Area

Populations of anadromous salmonids are at risk or already extinct in many river basins of Oregon, leading to many listings and proposed listings for anadromous fish. Disease, predation, competition from introduced species, climatic variation and unfavorable ocean conditions are among the many natural events that have taken a toll (Botkin *et al.* 1995, NMFS 1995, Spence *et al.* 1996, State of Oregon 1997). These natural events exacerbated population and habitat declines induced by human activities such as land and water development, over harvest, artificial propagation, and water pollution (Botkin *et al.* 1995, NMFS 1995, Spence *et al.* 1996, State of Oregon 1997).

Many land and water management activities have degraded habitats of declining salmonids. Significant examples include water withdrawals, unscreened water diversions, crop production, livestock production, hydropower development, road construction, removal of large woody debris from streams, splash dams, timber harvest, mining, urbanization and outdoor recreation (Botkin *et al*. 1995, NMFS 1995, Spence *et al*. 1996, State of Oregon 1997). Connectivity (defined as the flow of energy, organisms, and materials between streams, riparian areas, floodplains, and uplands) has been reduced. Delivery of fine sediment to streams has increased, filling pools and reducing spawning and rearing habitats for fish. The volume and distribution of instream and riparian large woody debris that traps sediment, stabilizes stream banks, and helps form pools, has been reduced. Vegetative canopies that reduce temperature fluctuations have been reduced or eliminated. Streams have become straighter, wider, and shallower, thus reducing spawning and rearing habitats and increasing temperature fluctuations. Hydrological regimes have been altered, including the timing, size and other characteristics of peak flow regimes necessary to sustain channel conditions and sustain fish migration behavior. Floodplain function, water tables and base flows have been altered resulting in riparian, wetland and stream dewatering. Finally, increases in heat, nutrients and toxicants have degraded water quality.

The Services conclude that not all of the biological requirements of the species within the action area are being met under current conditions, based on the best available information on the status of the affected listed, proposed and candidate species rangewide and within the action area; information regarding population status, trends, and genetics; and the environmental baseline conditions within the action area. Significant improvement in habitat conditions is needed to meet the biological requirements for survival and recovery of these species. Any further degradation of these conditions would have a significant impact on the future of the affected species.

CREP will be implemented on agricultural lands in Oregon. This section contains an analysis of past and ongoing agricultural practices on stream environments, based largely on Spence *et al*. 1996. The purpose of this extended discussion is to provide a substantial context for nondiscretionary measures included in the incidental take statement issued with this Biological Opinion, and for discretionary conservation recommendations that FSA should carry out consistent with its section 7(a)(1) authority.

A. Grazing Lands

Livestock grazing is the second most dominant nonfederal land use in Oregon, following timber production. Over 3.8 million hectares (9.4 million acres) of rangeland, approximately 0.8 million hectares (2.0 million acres) of pastureland, and an undetermined amount of land used primarily as crop or forest lands are grazed by cattle and sheep (USDA 1989). This area is approximately 39 percent the total nonfederal land base in Oregon. In 1996, 1.47 million cattle and 0.33 million sheep were produced for sale in Oregon (Oregon Department of Agriculture

1996). Most of the rangelands in Oregon lie east of the Cascade Range (Palmisano *et al*. 1993), but livestock are also concentrated in the Willamette Valley and coastal valleys.

Range condition is a measure of rangeland health. Heavy livestock grazing in the western United States beginning in the mid-to-late 19th century and continuing in many areas until the mid 20th century or later severely damaged many rangelands. The 1982 National Resource Inventory documented widespread degradation of Oregon's rangelands and found that 40 percent of Oregon's rangelands were in "poor" condition, 37 percent were "fair" and only 2 percent were classified as "good" (USDA 1989). An "upward" trend in the condition of 11 percent of Oregon's rangelands suggests improvement in the condition of some rangelands, although the condition of 71 percent was reported as "static" and 8 percent were trending "downward" (USDA 1989). Despite improved upland conditions in many areas, extensive field observations in the late 1980's suggest riparian areas in much of the West are in the worst condition in history (Chaney *et al*. 1993). A survey of more than 29,000 miles of Oregon's rivers and streams found that beneficial uses were "not supported" on 27 percent of the area surveyed, and only "partially supported" on another 30 percent (Oregon Department of Environmental Quality 1992). Livestock grazing was found to be the leading source of nonpoint source pollution, followed closely by crop and timber production, and adversely affected water quality in every river basin with proportionately greater impacts in eastern Oregon. In April 1997, USDA officially launched a National Riparian Buffer Initiative, with a goal of establishing two million miles of conservation buffers by the year 2002 to help restore streams damaged by grazing and crop production (USDA 1997).

Despite the generally poor condition of most riparian areas, the potential for restoring riparian areas damaged by grazing is arguably greater than for those affected by other activities (Behnke 1977; Platts 1991). Recovery of grasses, willows and other woody species can occur within a few years when grazing pressure is reduced or eliminated (Elmore and Beschta 1987; Platts 1991; Elmore 1992). Restoration of fully functioning riparian areas that support a variety of plant species, including older forests of cottonwood and other large tree species, will take considerable time. Nevertheless, many important riparian functions such as shading, bank stabilization, sediment and nutrient filtering, and allochthonous inputs may be rapidly restored to the benefit of salmonids, provided the stress of grazing is alleviated and prior damage has not been too severe.

1. Grazing Effects on Vegetation

Heavy livestock grazing around the turn of the century had significant and widespread effects, many of which persist today, on upland and riparian vegetation. Rangelands have experienced decreases in the percentage of ground covered by vegetation and associated organic litter (Heady and Child 1994). Species composition of plants in upland areas has shifted from perennial grasses toward nonnative annual grasses and weedy species (Heady and Child

1994). In eastern Oregon, upland sites that once supported plant associations of Idaho fescue now lack native bunchgrasses and have been replaced with introduced tarweed, gumweed, and other noxious plants (Johnson *et al*. 1994). In riparian areas, willow, aspen, sedge, rush, and grass communities have been reduced or eliminated and replaced with annual grasses or sagebrush. Diaries of early trappers in eastern Oregon noted that grasses were as high as seven feet (Wilkinson 1992) and that streams were well lined with willows, aspen, and other woody vegetation (Elmore 1992). In eastern Oregon meadows, alteration of the vegetation has been so pervasive that little is known about the native vegetation that once inhabited riparian meadow communities. Currently, these meadows are dominated by Kentucky bluegrass, big sagebrush, and annual brome grasslands (Johnson *et al*. 1994). Kauffman and Pyke (in press), Belsky *et al.* (1999) and Fleischner (1994) recently reviewed the literature and found many examples of deleterious changes in species composition, diversity, and richness associated with livestock grazing and beneficial changes associated with removal of livestock in western states.

Much early alteration of rangelands was by settlers who engaged in widespread clearing of grasslands and riparian forests to grow crops, build houses, obtain fuelwood, and increase availability of land for domestic animals (Heady and Child 1994). Conversion of lands for livestock production continues today. Woody shrubs and trees are sometimes removed by using anchor chains or cables stretched between tractors to uproot vegetation and increase grass production (Heady and Child 1994). Removal of woody shrubs through chemical application or by mechanical means is also a common practice in range management. In addition, suppression of fire on rangelands is responsible for changes in upland vegetation, including encroachment by juniper in many areas of eastern Oregon and Washington (Miller *et al*. 1989).

Cattle and sheep affect vegetation primarily through browsing and trampling. Grazing animals are selective in what they eat; consequently, preferred vegetation types are generally removed first, followed by less palatable species. Heavy, continual grazing causes plants to be partially or wholly defoliated, which can reduce biomass, plant vigor, and seed production (Kauffman 1988; Heady and Child 1994). Selection of specific plant species may allow other taxa to dominate (Kauffman and Krueger 1984; Fleischner 1994). Vegetation may also be lost or damaged through trampling, which tears or bruises leaves and stems, and may break stems of woody plants. Regeneration of some woody vegetation, such as willow, cottonwood, and aspen, is inhibited by browsing on seedlings (Fleischner 1994). Vegetation may also be directly lost when buried by cattle dung. In a dairy pasture, MacDiarmid and Watkin (1971) found that 75 percent of grasses and legumes under manure piles were killed.

Livestock grazing also influences vegetation by modifying soil characteristics. Hooves compact soils that are damp or porous, which inhibits the germination of seeds and reduces root growth (Heady and Child 1994). Changes in infiltration capacity associated with trampling may lead to more rapid surface runoff, lowering moisture content of soil and the ability of plants to germinate or persist (Heady and Child 1994). However, sometimes, trampling may break up impervious surface soils, allowing for greater infiltration of water and helping to cover seeds (Savory 1988 in Heady and Child 1994). Soils in arid and semi-arid lands have a unique microbiotic surface layer or crust of symbiotic mosses, algae, and lichens that covers soils between and among plants. This "cryptogamic crust" plays an important role in hydrology and nutrient cycling and is believed to provide favorable conditions for the germination of vascular plants (Fleischner 1994). Trampling by livestock breaks up these fragile crusts, and reformation may take decades. Anderson *et al*. (1982) found recovery of cryptogamic crusts took up to 18 years in ungrazed exclosures in Utah. Finally, livestock indirectly affect plant species composition by aiding the dispersion and establishment of nonnative species; seeds may be carried on the fur or in the dung of livestock (Fleischner 1994).

The effects of livestock grazing on vegetation are especially intense in the riparian zone because of the tendency for livestock to congregate in these areas. Gillen *et al*. (1984) found that 24 percent to 47 percent of cattle in two pastures in north-central Oregon were observed in riparian meadows occupying only 3 percent to 5 percent of the total land area. Roath and Krueger (1982) reported that riparian meadows that are only 1 percent to 2 percent of the total land area accounted for 81 percent of the total herbaceous biomass removed by livestock. Similar preferences for riparian areas have been observed elsewhere in the west (reviewed in Kauffman and Krueger 1984; Fleischner 1994). Cattle and sheep typically select riparian areas because they offer water, shade, cooler temperatures, and an abundance of high quality food that typically remains green longer than in upland areas (Kauffman and Krueger 1984; Fleischner 1994; Heady and Child 1994). In mountainous terrain, the preference of cattle and sheep for the riparian zone also appears related to hillslope gradient (Gillen *et al*. 1984). Heady and Child (1994) suggest that cattle avoid slopes greater than 10 to 20 percent. The intensity of use by livestock in riparian zones exacerbates all of the problems noted above and generates additional concerns. Alteration of flow regimes, changes in the routing of water, and incision of stream channels can lead to reduced soil moisture in the floodplain. Many types of riparian vegetation are either obligate or facultative wetland species adapted to the anaerobic conditions of permanently or seasonally saturated soils. Stream downcutting and the concomitant lowering of the water table can lead to encroachment of upland species, such as sagebrush and bunchgrasses into areas formerly dominated by willows, sedges, rushes and grasses (Elmore 1992). In addition, flood events may be important mechanisms for seed dispersal throughout the floodplain for woody plants, a function diminished as channels are incised.

2. Effects on Soils

Rangeland soils are frequently compacted by livestock. The degree of soil compaction depends on soil characteristics, including texture, structure, porosity, and moisture content (Platts 1991; Heady and Child 1994). Generally, soils that are high in organic matter, porous, and composed of a wide range of particle sizes are more easily compacted than other soils. Similarly, moist soils are usually more susceptible to compaction than dry soils, although extremely wet soils may give way and then recover following trampling by livestock (Clayton and Kennedy 1985). The result of soil compaction is an increase in bulk density (specific gravity) in the top five to 15 cm of soil as pore space is reduced. Because of the loss of pore space, infiltration is reduced and surface runoff is increased, thereby increasing the potential for erosion. The available studies show that compaction generally increases with grazing intensity, but that site-specific soil and vegetative conditions are important in determining the response of soils to grazing activity (reviewed in Kauffman and Krueger 1984; Heady and Child 1994).

Trampling by livestock may also displace or break up surface soils. In instances where surface soils have become impervious to water, light trampling may increase the soil's ability to absorb water. On the other hand, loosening soils makes them more susceptible to erosion. Heavily pulverized soil (dust) may become hydrophobic, reducing infiltration and increasing surface runoff. In arid and semi-arid climates, the cryptogamic crust has been shown to increase soil stability and water infiltration (Loope and Gifford 1972; Kleiner and Harper 1977; Rychert *et al*. 1978). Disruption of the cryptogamic crust may thus have long-lasting effects on erosional processes.

Livestock also alter surface soils indirectly by removing ground cover and mulch, which in turn affects the response of soils to rainfall. Kinetic energy from falling raindrops erodes soil particles (splash erosion), which may then settle in the soil interstices resulting in a less pervious surface. Livestock grazing can increase the percentage of exposed soil and break down organic litter, reducing its effectiveness in dissipating the energy of falling rain.

3. Effects on Hydrology

Grazing modifies two fundamental hydrologic processes, evapotranspiration and infiltration, that ultimately affect the total water yield from a watershed and the timing of runoff to streams. Loss of upland and riparian vegetation results in reduced interception and transpiration losses, thus increasing the percentage of water available for surface runoff (Heady and Child 1994). Shifts in species composition from perennials to annuals may also reduce seasonal transpiration losses. Reductions in plant biomass and organic litter can increase the percentage of bare ground and can enhance splash erosion, which clogs soil pores and decreases infiltration. Similarly, soil compaction reduces infiltration. Rauzi and Hanson (1966) report higher infiltration rates on lightly grazed plots, compared with moderately and heavily grazed plots in South Dakota. Similar experiments in northeastern Colorado showed reductions in infiltration in heavily grazed plots, but no differences between moderately and lightly grazed plots (Rauzi and Smith 1973). Johnson (1992) reviewed studies related to grazing and hydrologic processes and concluded that heavy grazing nearly always decreases infiltration, reduces vegetative biomass, and increases bare soil.

Decreased evapotranspiration and infiltration increases and hastens surface runoff, resulting in a more rapid hydrologic response of streams to rainfall. Some authors have suggested that the frequency of damaging floods has increased in response to grazing; however, there remains uncertainty about the role of grazing in mediating extreme flow events (reviewed in Belsky *et al*. 1999 and Fleischner 1994).

Reduced stability of streambanks associated with loss of riparian vegetation can lead to channel incision or "downcutting" during periods of high runoff. In naturally functioning systems, riparian vegetation stabilizes streambanks, slows the flow of water during high flow events, and allows waters to spread out over the floodplain and recharge subsurface aquifers (Elmore 1992). Moreover, riparian vegetation facilitates sediment deposition and bank building, increasing the capacity of the floodplain to store water, which is then slowly released as baseflow during the drier seasons (Elmore and Beschta 1987). Downcutting effectively separates the stream channel from the floodplain, allowing flood waters to be quickly routed out of the system and leading to lowering of the water table (Platts 1991; Elmore 1992; Armour *et al*. 1994). Consequently, summer streamflows may decrease although total water yield increases in response to vegetation removal (Elmore and Beschta 1987). Li *et al*. (1994) found that streamflow in a heavily grazed eastern Oregon stream became intermittent during the summer, while a nearby, well-vegetated reference stream in a similar-sized watershed had permanent flows. They suggested that the difference in flow regimes was a consequence of diminished interaction between the stream and floodplain with resultant lowering of the water table.

4. Effects on Sediment Transport

The presence of livestock in the riparian zone increases sediment transport rates by increasing both surface erosion and mass wasting (Platts 1991; Marcus *et al*. 1990; Heady and Child 1994). Devegetation and exposure of soil by grazing helps to detach soil particles during rainstorms, thus increasing overland sediment transport. Rills and gullies often form in areas denuded by livestock trails or grazing, resulting in increased channelized erosion (Kauffman *et al*. 1983). As gullies expand and deepen, streams downcut, the water table drops, and sediments are transported to depositional areas downstream (Elmore 1992; Fleischner 1994; Henjum *et al*. 1994). Stream downcutting leads to further desertification of the riparian area and promotes soil denudation and the establishment of xeric flora. This also increases the potential for soil erosion. Some evidence suggests that significant channel downcutting in the Southwest occurred before the introduction of livestock (Karlstrom and Karlstrom 1987 in Fleischner 1994); however, studies in eastern Oregon and northern California implicate livestock as a major cause of downcutting (Dietrich *et al*. 1993; Peacock 1994).

Mass wasting of sediment occurs along stream banks where livestock trample overhanging cut banks (Behnke and Zarn 1976; Platts and Raleigh 1984; Fleischner 1994). Grazing also removes vegetation that stabilizes streambanks (Platts 1991). Where banks are denuded, undercutting and sloughing occurs, increasing sediment loads, filling stream channels, changing pool-riffle ratios, and increasing channel width (Platts 1981 in Fleischner 1994).

5. Effects on Thermal Energy Transfer and Stream Temperature

Riparian vegetation shades streams and regulates stream temperatures. On rangelands east of the Cascades, black cottonwood, mountain alder and quaking aspen are the dominant deciduous tree species in natural communities, whereas west of the Cascades, black cottonwood, red alder and big leaf maple are dominant (Kauffman 1988). Shrubby vegetation, such as willows, may also be an important source of shade along smaller streams and in mountainous areas (Henjum *et al*. 1994), and even tall grasses can provide some measure of shade along narrow first and second-order streams (Platts 1991).

The removal of riparian vegetation along rangeland streams can result in increased solar radiation and thus increased summer temperatures. Li (1994) noted that solar radiation reaching the channel of an unshaded stream in eastern Oregon was six times greater than that reaching an adjacent, well-shaded stream and that summer temperatures were 4.5 ^{o}C warmer in the unshaded tributary. Below the confluence of these two streams, reaches that were unshaded were significantly warmer than shaded reaches both upstream and downstream. A separate comparison of water temperatures at two sites of similar elevation in watersheds of comparable size found temperature differences of 11^{o}C between shaded and unshaded streams (Li 1994). Warming of streams from loss of riparian vegetation is likely widespread in eastern Oregon and may be particularly acute because of low summer flows and many cloud-free days.

The effects of a riparian canopy in winter on stream temperatures are less well understood and various studies have shown increases, decreases, and no change in water temperature following removal of a riparian canopy (reviewed in Beschta *et al*. 1987). Riparian cover can inhibit energy losses from evaporation, convection, and long-wave radiation during the winter. Several authors have suggested that removal of vegetation can increase radiative heat loss and add to the formation of anchor ice (Beschta *et al*. 1991; Platts 1991; Armour *et al*. 1994). This is most likely to occur in regions where skies are clear on winter nights and where snow-cover is inadequate to blanket and insulate streams (Beschta *et al*. 1987), primarily in mountainous regions.

Alteration of stream temperature processes may also result from changes in channel morphology. Streams in areas that are improperly grazed are wider and shallower than in ungrazed systems, exposing a larger surface area to incoming solar radiation (Bottom *et al*. 1985; Platts 1991). Wide, shallow streams heat more rapidly than narrow, deep streams (Brown 1980). Similarly, wide, shallow streams may cool more rapidly, increasing the likelihood of anchor ice formation. Reducing stream depth may expose the stream bottom to direct solar radiation, which may allow greater heating of the substrate and subsequent conductive transfer to the water.

6. Effects on Nutrients and Other Solutes

Livestock activities can directly affect nutrient dynamics through several mechanisms. The removal of riparian vegetation by grazing reduces the supply of nutrients provided by organic leaf litter. Livestock also redistribute materials across the landscape. Because riparian areas are favored by cattle and sheep, nutrients eaten elsewhere on the range are often deposited in riparian zones or near other attractors, such as salt blocks (Heady and Child 1994). The deposition of nutrients in riparian areas increases the likelihood that elements such as nitrogen and phosphorous will enter the stream. Nutrients derived from livestock wastes may be more bioavailable than those bound in organic litter. Elimination of the cryptogamic crust by livestock may also alter nutrient cycling in arid and semi-arid systems. These microbiotic crusts complete most of the nitrogen fixation in desert soils (Rychert *et al*. 1978). Loss of these crusts can reduce the availability of nitrogen for plant growth, potentially affecting plant biomass in uplands (Kauffman and Pyke, in press; Belsky *et al.* 1999, Fleischner 1994).

Riparian areas play a major role in regulating the transportation and transformation of nutrients and other chemicals. As stream channels incise and streams are separated from their floodplains, soil moisture is reduced, which in turn alters the quantity and form of nutrients and their availability to aquatic communities. In the anaerobic environments of saturated soils, microbial activity transforms nitrate nitrogen (NO_3) into gaseous nitrous oxide (N_2O) and elemental nitrogen (N_2) liberated to the atmosphere (Green and Kauffman 1989). Under drier soil conditions (oxidizing environments), denitrification does not occur and nitrate-nitrogen concentrations in the soil increase. Because nitrate is negatively charged, it is readily transported by subsurface flow to the stream channel (Green and Kauffman 1989). Thus, by altering the hydrologic conditions in the riparian zone, grazing can increase how much nitrate nitrogen is released to streams. Excessive nitrate concentrations encourage algal growth, increase turbidity, and may cause oxygen depletion because of increased biochemical oxygen demand.

The form of other elements including manganese, iron, sulfur, and carbon also depends on the redox potential of soils. In their reduced form, manganese, iron, and sulfur can be toxic to plants at high concentrations (Green and Kauffman 1989). Obligate and facultative wetland plant species have special adaptations for coping with these reduced elements that allow them to survive where more xeric plants cannot. Thus, changes in hydrologic condition caused by downcutting can modify the form of elements available to plants, altering competitive interactions between plants and changing riparian plant communities.

7. Effects of Vegetation Management

Fertilizers, herbicides, mechanical treatments, and prescribed fire are commonly used in rangeland management to alter vegetation in favor of desired species. In principle, the potential effects of these activities on salmonids and their habitats are no different from similar activities in forested environments. However, because the physical and biological processes that regulate the delivery of water, sediments, and chemicals to streams differ on forests and rangelands, so may be the response of aquatic ecosystems.

Fertilizers are used on rangelands to increase forage production, improve nutritive quality of forage, and enhance seedling establishment, although the high costs and varied results have led to a decline in fertilizing rangeland in the past 20 years (Heady and Child 1994). Fertilizers that reach streams through direct application or runoff can adversely affect water quality. Nutrient enrichment (especially nitrogen) promotes algal growth, which in turn can lead to oxygen depletion as algae die and decompose. Conversely, fertilizer applied to rangelands may reduce sedimentation, hydrologic, and temperature effects by stimulating recovery of vegetation, including woody riparian shrubs.

Herbicides are typically used to target unpalatable or noxious weeds that compete with desired forage species. Many herbicides commonly used in forestry (e.g., 2,4-D, picloram, glyphosate, tricopyr) are used in range management as well, although other highly selective herbicides may be used to control particular weeds common to rangelands, including unpalatable woody shrubs. Direct toxic effects on aquatic biota may occur where herbicides are applied directly to stream channels; however, risks of contamination can be reduced if adequate no-spray buffers are maintained (Heady and Child 1994). Herbicide applications to upland areas may decrease total ground cover, increasing the potential for surface erosion. In the riparian zone, use of herbicides may reduce production of deciduous trees and shrubs, opening streams to greater direct solar radiation, which in turn leads to elevated stream temperatures and increased algal production. These conditions can lead to insufficient nighttime dissolved oxygen concentrations and afternoon gas supersaturation. The loss of riparian vegetation also decreases the amount of organic litter and large wood delivered to streams. Furthermore, without the root structure of woody vegetation, banks are prone to collapse, increasing sedimentation and reducing cover for fish.

The influence of mechanical treatment and prescribed fire on aquatic ecosystems in rangelands depends on the type and intensity of disturbance. The use of tractors with dozer blades, brush rakes, cables, or rolling cutters for vegetation removal all can lead to compaction of rangeland soils (Heady and Child 1994), thus increasing surface runoff and erosion. Disking of soils may break up impervious soils and allow greater infiltration of water. Unless the area is rapidly revegetated, however, raindrop splashes on exposed soils are likely to increase surface erosion and increase sediment delivery to streams. Disking and dozer use also rearranges soil layers, mixing topsoil with woody debris, which may affect reestablishment of vegetation. Positive effects of mechanical vegetation removal are also possible. Removal of vegetation with high evapotranspiration rates (e.g., juniper woodlands that have encroached because of grazing and lack of wildfires) may potentially increase water available during the summer, although documentation of this effect is poor. Prescribed fire is most likely to affect aquatic ecosystems through increased surface runoff and erosion resulting from the removal of vegetation and formation of hydrophobic soils.

In summary, manipulations of vegetation on rangelands can influence salmonid habitats through both direct and indirect pathways. These changes may harm or benefit salmonids depending on whether temperature, spawning sites, cover, or food limits the production of salmonids. Salmonid abundance will decrease if the increased invertebrate production is offset by undesirable alterations in the benthos assemblage to less nutritious species, reduced cover, increased sedimentation, and lower water quality.

8. Effects on Physical Habitat Structure

Livestock-induced changes in physical structure within streams result from the combined effects of modified hydrologic and sediment transport processes in uplands and the removal of vegetation within the riparian zone. Platts (1991) and Elmore (1992) reviewed effects of grazing on channel morphology and are the sources of most information presented below. Loss of riparian vegetation from livestock grazing generally leads to stream channels that are wider and shallower than those in ungrazed or properly grazed streams (Hubert *et al*. 1985; Platts and Nelson 1985a, 1985b in Marcus *et al*. 1990). Loss of riparian root structure promotes greater instability of stream banks, which reduces the formation of undercut banks that provide important cover for salmonids (Henjum *et al*. 1994). Furthermore, increased deposition of fine sediments from bank sloughing may clog substrate interstices and reduce both invertebrate production and the quality of spawning gravels. Over the long-term, reductions in instream wood diminish the retention of spawning gravels and decrease the frequency of pool habitats. In addition, the lack of structural complexity allows greater scouring of streambeds during high-flow events, which can reduce gravels available for spawning and cause channel downcutting.

9. Effects on Stream Biota

As with forest practices, removal of riparian vegetation by livestock can fundamentally alter the primary source of energy in streams. Reduction in riparian canopy increases solar radiation and temperature, and thus stimulates production of periphyton (Lyford and Gregory 1975). In a study of seven stream reaches in eastern Oregon, Tait *et al*. (1994) reported that thick growths of filamentous algae encrusted with epiphytic diatoms were found in reaches with high incident solar radiation, whereas low amounts of epilithic diatoms and blue-green algae dominated in shaded reaches. Periphyton biomass was significantly correlated with incident solar radiation.

While densities of macroinvertebrates in forested streams typically increase in response to increased periphyton production, the effect of stimulated algal growth in rangeland streams is less clear. Tait *et al*. (1994) found that biomass, but not density, of macroinvertebrates was greater in reaches with greater periphyton biomass. The higher biomass was a consequence of many *Dicosmoecus* larvae, a large-cased caddisfly, that can exploit filamentous algae. Consequently, any potential benefits of increased invertebrate biomass to organisms at higher trophic levels, including salmonids, may be small, because these larvae are well protected from fish predation by their cases. Tait *et al*. (1994) suggest that these organisms may act as a trophic shunt that prevents energy from being transferred to higher trophic levels.

Evidence of negative effects of livestock grazing on salmonid populations is largely circumstantial, but is convincing nonetheless. Platts (1991) found that in 20 of 21 studies identified, stream and riparian habitats were degraded by livestock grazing, and habitats improved when grazing was prohibited in the riparian zone. Fifteen of the 21 studies associated decreasing fish populations with grazing. Although they caution that some of these studies may be biased because of a lack of grazing history, the negative effects of grazing on salmonids seem well supported. Storch (1979) reported that in a reach of Camp Creek, Oregon, passing through grazed areas, game fish made up 77 percent of the population in an enclosure, but only 24 percent of the population outside the enclosure. Platts (1981) found fish density to be 10.9 times higher in ungrazed or lightly grazed meadows of Horton Creek, Idaho, compared with an adjacent heavily grazed reach. Within an enclosure along the Deschutes River, Oregon, the fish population shifted from predominately dace (*Rhinichthys* sp.) to rainbow trout over a ten-year period without grazing (Claire and Storch 1983). Platts (1991) cited other examples of improved habitat conditions resulting in increased salmonid populations.

B. Croplands.

Crop production is the third most common use of nonfederal land in Oregon, following grazing and timber production. The total cropland base includes more than 2.0 million hectares (5.0 million acres), of which 1.1 million hectares (2.8 million acres) are harvested and 0.7 million hectares (1.6 million acres) are irrigated (USDA 1992). Of the harvested cropland, wheat accounts for 43 percent and hay for 39 percent, found mostly in eastern Oregon. The remaining 18 percent is mostly barley, vegetables, orchards, oats, and nursery and greenhouse crops, in that order.

Like the other forms of food and fiber production, farming results in massive alterations of the landscape and the aquatic and riparian ecosystems contained therein. Usually, the effects of agriculture on the land surface are more severe than logging or grazing because vegetation removal is permanent and disturbances to soil often occur several times per year. Crop production often takes place on the historical floodplains of river systems, where it has a direct impact on stream channels and riparian functions. In the Pacific Region, 21 percent of the cropland is considered "floodprone," that is, lowland and relatively flat areas ajoining inland and coastal waters such as streams, rivers, lakes and estuaries (USDA 1989). Moreover, irrigated agriculture frequently requires the diversion of surface waters, which decreases water availability and quality for salmonids and other aquatic species.

Oregon's statewide water quality survey that found that the geographic scope of agriculture's impact on water quality was equal to timber operations and second only to livestock grazing (Oregon Department of Environmental Quality 1992). The Willamette River Basin was selected as one of 50 of the Nation's largest river basins for inclusion in the National Water-Quality Assessment (NWQA) program. Among other things, that assessment showed that fish communities and instream and riparian habitat quality in agricultural portions of the basin ranked among the worst found when compared to other NWQA sites (Wentz *et al*. 1998). Poor riparian quality, high susceptibility to bank erosion, and a high degree of channel modification were among the most common factors contributing to this condition. Another NWQA project examining the Central Columbia Plateau in Washington and Idaho found similar problems and noted that present-day grazing and cropping practices are limiting natural recovery of the vegetation (Williamson *et al*. 1998). Qualitative summaries of the historical effects of agriculture on aquatic ecosystems have been reported by Smith (1971), Cross and Collins (1975), Gammon (1977), and Menzel *et al*. (1984).

1. Effects on Vegetation

In Oregon, natural grasslands, woodlands and wetlands have been eliminated to produce domestic crops. For example, in the Willamette Valley, the original fire-maintained prairies and floodplain forests were replaced with croplands (Johannessen *et al*. 1971). By the late 1970's, more than 40 percent of the tidal marshes and 75 percent of the tidal swamps in the Pacific Northwest were lost, primarily due to diking (Thomas 1983). Wetland areas in most estuaries have been reduced by 50 to 95 percent due to conversion for agricultural and urban use (Boule and Bierly 1987). The area of the Coos Bay estuary has been reduced by 90 percent and the area of the Coquille River estuary has been reduced by 96 percent (Botkin *et al*. 1995). Replacement of natural forest and shrubland vegetation with annual crops frequently results in large areas of tilled soil that become increasingly compacted by machinery and are only covered with vegetation for part of the year. Commonly, little or no riparian vegetation is retained along streams as farmers attempt to maximize acreage in production. In agricultural regions of western Oregon, the rate of river bank clearing, riparian grazing, channel simplification, and floodplain drainage have slowed, but there is no policy in place to reverse the effects of most of these practices that have depleted long, continuous strips of the riparian zone

(Botkin *et al*. 1995). Although some agricultural lands may be restored to more natural communities, cropland conversion is usually a permanent alteration of the landscape.

2. Effects on Soils

Agriculture involves repeated tillage, fertilization, pesticide application, and harvesting of the cropped acreage. The repeated mechanical mixing, aeration, and introduction of fertilizers or pesticides significantly alter physical soil characteristics and soil microorganisms. Further, tillage renders a uniform characteristic to soils in the cropped areas. Although tillage aerates the upper soil, compaction of fine textured soils typically occurs just below the depth of tillage, altering the infiltration of water to deep aquifers. Other activities requiring farm machinery to traverse the cropped lands, and roads along crop margins, causes further compaction, reducing infiltration and increasing surface runoff. Where wetlands are drained for conversion to agriculture, organic materials typically decompose, significantly altering the character of the soil. In extreme cases, the loss of organic materials results in "deflation," the dramatic lowering of the soil surface. Soil erosion rates are generally greater from croplands than from other land uses but vary with soil type and slope. The estimated average annual erosion on all 1982 cropland for Oregon was 5.7 tons per acre (USDA 1989).

3. Effects on Hydrology

Changes in soils and vegetation on agricultural lands typically result in lower infiltration rates, which yield greater and more rapid runoff. For example, Auten (1933) suggested that forested land may absorb fifty times more water than agricultural areas. Loss of vegetation and soil compaction increase runoff, peak flows, and flooding during wet seasons (Hombeck *et al*. 1970). Reduced infiltration and the rapid routing of water from croplands may also lower the water table, resulting in lower summer base flows, higher water temperatures, and fewer permanent streams. Typically, springs, seeps, and headwater streams dry up and disappear, especially when wetlands are ditched and drained.

Water removed from streams and spread on the land for irrigated agriculture reduces streamflows, lowers water tables, and leaves less water for fish. Often the water is returned considerable distances from where it was withdrawn, and the return flows typically raise salinity and temperature in receiving streams. Extreme examples of this occur in many rivers in eastern Oregon. The flows of these rivers are naturally low in late summer, but the additional losses from irrigation accentuate low flows. Reductions in summer base flows greatly degrade water quality because the water warms more than normal and causes increased evaporation, which concentrates dissolved chemicals and increases the respiration rates of aquatic life.

Streams are typically channelized in agriculture areas, primarily to reduce flood duration and to alter geometry of cropped lands to improve efficiency of farm machinery. Because peak flows pass through a channelized river system more quickly, downstream flood hazards are increased (Henegar and Harmon 1971). When channelization is accompanied by widespread devegetation, the severity of flooding is increased, such as occurred in the Mississippi Valley in 1993. On the other hand, channelization of streams leads to decreases in summer base flows because of reduced groundwater storage (Wyrick 1968), which can limit habitat availability for fish and increase crowding and competition. In more extreme cases, streams may dry completely during droughts (Gorman and Karr 1978; Griswold *et al*. 1978).

4. Effects on Sediment Transport

Because of the intensity of land use, agricultural lands contribute substantial quantities of sediment to streams. The Soil Conservation Service (1984) estimated that 92 percent of the total sediment yields in the Snake and Walla Walla River basins of southeastern Washington resulted from sheet and rill erosion from croplands that accounted for only 43 percent of the total land area. The loss of vegetative cover increases soil erosion because raindrops are free to detach soil particles (splash erosion). Fine sediments mobilized by splash erosion fill soil interstices, which reduces infiltration, increases overland flow, and adds to sheet and rill erosion. Agricultural practices typically smooth and loosen the land surface, enhancing the opportunity for surface erosion. When crop lands are left fallow between cropping seasons, excessive erosion can greatly increase sediment delivery to streams (Soil Conservation Service 1984). Mass failures are probably rare on most agricultural lands because slopes are generally gentle; however, sloughing of channel banks may occur in riparian zones in response to vegetation removal.

5. Effects on Thermal Energy Transfer and Stream Temperature

Removal of riparian forests and shrubs for agriculture reduces shading and increases wind speeds, which can greatly increase water temperatures in streams passing through agricultural lands. In addition, bare soils may retain greater heat energy than vegetated soils, thus increasing conductive transfer of heat to water that infiltrates the soil or flows overland into streams. In areas of irrigated agriculture, temperatures increases during the summer are exacerbated by heated return flows (Dauble 1994).

6. Effects on Nutrient and Solute Transport

Agricultural practices may substantially modify the water quality of streams. Omernik (1977), in a nationwide analysis of 928 catchments, found that streams draining agricultural areas had mean concentrations of total phosphorus and total nitrogen 900 percent greater than those in streams draining forested lands. Smart *et al*. (1985) found that water quality of Ozark streams was more strongly related to land use than to geology or soil. Exponential increases in chlorine, nitrogen, sodium, phosphorus, and chlorophyll-a occurred with increases in percent pasture in streams draining both forested and pastured catchments, and fundamental alterations in chemical habitats resulted as the dominant land use changed from forest to pasture to urban. Stimulation of algal growth by nutrient enrichment from agricultural runoff may affect other aspects of water quality. As algal blooms die off, oxygen consumption by microbial organisms is increased and can substantially lower total dissolved oxygen concentrations in surface waters (Waldichuk 1993). Nutrient enrichment from agricultural runoff has been found to significantly effect water quality in two rivers in interior British Columbia. Die-off of nutrient-induced algal blooms resulted in significant oxygen depletion (concentrations as low as 1.1 mg/L^{-1}) in the Serpentine and Nicornekl rivers during the summer, which in turn caused substantial mortality of coho salmon.

7. Effects of Fertilizer and Pesticide Use

Fifty pesticides were detected in streams sampled for the Willamette Basin NWQA study, and 10 pesticides exceeded criteria established by the EPA for the protection of freshwater aquatic life from chronic toxicity (Wentz *et al*. 1998). Forty-nine of those pesticides were detected in streams draining predominantly agricultural land, whereas 25 pesticides were detected in streams draining mostly urban areas. Atrazine, simazine, metolachlor, deethylatrazine, diuron, and diazinon were the most commonly detected pesticides in streamwater; all were detected in more than one-half of samples. Their concentration varied seasonally in response to runoff and application rates. The highest pesticide concentration generally occurred in streams draining predominantly agricultural land. In streams in the Pudding Basin, concentrations of atrazine, simazine and metalacholor during spring runoff increased as the percent of drainage area in agriculture increased. Salmon deaths have occurred due to accidental contamination of pesticides, and sublethal concentrations have been implicated in a wide range of behavioral, immunological, and endocrine disfunctions, and indirect effects such as interference with food webs (Botkin *et al*. 1995; Ewing 1999).

The two most commonly used agricultural chemicals, herbicides and nitrogen, are frequently found in groundwater in agricultural areas. In Oregon, groundwater nitrogen concentrations at or above health advisory levels were found in Clatsop, Marion, Deschutes, Morrow, Umatilla, Union, and Malheur counties, and elevated levels were reported for Multnomah, Linn, and Lane counties (Vomocil and Hart 1993). Because of the lack of a statistically representative sample of groundwater in the region's agricultural areas, the degree and extent of contamination is unknown.

Unlike native vegetation, agricultural crops require substantial inputs of water, fertilizer, and pesticides to thrive. Currently used pesticides, although not as persistent as previously-used chlorinated hydrocarbons, are still toxic to aquatic life. Where pesticides are applied at recommended concentrations and rates, and where there is a sufficient riparian buffer, the toxic effects to aquatic life may be small. However, agricultural lands are also characterized by poorly-maintained dirt roads and ditches that, along with drains, route sediments, nutrients, and pesticides directly into surface waters. Thus, roads, ditches, and drains have replaced headwater streams but rather than filter and process pollutants, these constructed systems deliver them directly to surface waters (Larimore and Smith 1963).

8. Effects on Physical Habitat Structure

Agricultural practices typically include stream channelization, large woody debris removal, construction of revetments (bank armoring), and removal of natural riparian vegetation. Each of these activities reduces physical habitat complexity, decreases channel stability, and alters the food base of the stream (Karr and Schlosser 1978). Natural channels in easily eroded soils often braid and meander, creating considerable channel complexity and accumulations of fallen trees. Large wood helps create large, deep, persistent pools (Hickman 1975), and meander cutoffs; the absence of snags simplifies the channel. A survey of coastal stream habitat found pieces of large woody debris are at desirable levels in only about 20 percent of stream segments, whereas large riparian conifers (key for recruitment of large woody debris into streams) are at desirable levels along only about 1 percent of streams (State of Oregon 1997). A higher degree of degradation is expected to be found on non-surveyed lands, agricultural and urban lands. Channelization lowers the base level of tributaries, stimulating their erosion (Nunnally and Keller 1979). The channelized reach becomes wider and shallower, unless it is revetted, in which case bed scour occurs that leads to channel downcutting or armoring. Channel downcutting leads to a further cycle of tributary erosion. Richards and Host (1994) reported significant correlations between increased agriculture at the catchment scale and increased stream downcutting. Incised channels in an agricultural region were found to have less woody debris and more deep pools than non-incised channels (Shields *et al*. 1994).

9. Effects on Stream Biota

Agricultural practices also cause biological changes in aquatic ecosystems. In two states typified by extensive agricultural development and with extensive statewide ecological stream surveys, instream biological criteria were not met in 85 percent of the sites (Ohio EPA 1990; Maxted *et al*. 1994a). Nonpoint sources of nutrients and physical habitat degradation were identified as causes of much of the biological degradation. In another study, Maxted *et al*. (1994b) also showed that shading had marked effects on stream temperatures and dissolved oxygen concentrations. In some agricultural stream reaches without riparian vegetation, the extremes exhibited in both temperature and dissolved oxygen would preclude the survival of all but the most tolerant organisms. Higher temperatures increase respiration rates of fish, increasing oxygen demand just when oxygen is depleted by stimulated plant respiration at night.

During daylight hours, high plant respiration (elevated by greater nutrient concentrations, higher temperatures, and lower flows) may produce gas supersaturation and cause fish tissue damage. Smith (1971) reported that 34 percent of native Illinois fish species were extirpated or decimated, chiefly by siltation, and lowering of water tables associated with drainage of lakes and wetlands. Although point sources were described by Karr *et al*. (1985) as having intensive impacts, nonpoint sources associated with agriculture were considered most responsible for declines or extirpations of 44 percent and 67 percent of the fish species from the Maumee and Illinois drainages, respectively. Sixty-three percent of California's native fishes are extinct or declining (Moyle and Williams 1990), with species in agricultural areas being particularly affected. Nationwide, Judy *et al*. (1984) reported that agriculture adversely affected 43 percent of all waters and was a major concern in 17 percent of the Nation's waters.

Modification of physical habitat structure has been linked with changes in aquatic biota in streams draining agricultural lands. Snags are critical for trapping terrestrial litter that is the primary food source for benthos in small streams (Cummins 1974), and as a substrate for algae and filter feeders in larger rivers. Behnke *et al*. (1985) describe the importance of snags to benthos and fish in rivers with shifting (sand) substrates. Such systems, typical of agricultural lands, support the majority of game fish and their prey. Marzolf (1978) estimates 90 percent of macroinvertebrate biomass was attached to snags. Hickman (1975) found that snags were associated with 25 percent higher standing crops for all fish and 51 percent higher standing crops for catchable fish. Fish biomass was 4.8 to 9.4 times greater in a stream side with instream cover than in the side cleared of all cover (Angermeier and Karr 1984). Gorman and Karr (1978) reported a correlation of 0.81 between fish species diversity and habitat diversity (substrate, depth, velocity). Shields *et al*. (1994) found that incised channels in agricultural regions supported smaller fishes and fewer fish species.

On a larger scale, habitat and reach diversity must be great enough to provide refugia for fishes during temperature extremes, droughts, and floods (Matthews and Hems 1987). If refugia occur, fishes in agricultural streams can rapidly recolonize disturbed habitats and reaches. However, loss of refugia, alterations in water tables, simplifications of channels, and elimination of natural woody riparian vegetation symptomatic of agricultural regions create increased instability and results in stream degradation (Karr *et al*. 1983).

Effects of the Action

<u>Overview of effects</u>

The purpose of the CREP program is to contribute to the restoration of natural habitat conditions in riparian and wetland areas on private agricultural lands in Oregon for the benefit of listed salmonids. If implemented properly, the Services expect that the program will be successful in meeting this goal. However, implementation of certain restoration practices and specific projects may cause some short- and long-term adverse effects and may take some listed species even though the projects will eventually provide important long-term benefits. Most of these potential adverse effects have been eliminated or minimized through application of the BMPs described in the BA. Where necessary, the Services have also developed Reasonable and Prudent Measures and Terms and Conditions to further minimize the potential for take.

The FSA has organized the proposed CREP program into six categories of project activities. An overview of the potential impacts associated with each of these six project groups is described below and in Table 3.

1. Streambank shaping and revegation

Streambank shaping activities of less than 30 linear feet could cause temporary decreases in water quality (sedimentation and turbidity) and may impact existing riparian and upland vegetation. However, any such impacts will be temporary in nature and eliminated through various stabilization techniques and follow-up vegetation planting. Any excess fill materials removed during the completion of the above activities will be deposited in appropriate upland areas and stabilized to eliminate future sediment loading in streams. This activity could result in a small but unquantifiable level of harm to listed aquatic species due to stream sediment impacts. On projects that propose more than 30 linear feet of streambank shaping, FSA will carry out an additional site-specific consultation with the Services regarding the harm or other forms of take that could result from the action.

2. Grading/leveling/filling/seedbed preparation in riparian areas

Site preparation work will result in temporary removal of vegetation in marginal pastureland areas. Soil disturbance will occur on some sites, but BMPs, distance of these practices to streams, and the limited nature of earth moving activities will avoid most potential impacts to water quality. Revegetation of these sites will ensure that any impacts are of limited duration. This activity could result in a small but unquantifiable level of harm to listed aquatic species due to stream sediment impacts.

3. Planting of grass, shrubs and trees

Revegetation activities will cause only minor disturbances to soils, since nearly all plantings will be done by hand. Plant growth in these disturbed sites will be rapid because planting activities will only occur during optimal seasonal growth periods for the respective plant species involved. This activity is not likely to result in take of listed species.

4. Control or removal of invasive plant species outside of streambank areas

BMPs related to handling and application of chemicals are likely adequate to minimize any water quality impacts related to these activities. Assuming FSA is successful at ensuring that pesticides and other chemicals do not enter the water body, this activity will result in no adverse effects to listed species. If pesticides do enter the water body, this activity could result in adverse effects to listed species.

5. Installation of livestock exclusion fencing, off-channel livestock watering facilities and livestock stream crossings

Installation of fences and watering facilities in upland habitats will result in short-term loss of vegetation along the fence line and in the vicinity of watering facilities. Installation of livestock water crossings across small streams could result in an increase in sedimentation in the short- and long-term. Revegetation efforts and exclusion of livestock from riparian environments will reduce these impacts in the long term. In addition, riparian buffer zones between streambanks and fence lines will be planted with vegetation. Reestablishment of the riparian vegetation will provide streambank stabilization, reduce sedimentation of adjacent streams, increase stream shading, improve wildlife habitat, reduce nutrient inflow from adjacent agricultural lands and provide a future source of large woody debris. Installation of livestock crossing facilities may cause harm to a small but unquantifiable number of listed fish species if installation activities increase sediment inputs into the stream; relevant BMPs should minimize, but may not entirely eliminate, this potential impact.

6. Wetland Restoration

This activity should result in net increases in wetland habitat and an improvement in existing wetland habitat conditions. Removal of dikes and construction of new dikes, berms, or water control facilities may harm listed aquatic species due to sediment impacts.

Table 3. Potential adverse impacts to listed and proposed species by CREP program activities as described in the BA.

CREP Activity	Description	Impacts			
		Fish	Plants	Birds	Mammals
1. Streambank shaping and revegetation	Shape banks to address erosion concerns. Activity will occur on less than 5% of CREP project area. Could temporarily increase siltation, impact natural stream processes, and remove natural vegetation.	Some potential to take locally occurring salmon, steelhead, trout, and Oregon chub.	No Take	No Take	No Take
2. Grading, leveling, filling, seedbed preparation in riparian areas	Installation of riparian buffer and filter strips. Some minor earthmoving. Could temporarily increase siltation.	Application of BMPs may result in some take of fish if sediment inputs not adequately controlled.	No Take	No Take	No Take
3. Planting of grass, shrubs, and trees.	Planting of vegetation according to standards in the riparian buffer, filter strip, and riparian herbaceous practices.	Application of BMPs will result in no take of species.	No Take	No Take	No Take
4. Control or removal of invasive plants.	Mechanical, biological, and chemical control of invasive plants. Herbicides will only be applied by hand to minimize the potential for drift and direct input of chemicals into the water body.	Application of BMPs will result in no take of species if chemicals do not enter water body. Activities may take if chemicals do enter the water body.	No Take	No Take	No Take
5. Installation of livestock fencing, off-channel watering facilities, and livestock stream crossings.	Install fencing, livestock watering facilities, and stream crossings to eliminate cattle from stream areas. Could temporarily increase siltation, impact natural stream processes, and remove natural vegetation.	Some potential to take locally occurring salmon, steelhead, trout, and Oregon chub when installing livestock crossings.	No Take	No Take	No Take
6. Wetland restoration.	Breach dikes and permit flooding of low-lying agricultural land. May also construct dikes or berms, remove fill material, and install water control facilities.	Construction of new dikes, berms, or water control structures may take listed fish species.	No Take	No Take	No Take

CREP Activities Not Likely to Adversely Affect

The Services agree with FSA that many CREP activities are not likely to adversely affect listed or proposed species. These types of activities are described below.

Listed and Proposed Fishes The Services concur with FSA that the following CREP activities are not likely to adversely affect listed or proposed fish species because they will avoid the addition of significant amounts of sediment into fish habitats, they will not allow for the introduction of toxic pesticides or herbicides into these same habitats, and these actions are of low potential to cause other adverse impacts to listed or proposed fishes or their habitats:

1. The Riparian Forest Buffer Practice and Riparian Herbaceous Cover Practice when:
    a. planting is done by hand and is outside of bankfull edge;
    b. there is no grading or shaping of the streambank;
    c. chemical pesticides do not enter the stream (i.e., noxious weeds are removed by mechanical means or with chemicals applied with hand sprayers at a sufficient distance from the water body); and
    d. native species are utilized as described in the BA (BMP #15) and consistent with President Clinton's Executive Order 13112 (February 3, 1999)(see below). It is our opinion that use of the non-native hybrid poplar is not consistent with BMP #15.

2. The Filter Strip Practice when it is installed upslope of an installed Riparian Forest Buffer or Riparian Herbaceous Cover and consistent with the BMPs in the BA.

3. Installation of livestock exclusion fencing when it is installed outside of bankfull edge and requires no instream crossings.

Listed and Proposed Plants The CREP may affect five listed or proposed plant species (Table 2). These species are limited in their distribution, and many projects may be quickly screened to determine if there is any likelihood of affecting a listed or proposed plant. If a CREP project site occurs within a location, mapped soil unit, or soil series or type as identified in Table 2, the project site must be surveyed by a qualified botanist in the appropriate season to determine if the species is present. The application of the CREP program is not likely to adversely affect listed and proposed plants because the surveys are likely to avoid any negative impacts to listed and proposed plants through project redesign

Listed Birds The application of the entire CREP program is not likely to adversely affect listed birds because FSA has agreed to the following conditions:

1. For the Aleutian Canada goose, the activities occur outside of Coos, Curry and Tillamook counties. Where project sites are located within ¼ mile of active resting and foraging sites for the Aleutian Canada Goose as identified by USFWS in the coastal areas of Tillamook, Coos and Curry Counties, work activities producing noise above ambient levels will not occur during the birds' normal wintering and migration period from October 1 to April 30. In addition, all CREP projects proposed in the area of the New River bottoms (southern Coos and northern Curry counties) within Township 30 South, Range 15 West, Sections 14, 15, 27, 28, 33, 34 and in Township 31 South, Range 15 West, Sections 3, 4, 8, 9, 16, 17, or near the Nestucca River near Pacific City within Township 4 South, Range 10 West, Section 19, Willamette Meridian, will not proceed without site-specific consultation with USFWS to evaluate the potential for local adverse effects to the Aleutian Canada goose.

2. For the bald eagle, the actions occur greater than ½ mile from any eagle nest. For any project within ¼ mile non-line-of-sight or ½ mile line-of-sight of an eagle nest identified by ODFW, no activities producing noise above ambient levels will occur at the site from January 1 to August 31. If a proposed activity is near a bald eagle nest and must occur during this restricted period, site-specific consultation with USFWS will be initiated to evaluate the potential for adverse effects. and take.

Listed Mammals The application of the entire CREP program is not likely to adversely affect the Columbian white-tailed deer because the type of activities being considered would be considered a beneficial effect to this species due to the improvement of riparian habitat used by the deer.

Most of the above actions are not likely to adversely affect aquatic listed species because they will occur outside of the bankfull edge of a stream. Activities occurring within the bankfull edge may result in short-term adverse effects and take of listed species; these are discussed below.

<u>CREP Activities That May Adversely Affect Listed Species</u>

In general, long-term effects resulting from CREP Program activities are expected to be beneficial, as the intent of the program is to restore natural stream functions. The BA stated that CREP projects may affect listed, proposed, and candidate species but are generally "not likely to adversely affect" because operational procedures (BMPs and the Services' guidance) will minimize, to the extent practicable, the effects of specific actions. The Services generally concur with this conclusion, but under some circumstances we expect that some short-term adverse effects may occur during project implementation as described below.

Listed and Proposed Fishes All 19 sensitive fish species addressed in this consultation may be adversely affected in the short- and long-term by projects designed to provide long-term benefits.

These activities include bank stabilization or shaping, construction of livestock crossing facilities, or preparation of planting areas. These activities could have direct or indirect, negative short-term impacts to fish during critical life stages such as migration, breeding/spawning, and juvenile rearing. Effects may result in disturbance (i.e., physical, psychological, or physiological stressors), displacement, or alteration of habitats. Such impacts include physical interaction with eggs, juveniles, adults, or short-term sedimentation during any instream or near stream restoration work.

Projects implemented under CREP may involve the use of certain herbicides, pesticides and fertilizers in a variety of the practices approved for use in the program. However, we have not been provided sufficient information on how these chemicals will be applied to concur with FSA's determination that no take of listed species will occur. We are primarily concerned that pesticides or other chemicals may on occasion enter the water body and will directly or indirectly impact listed species. As described above, the Services concur that application of chemicals at the lowest application rate consistent with the intended purpose using spot application with a low-pressure backpack sprayer away from the water body is not likely to adversely affect listed species. If FSA expects that some CREP participants will use other application methods that have a higher likelihood of impacting listed species, we assume that "agency personnel" referred to in BMP #9 includes the Services and that we are able to review these projects prior to implementation.

The impacts of these activities will be minimized through the use of BMPs in the BA, ODFW/NMFS guidelines and the application of timing restrictions, as appropriate. The Services believe that any short-term negative impacts are outweighed by the long-term beneficial effects of the proposed action.

Fish Critical Habitat These activities may also adversely affect listed or proposed critical habitat for listed fishes (see Table 1). These effects would most likely be in the form of short-term adverse effects (e.g., sedimentation) due to activities aimed at long-term habitat benefits.

Critical habitat comprises physical and biological habitat features which are essential to the conservation of a given species. Designated or proposed critical habitat supplies sufficient amounts of space, food, water, oxygen, light, and cover; identifies sites suitable for spawning, rearing, and historic distribution; and determines which areas are ecologically significant. The Oregon CREP may adversely affect designated or proposed critical habitat for all of these fishes due to short-term disturbance of some or all of the above mentioned physical and biological habitat features. However, consistent with the goal of CREP to restore degraded habitats, adverse effects would be of short duration and would be substantially outweighed by the beneficial long-term effects of habitat restoration.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future Federal actions that are unrelated to FSA's CREP are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

In 1992, the Oregon Department of Agriculture asked the Oregon Water Resource Commission to "reserve" 3.3 million acre feet of water from the Columbia, Snake, and Willamette Rivers and their tributaries for future economic development, primarily agriculture (Andrews 1992). This request was based on calculations of future water demand associated with anticipated agricultural development. Not all of these requests have been approved. Many have, however, and consideration of the remaining requests (Oregon Water Resource Department and Comission 1999) shows a strong abiding demand by state and private interests for substantial expansion of agricultural activity in Oregon.

In 1997, the State of Oregon adopted "The Oregon Plan" to improve water quality and restore declining fish populations (State of Oregon 1997). Agricultural water quality management plans now being developed around the state pursuant to "The Oregon Plan" are expected gradually to reduce water quality degradation associated with agriculture but are not designed to address any other adverse effects of agriculture on fish. For actions on non-Federal lands which the landowner or administering non-Federal agency believes are likely to result in adverse effects to listed species or their habitat, the landowner or agency should work with the Services to obtain any necessary incidental take permits under section 10 of the Act, which requires submission of a habitat conservation plan.

Significant improvement in listed and proposed anadromous salmonid reproductive success on non-Federal lands is unlikely without meaningful changes in agricultural land and water management practices. Until improvements in non-Federal land management practices are accomplished, the Services assume that future private and state actions will continue at similar intensities as in recent years, or will increase.

Conclusion

The Services have determined, based on the information, analysis, and assumptions described in this Opinion, that FSA's proposed Oregon Conservation Reserve Enhancement Program is not likely to jeopardize the continued existence of the listed and proposed species under the respective jurisdictions of NMFS and USFWS shown in Table 1. In arriving at this determination, the Services considered the current status of the listed and proposed species; environmental baseline conditions; the direct and indirect effects of approving the action; and the cumulative effects of actions anticipated in the action area. The Services have evaluated the proposed action and found that it would cause short-term adverse degradation of some environmental baseline indicators for listed and proposed fishes. However, the proposed action is not expected to result in further degradation of aquatic habitats over the long term. Thus, the effects of the proposed action would not reduce prespawning survival, egg-to-smolt survival, or upstream/downstream migration survival rates to a level that would appreciably diminish the likelihood of survival and recovery of proposed or listed fishes, nor is it likely to result in destruction or adverse modification of critical habitats.

CREP represents an important contribution to the recovery of listed salmonids in Oregon. Although the Services believe that the implementation of CREP will result in overall benefit to listed and proposed salmonids and their habitats, the reasons for the declines of salmonid fishes in the Pacific Northwest are varied and complex, and this program alone will not be sufficient to achieve recovery. The ecological functions provided by the conservation practices implemented as part of CREP will be evaluated through the implementation of the NRCS MOU between NRCS, USFWS, NMFS, EPA, and the State of Oregon.

INCIDENTAL TAKE STATEMENT

Sections 4(d) and 9 of the Act, as amended, prohibit taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Under the terms of section 7(b)(4) and section 7(a)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Sections 7(b)(4) and 7(o)(2) of the Act do not apply to the incidental take of listed plant species. However, protection of listed plants is provided to the extent that the Act requires a Federal permit for removal and reduction to possession of endangered plants from areas under Federal jurisdiction, or for any act that would remove, cut, dig up, or damage or destroy any such species on any other area in knowing violation of any regulation of any State or in the course of any violation of a State criminal trespass law.

In general, an incidental take statement specifies the impact of any incidental taking of endangered or threatened species. It also provides reasonable and prudent measures that are necessary to minimize impacts and sets forth mandatory terms and conditions required to accomplish the reasonable and prudent measures.

Amount of take anticipated

Certain site-specific actions associated with Oregon's CREP may incidentally take an unquantifiable number of listed and proposed fish shown in Table 1. The amount of take is anticipated to be small and of a temporary nature. Designated critical habitat for listed salmonids may be adversely affected by CREP project implementation, but the negative effects are expected to be short-term. The potential for take has been substantially reduced through the application of the BMPs. The Services have determined that the level of anticipated take resulting from implementation of the Oregon CREP is not likely to jeopardize any of the species nor adversely modify designated critical habitats shown in Table 1.

Reasonable and prudent measures

The measures described below are non-discretionary. They must be implemented so that they become binding conditions in order for the exemption in section 7(a)(2) to apply. The FSA has the continuing duty to regulate the activities covered in this incidental take statement. If the FSA fails to require the applicants to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, or fails to retain the oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. The Services believe that activities carried out in a manner consistent with the BMPs and these Reasonable and Prudent Measures, except those otherwise identified, will not necessitate further site-specific consultation. Activities which differ from the BMPs or RPMs will require further consultation.

The Services believe that the following reasonable and prudent measures are necessary and appropriate to minimize the likelihood of take of listed fish resulting from implementation of the Oregon CREP. Should additional habitat inhabited by listed species be designated as critical habitat, these reasonable and prudent measures would also minimize adverse effects to that habitat.

The FSA shall:

1. Ensure the development and implementation of a comprehensive monitoring program to assess the effectiveness of the CREP in meeting its objectives;

2. Avoid take of listed fish in any wetland restoration activities that are part of the Oregon CREP;

3. Manage herbicides, pesticides and other chemicals as needed to ensure that no degradation of water quality, aquatic habitats and wetlands occurs in the activity area and downstream;

4. Locate, design and maintain livestock crossings or fords as necessary to minimize degradation of riparian and aquatic habitats in the activity area and downstream; and

5. Minimize take associated with instream work proposed in the CREP BA (i.e., streambank stabilization, off-channel livestock watering facilities, and livestock crossings) by applying appropriate timing restrictions.

Terms and conditions

In order to be exempt from the prohibitions of section 9 of the Act, the FSA must also comply with the following terms and conditions, which implement the reasonable and prudent measures. These terms and conditions are non-discretionary.

1. To implement Reasonable and Prudent Measure #1, above, the FSA shall:

Provide NMFS and USFWS with a yearly monitoring report describing the success with which the Oregon CREP meets the program objectives. This report will include implementation and effectiveness monitoring components.

Implementation Monitoring The annual implementation monitoring report shall focus on summarizing CREP enrollment, including: the level of program participation; the total acres and average widths enrolled in each of the component conservation practices; the total number of acres and distribution of successfully implemented conservation practices; a summary of non-Federal CREP program expenditures; and recommendations to improve the quality of the monitoring program. The Services are particularly interested in an accounting of CREP projects which include streambank stabilization. For those projects, include the following information in the monitoring report: the number of such projects each year, the justification for the work, materials used, size (width and linear feet, acres for wetland restoration) of the project, whether one or both banks were stabilized, and a narrative assessment of each project's effects on natural stream function.

Effectiveness Monitoring This component of the annual report will assess habitat trends as a result of CREP participation, and will specifically focus on the six objectives of the Oregon CREP as defined by FSA:

A. Ensure that 100 percent of the area enrolled for the riparian forest practice are restored to a properly functioning condition in terms of distribution and growth of woody plant species.

B. Reduce sediment and nutrient pollution from agricultural lands adjacent to the riparian buffers by more than 50 percent.

C. Ensure that adequate vegetation is established on enrolled riparian areas to stabilize 90 percent of stream banks under normal (non-flood) water conditions.

D. Ensure that vegetation adequate to reduce the rate of stream water heating to ambient levels is achieved on all riparian buffer lands.

E. Provide a contributing mechanism for farmers and ranchers to meet the water quality requirements established by the Federal Water Pollution Control Act and Oregon's agricultural water quality laws.

F. Provide adequate riparian buffers on 2,000 stream miles to permit natural restoration of stream hydraulic and geomorphic characteristics which meet the habitat requirements of salmon and trout.

FSA shall ensure the design and implementation of a scientifically credible, statistically robust monitoring plan that focuses on the six objectives listed above. The CREP effectiveness monitoring program will use a standardized design and single set of protocols to facilitate data analysis and interpretation. This monitoring program may make use of existing monitoring efforts if those results do not violate the scientific or statistical credibility of the CREP monitoring program and can provide data specific to CREP objectives. FSA will develop this quantitative monitoring program in consultation with a biostatistician to ensure that the monitoring design and protocols will adequately assess CREP effectiveness in achieving its objectives.

The annual report shall be submitted to:

Branch Chief - Portland
National Marine Fisheries Service
525 NE Oregon Street
Portland, OR 97232

and

State Supervisor
U.S. Fish and Wildlife Service
Oregon State Office
2600 SE 98th Avenue, Suite 100
Portland, Oregon 97266

Implementation of a rigorous monitoring program will reduce take associated with CREP actions by ensuring that BMPs are carried out as stated in the BA and in this Biological Opinion. Implementation and effectiveness monitoring will determine whether BMPs provide the expected level of protection to listed species. If monitoring indicates that BMPs are not adequate to protect listed species, this information can be used as feedback to improve the program.

2. To implement Reasonable and Prudent Measure #2, above, the FSA shall:

Field biologists from NMFS and/or USFWS will review all site-specific wetland restoration projects that include new construction or removal of dikes, berms, water impoundments, or water control facilities. If NMFS or USFWS determines that a proposed activity may take listed species, they will work with FSA and other project proponents to identify additional site-specific steps to avoid the take of listed species. If take cannot be avoided, a site-specific consultation will be required.

3. To implement Reasonable and Prudent Measure #3, above, the FSA shall:

Include the following terms and conditions in each project specification calling for pesticides or other chemical applications.

A. Few of the many registered pesticides have been subject to section 7 consultation under the Act. For some of those that have, the EPA has produced supplemental endangered species label guidelines. For all CREP projects, follow all EPA guidelines addressing threatened and endangered species (e.g., listed plants in Harney and Wallowa counties, see Appendix D.).

B. When rain is predicted within 24 hours of chemical application, the following conditions apply unless the product label specifically allows or recommends otherwise:

(1) Do not implement broadcast spraying. Broadcast spraying is defined as any application other than a hand-operated wand for individual plant treatment.

(2) Herbicides that readily translocate through the soil (e.g., picloram) shall not be used.

(3) Pesticides that utilize some atmospheric moisture to increase their effectiveness (e.g., "Oust") can be used during this period if such use poses no additional risk of contamination to groundwater and surface water and no increased toxicity to aquatic organisms.

C. When operating within 25 feet of water (including streams, ponds, seeps, springs, bogs, wetlands, standing water ponds, and riparian areas), applicators will conduct a special, site-specific evaluation and will select a pesticide that is least toxic to aquatic organisms yet is still consistent with the intended purpose of the application. Preference will be given to glyphosate products such as Rodeo or other products that are demonstrated to have relatively lower levels of adverse effect on aquatic organisms. These pesticides will be applied at the lowest application rate consistent with the intended purpose. Use a low pressure hand wand attached to a backpack sprayer or by hand painting stumps after mowing.

D. All applicators must be familiar with and follow the relevant guidelines and recommendations of the *Oregon Pesticide Applicator Manual*, produced by the Oregon State University Extension Service. This includes all recommendations pertaining to weather conditions, especially:

(1) No spraying when rain, fog, or other precipitation is falling or is imminent;

(2) No spraying in unstable air situations that may affect spray pattern or lead to offsite movement of spray, such as high air temperatures, during temperature inversions, or on windy days.

4. To implement Reasonable and Prudent Measure #4, above, the FSA shall:

Include the following terms and conditions in each project specification calling for livestock crossings or fords. Livestock crossings, or fords, are intended to provide a stabilized area to provide access across a riparian buffer and waterway for livestock and farm equipment.

A. Do not place crossings in areas where listed salmonids spawn or are suspected of spawning, or within a reasonable distance (e.g., 100 feet) upstream of such areas where impacts to spawning areas may occur.

B. Minimize the number of crossings.

C. Design and construct or improve essential crossings to accommodate reasonably foreseeable flood risks, including associated bedload and debris, and to prevent the diversion of streamflow out of the channel and down the road if there is crossing failure.

D. Stabilize bank cuts, if any, with vegetation and protect approaches and crossings with river rock (not crushed rock) when necessary to prevent erosion.

E. Ensure that livestock crossings in and of themselves do not create barriers to the passage of adult and juvenile fish.

5. To implement Reasonable and Prudent Measure #5, above, the FSA shall:

Implement instream work consistent with ODFW's *Oregon Guidelines for Timing of In-Water Work to Protect Fish and Wildlife Resources* (see ODFW's World Wide Web Page at www.dfw.state.or.us/hcd/timing for the most current version of these guidelines).

The incidental take statement included in this Biological Opinion is limited to the Act. It does not constitute an exemption for non-listed migratory birds and bald and golden eagles from the prohibitions of take under the Migratory Bird Treaty Act of 1918, as amended (U.S.C. 703-712), or the Bald and Golden Eagle Protection Act of 1940, as amended (U.S.C. 668-668d), or any other Federal statutes.

If a dead, injured, or sick endangered or threatened species specimen is located, initial notification must be made to the nearest Fish and Wildlife Service Law Enforcement Office, located at 9025 SW Hillman Court, Suite 3134, Wilsonville, OR 97070; phone: 503-682-6131. Care should be taken in handling sick or injured specimens to ensure effective treatment and care or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered and threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. The term "conservation recommendations" is defined as suggestions from the Services regarding discretionary agency activities to: 1) minimize or avoid adverse effects of a proposed action on listed species or critical habitat; 2) conduct studies and develop information; and 3) promote the recovery of listed species. The recommendations provided here relate only to the proposed action and do not necessarily represent complete fulfillment of the FSA's 7(a)(1) responsibilities.

The Services recommend that the following conservation measures be implemented:

1. **Work with the Oregon Department of Forestry and other partners to ensure the long-term viability of CREP riparian buffers.**

As expressed in December 11, 1998, and March 5, 1999, letters to FSA, the Services remain concerned that some riparian forest buffers may be designed to encourage subsequent timber harvest in the buffers. Such an approach is inconsistent with the basic intent of the CREP program.

The Services are concerned about the long-term viability of the CREP riparian buffers and exactly how the Oregon Forest Practices Act will apply to riparian lands enrolled in CREP. The science is clear that maintenance of these buffers beyond the 10 to 15-year enrollment period is critical to the long-term recovery of listed salmon and trout. Although some short-term benefits will accrue within the first few years of buffer installation, many of the habitat attributes most important to salmonids (e.g., large trees, improved stream morphology, etc.) will not fully develop in 10 or 15 years. In addition, the target fish populations will require more time to respond to improved conditions and reverse the declining trend in numbers.

The Services disagree with public statements suggesting the need to exempt CREP landowners "from the administrative process of the Forest Practices Act" to enable timber harvest in the riparian buffers within 20 feet of the stream (Capital Press, Nov. 27, 1998, and recent meetings). Such an approach could result in substantial Federal CREP funds being spent to install riparian habitat features that are subsequently removed before they reach their full potential to improve salmonid habitat. This outcome would be an unwise use of limited Federal conservation funds.

The Services therefore recommend that FSA and State agencies not relax existing forest practice standards to encourage participation in the CREP program. Instead, the Oregon Department of Forestry and other participating agencies should fully inform landowners that salmonid recovery will likely require longer term commitments to be successful. FSA and the State should focus efforts on encouraging willing landowners to retain these important buffers beyond the enrollment period, and they should not take action that would in fact encourage buffer removal.

2. **Widen riparian buffers.**

The width of riparian buffers are currently limited to 135 feet, except that wider buffers are allowed when they may "meet a specific management criteri[on]". The Services recommend that greater riparian buffer widths (possibly tied to floodplain boundaries) be routinely encouraged in CREP contracts in order to maximize the development of fully formed and functional riparian areas under CREP.

3. **Use native vegetation.**

The BA states that native vegetation will be used for plantings wherever feasible (BMP #15). The Services support FSA's stated desire to use native vegetation, especially given President Clinton's recent Executive Order 13112 addressing invasive species and the restoration of native species. The Service assumes "feasible" means that appropriate native stock are available to meet the CREP project needs in sufficient quantities and at a reasonable cost. Use of non-native stock or seed should only occur after a good faith attempt has been made to locate native materials. There are a growing number of nurseries in Oregon that can provide native plants for CREP projects; the journal *Hortus West* (800-704-7927) is an excellent reference that lists the addresses of several hundred nurseries and contractors specializing in native materials for habitat restoration projects. The Service believes that use of hybrid poplar is inappropriate for the CREP program and is inconsistent with Executive Order 13112.

4. **Conduct a sustainable agriculture analysis.**

FSA, in coordination with other USDA agencies and programs, should continue and expand efforts to provide information and technical assistance that will allow agricultural producers and other interested parties to evaluate alternative conservation systems necessary to recover declining aquatic species and their habitats, and costs associated with those systems, in a timely manner.

Oregon's request for a Conservation Reserve Enhancement Program as described in "Oregon's Riparian Enhancement Initiative" dated September 1998 confirmed that patterns of aquatic ecosystem degradation due to agricultural production practices must be reversed to secure the long-term survival and recovery of listed salmonids. However, short-term land retirement programs such as CREP are costly and cannot fully address the need for more sustainable agricultural practices that fully integrate environmental, economic and social needs. The CREP Co-op Agreement concerning USDA's commitment to the Oregon CREP included provisions for development of land and water conservation plans to meet identified species recovery needs by establishing permanent vegetative cover or other comparable practices.

Most producers are motivated to choose management options that maximize profits. Impacts to declining species are not reflected in market signals, however, so conflicts arise between production and species needs. Giving producers information about government programs and conservation systems that not only meet the requirements of the Act but can be relied on to produce consistent, acceptable crop yields is very likely to increase their acceptance of conservation practices as part of their overall farm or ranch management system. Thus, developing such information for Oregon's many distinct growing areas is an urgent and high priority need.

USDA has the capacity to develop innovative research and technology transfer tools that will provide agricultural producers in Oregon with the tools they need to protect and restore aquatic ecosystems while achieving more cost-efficient production and increased profitability. For example, the Solutions to Environmental and Economic Problems (STEEP) project conducted in the Pacific Northwest which began in 1975 to develop and accelerate adoption of wheat production practices that control soil erosion became a national model for unified regional research and information transfer. A similar program is now needed to solve problems related to the environmental and socioeconomic impacts of alternative conservation systems necessary to restore riparian and aquatic habitats and increase salmonid survival. Three specific information and technical assistance needs are:

- Development of geographic and sector specific conservation systems to meet the needs of listed species while ensuring agricultural productivity.

- Analyses of socioeconomic barriers to the adoption of conservation systems, such as conflicts between conservation and production goals, agricultural traditions, and producer assumptions about cost and risk aversion.

- Development of a market-based strategy to deliver new riparian and aquatic conservation systems to Oregon's diverse agricultural sectors.

5. **Implement additional conservation incentives.**

FSA, in coordination with other USDA agencies and programs, should continue and expand efforts to make adoption of alternative riparian and aquatic conservation systems necessary to recover declining aquatic species and their habitats more cost effective for agricultural producers.

The Oregon CREP provides a substantial incentive for enrollment of certain acreage under the program. After these short-term contracts expire, however, the future use of enrolled acres will depend primarily on economics and related factors. Among other considerations will be the compatibility of permanent vegetative cover with existing use of adjacent land, the desirability and cost of conversion from crop production to other land uses such as grazing, forestry, or urbanization, geographic isolation of various tracts, and the availability of other incentives to continue conservation systems. "Oregon's Riparian Enhancement Initiative" noted that, without CREP, significant mitigation of existing agricultural impacts on salmonids is unlikely.

CREP and other conservation provisions of the Federal Agricultural Improvement and Reform Act of 1996 (the 1996 Farm Bill) were specifically designed to address high priority conservation needs. Administration of those programs by FSA, NRCS and other partners make a vital contribution to national environmental goals. However, authorization and funding for those programs will expire in 2002. Moreover, Farm Bill programs specifically targeted for conservation represent only a small fraction of the total number of agricultural programs available to producers. Many other agricultural programs administered by FSA and other USDA agencies, such as marketing, commodity and loan programs, may also have a significant direct or indirect effect on the likelihood of producers adopting conservation systems that would improve the survival of listed salmonids.

In view of the need for additional incentives to continue and expand existing conservation program benefits and achieve permanent adoption of sustainable agricultural practices and conservation systems, it is important that FSA, in coordination with other USDA agencies, investigate opportunities to include conservation incentives as part of other agricultural programs. Examples of expanded incentive opportunities include enhanced program benefits, premiums, purchasing preference or promotional assistance for beneficiaries who adopt appropriate conservation systems; targeted research, education or demonstration programs; and other "debt for nature" ideas. Alternatively, USDA should develop conservation-based eligibility criteria for its agricultural programs. Examples of FSA and other USDA programs to include in this investigation are:

- FSA programs to provide farm and commodity loans, dairy price support, domestic and foreign food assistance, catastrophic crop insurance and crop disaster assistance, emergency assistance for farmers in declared disaster areas, and farm ownership.

- Foreign Agricultural Service programs to provide incentives for eligible promotions and develop foreign markets for agricultural commodities.

- Risk Management Agency programs to provide crop insurance and other risk management assistance.

- Agricultural Marketing Service programs to provide marketing incentives through Marketing, Promotion and Information Boards.

- NRCS programs to provide conservation technical assistance, carry out the Conservation Farm Option pilot and other conservation provisions of the 1996 Farm Bill, reach out to socially disadvantaged farmers and ranchers, farmland protection, reduced flood risk, forestry incentives, and promotion of sustainable agricultural systems.

6. **Expand geographic boundaries of CREP.**

To further meet FSA's section 7(a)(1) requirement under the Act to utilize its authorities to conserve listed species, FSA should expand the geographic boundaries of the Oregon CREP program to include all Oregon basins, and not just those inhabited by listed salmonids. This would allow farmers and ranchers in the Warner and Goose Lake Basins, for example, to enroll in CREP and do their part to protect other listed and/or rare aquatic species. In some cases, expansion of the CREP program could play an important role in helping to conserve otherwise rare species prior to the need to list them as threatened or endangered.

7. **Validation Monitoring**

Design and implement a long-term validation monitoring program to document the overall impact of the CREP on fish species of concern. The objective of this component of the monitoring program would be a quantitative comparison of salmon and trout habitat characteristics and salmonid population trends in streams where there is enrollment in this program with similar streams where program participation is not significant.

8. **Enhanced Plant Conservation**

Currently, the CREP proposed action calls for designing CREP projects such that they “avoid” impacts to listed or proposed plant species. While this will likely result in a reduced consultation workload for USFWS through avoidance of impacts to these species, it may also result in missed opportunities to conserve these species by providing protection within, for example, wetland areas or riparian buffers developed or protected through CREP. Consequently, USFWS recommends that FSA encourage CREP participants and implementing agencies to consider conservation measures for these plants through follow-up, site-specific consultations where CREP projects might benefit the plant species addressed in Table 2 of this Biological Opinion. The USFWS will be glad to provide technical assistance in the design of such projects.

In order for the Services to be kept informed of actions minimizing or avoiding adverse effects, or those that benefit listed species or their habitats, the Services request notification of the implementation of any conservation recommendations.

REINITIATION OF CONSULTATION

This concludes formal consultation on the Oregon Conservation Reserve Enhancement Program. As required by 50 CFR Part 402.16, reinitiation of formal consultation is required if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations that are causing such take must be stopped, and formal consultation must be reinitiated. If you have questions regarding this Biological Opinion, please contact Paul Henson or Rollie White at the U.S. Fish and Wildlife Service (503/231-6179) or Kim Kratz or Marc Liverman at the National Marine Fisheries Service (503/231-2336).

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