Chapter: 7

State(s): Oregon

Recovery Unit Name: Deschutes Recovery Unit

Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

DISCLAIMER

Recovery plans delineate reasonable actions that are believed necessary to recover and/or protect listed species. Recovery plans are prepared by the U.S. Fish and Wildlife Service and, in this case, with the assistance of recovery unit teams, State and Tribal agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or indicate the approval of any individuals or agencies involved in plan formulation, other than the U.S. Fish and Wildlife Service. Recovery plans represent the official position of the U.S. Fish and Wildlife Service *only* after they have been signed by the Director or Regional Director as *approved*. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

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EXECUTIVE SUMMARY

CURRENT SPECIES STATUS

The U.S. Fish and Wildlife Service issued a final rule listing the Columbia River population of bull trout (*Salvelinus confluentus*) as a threatened species under the Endangered Species Act on June 10, 1998 (63 FR 31647). The Deschutes Recovery Unit forms part of the range of the Columbia River population. The Deschutes River basin is located in central Oregon. The Deschutes Recovery Unit encompasses the Deschutes River and its tributaries. The Deschutes River drains an area of approximately 26,936 square kilometers (10,937 square miles) and is approximately 405 kilometers (251 miles) from its headwaters to the confluence with the Columbia River.

The Deschutes Recovery Unit Team identified one core area, and one core habitat which could become a core area if bull trout are reestablished there. The lower Deschutes Core Area and upper Deschutes core habitat are separated by Big Falls on the mainstem Deschutes River at about River kilometer 212 (River Mile 132). Thus, the lower Deschutes Core Area is generally described as the mainstem Deschutes River and its tributaries from Big Falls downstream to the Columbia River. Current bull trout distribution is limited to the lower Deschutes Core Area, which includes five local populations in Shitike Creek, the Warm Springs River, and the three Metolius River population complexes. The upper Deschutes core habitat is generally described as the upper Deschutes River, Little Deschutes River, and other tributaries upstream from Big Falls at about River Kilometer 212 (River Mile 132). The upper Deschutes core habitat does not currently support bull trout populations, but had bull trout historically. The Recovery Unit Team believes it has the necessary elements to support reestablishment of bull trout. Verification of its potential to support bull trout is identified as a Priority 1 research need.

HABITAT REQUIREMENTS AND LIMITING FACTORS

A detailed discussion of bull trout biology and habitat requirements is provided in Chapter 1 of this recovery plan. Little data exists on the historical or

current use of the mainstem Columbia River by bull trout in this recovery unit. Subsequent to the collection of additional information the Deschutes Recovery Unit may be expanded to include portions of the mainstem Columbia River. There is much more information on historic and current use of both the upper Deschutes River, lower Deschutes River, and its' tributaries. Primary land and water management activities that depress bull trout populations and degrade habitat in this recovery unit include operation and maintenance of dams and other diversion structures, and the introduction of nonnative species. Impassable dams and diversion structures isolate and fragment bull trout local populations and adversely impact water quality and quantity. Introduced brook trout threaten bull trout through hybridization, competition, and possible predation.

RECOVERY GOAL AND OBJECTIVES

The goal of the bull trout recovery plan is to **ensure the long-term persistence of self-sustaining complex interacting groups of bull trout distributed throughout the species' native range, so that the species can be delisted**. To achieve this goal the following objectives have been identified for bull trout in the Deschutes Recovery Unit:

- Maintain current distribution of bull trout within the lower Deschutes Core Area and restore distribution in previously occupied areas within the Deschutes Recovery Unit.

- Maintain stable or increasing trends in abundance of adult bull trout.

- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.

- Conserve genetic diversity and provide opportunity for genetic exchange.

RECOVERY CRITERIA

Recovery criteria for the Deschutes Recovery Unit reflect the stated objectives, evaluation of population status, and recovery actions necessary to achieve the overall goal.

1) **Bull Trout are distributed among five or more local populations in the Deschutes Recovery Unit, with five or more local populations in the lower Deschutes Core Area.** In a recovered condition the lower Deschutes Core Area would have spawning and rearing populations in the Whitewater River, Jefferson/Candle/Abbot river complex, Canyon/Jack/Heising/mainstem Metolius river complex, Warm Springs River, and Shitike Creek. Core habitat in the upper Deschutes core habitat would also contain one or more local populations as yet to be identified. Feasibility analyses are needed to assess the potential for reintroducing bull trout into historic habitat in the upper Deschutes River basin. Additional population studies and a better understanding of bull trout fidelity to their natal streams is needed to better define local populations in the recovery unit.

2) **Estimated abundance of adult bull trout is 1,500 to 3,000 or more individuals in the recovery unit, distributed in the lower Deschutes Core Area.**

3) **Adult bull trout exhibit stable or increasing trends in abundance in the recovery unit; based on a minimum of 10 years of monitoring data.**

4) **Connectivity criteria will be met when migratory forms are present in all local populations, with intact migratory corridors among all local populations in core areas providing opportunity for genetic exchange and diversity**. In the lower Deschutes Core Area this means addressing upstream and downstream passage at Pelton Round-Butte's three dams. Passage barriers at Opal Springs Dam, Link Creek, and upper Squaw Creek must also be addressed. Additional barriers may also be identified. If reestablishment is undertaken in the upper Deschutes core habitat, upstream and downstream passage at Wickiup, Crane Prairie, and several privately owned-hydropower and irrigation diversion dams must be addressed.

ACTIONS NEEDED

Recovery for bull trout will entail reducing threats to the long-term persistence of populations and their habitats, ensuring the security of multiple interacting groups of bull trout, and providing habitat conditions and access to conditions that allow for the expression of various life-history forms. Seven categories of actions needed are discussed in Chapter 1; tasks specific to this recovery unit are provided in this chapter.

ESTIMATED COST OF RECOVERY

Total estimated cost of bull trout recovery in the Deschutes Recovery Unit is estimated at $2.1 million spread over a 25-year recovery period. Total cost includes estimates of expenditures by local, Tribal, State, and Federal governments and by private businesses and individuals. Cost estimates are not provided for tasks which are normal agency responsibilities under existing authorities.

ESTIMATED DATE OF RECOVERY

Time required to achieve recovery depends on bull trout status, factors affecting bull trout, implementation and effectiveness of recovery tasks, and responses to recovery tasks. Three to five bull trout generations (15 to 25 years), or possible longer, may be necessary before identified threats to the species can be significantly reduced and bull trout can be considered eligible for delisting.

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INTRODUCTION

Recovery Unit Designation

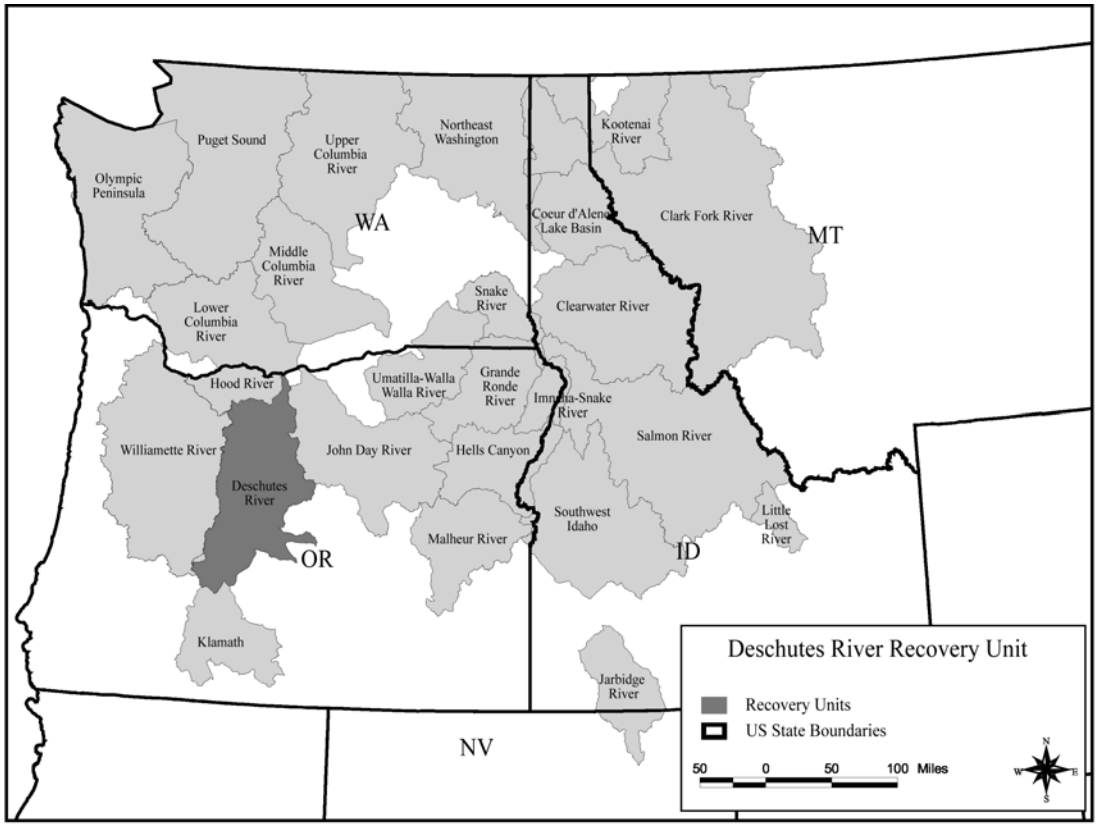
The Deschutes Recovery Unit is one of 22 recovery units designated for bull trout in the Columbia River Distinct Population Segment (Figure 1). Designation of the Deschutes Recovery Unit is based on its designation as a Gene Conservation Group by Oregon Department of Fish and Wildlife (Kostow 1995). The delineation of the Gene Conservation Group is based on the genetic analysis conducted by Spruell and Allendorf (1997).

Geographic Description

The Deschutes River originates at Little Lava Lake on the east slope of the Cascade Mountain range in Deschutes County, central Oregon. From this point it flows south through the Bureau of Reclamation's Crane Prairie and Wickiup Reservoirs, then generally north by northeast through Jefferson County. It then enters the Pelton/Round Butte Dam complex and its three reservoirs. The river continues flowing north by northeast through Wasco County, and forms the border between Wasco and Sherman counties to its confluence with the Columbia River, approximately 405 kilometers (252 miles) from its source. Elevation at Little Lava Lake is approximately 1,410 meters (4,700 feet), and elevation at the confluence with the Columbia River is approximately 23 meters (75 feet). The primary tributaries to the Deschutes River are the Little Deschutes River, Crooked River, Metolius River, Shitike Creek, Trout Creek, Warm Springs River, and the White River. The Deschutes River and its tributaries drain an area of approximately 26,939 square kilometers (10,400 square miles). Bend, Sisters, La Pine, Redmond, Prineville, and Madras are the major towns in the watershed.

Land ownership patterns and uses in the various subwatersheds making up the Deschutes River basin are as follows:

Figure 1. Bull trout recovery units in the United States. The Deschutes Recovery Unit is highlighted.



Little Deschutes River. Drains an area of approximately 2,642 square kilometers (1,020 square miles) comprised of about 30 percent private lands and 70 percent U.S. Forest Service and Bureau of Land Management lands. Land uses include agriculture such as animal production and animal feed production, forest products, and recreation.

Crooked River. Drains an area of approximately 11,137 square kilometers (4,300 square miles) comprised of about 50 percent U.S. Forest Service and Bureau of Land Management lands and 50 percent private lands. Land uses include grazing as a primary activity, as well as forest products, recreation, and irrigated agriculture.

Metolius River. Drains an area of approximately 816 square kilometers (315 square miles) comprised of 98 percent tribal and U.S. Forest Service lands; 28 percent

of these lands are designated wilderness. The remaining 2 percent is private property. Timber management and recreation are the primary activities.

Squaw Creek. Drains an area of about 606 square kilometers (234 square miles) from its origin at Broken Top Mountain's Bend Glacier at an elevation of over 2,700 meters (9,000 feet). Land ownership is about 82 percent Federal, 17 percent private, and less than 1 percent State. It is designated as a Wild and Scenic River, though the U.S. Forest Service has not as yet completed a Wild and Scenic Management Plan.

Shitike Creek. Drains an area of approximately 197 square kilometers (76 square miles) from its origin, Harvey Lake, at an elevation of 1,584 meters (5,280 feet) to its confluence with the Deschutes River at an elevation of 443 meters (1,476 feet). Shitike Creek flows entirely within the Confederated Tribes of the Warm Springs Reservation. The community of Warm Springs is located near the river's mouth. The majority of the drainage is managed for "conditional use," which is similar to the Federal wilderness designation.

Warm Springs River. Drains an area of approximately 1,362 square kilometers (526 square miles). The entire perennial flow is within the Confederated Tribes of the Warm Springs Reservation. Grazing, forest products, and recreation are the primary land uses.

Trout Creek. Drains an area of approximately 1,805 square kilometers (697 square miles) comprised of about 5 percent U.S. Forest Service land and the balance private lands. Agriculture, livestock production, forest products and recreation are the primary land uses.

White River. Drains an area of approximately 953 square kilometers (368 square miles); the headwaters and about half the length of the river are within the Mt. Hood National Forest. Agriculture and livestock production are the prevalent land management activities in the lower portion of the subwatershed.

Westside tributary headwaters are on the eastern slopes of the Cascade Mountain range where annual precipitation ranges up to 254 centimeters (100 inches),

much of it in the form of snow. Lower reaches of these tributaries, the mainstem Deschutes River, and eastside tributaries may only receive 23 to 36 centimeters (9 to 14 inches) of precipitation annually. Weather is generally cool to cold in the winter, and hot and dry in the summer, with the exception of the higher elevations of the Cascade Mountains (NPPC 2001; USFS and BLM 1999).

The Deschutes basin is in the southern portion of the Columbia basin physiographic province. Loess, volcanic ash, and pumice have been deposited over a basalt plateau in this region. Erosional forces have redeposited much of the loess and ash from upland areas to valley bottoms. Soils are comprised of silt, clay loams, stony loams, cobbly loams, and clay (Northwest Power Planning Council 2001; USFS and BLM 1999).

Some westside tributaries such as the Metolius have their sources in high Cascade Mountain lakes, glaciers, and springs, providing a relatively uniform and consistent range of flows. Others, such as Shitike Creek, have more typical dendritic drainage and thus more variable flows. Eastside tributaries have their sources in the Ochoco Mountain range, a lower and drier range than the Cascades.

Fish Species. A number of other native and exotic species of fish occupy the Deschutes basin. Native species include spring and fall chinook (*Oncorhynchus tshawytscha*), summer steelhead (*Oncorhynchus mykiss*), sockeye salmon (*Oncorhynchus nerka*), Pacific lamprey (*Lampetra tridentata*), mountain whitefish (*Prosopium williamsoni*), northern pikeminnow (*Ptychocheilus oregonensis*), bridgelip sucker (*Catostomus columbianus*), largescale sucker (*Catostomus marcocheilus*), torrent sculpin (*Cottus rhotheus*), and rainbow trout (*Oncorhynchus mykiss*). Exotic species include brown trout (*Oncorhynchus trutta*), smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), three-spine stickleback (*Gasterosteus aculeatus*), and brook trout (*Salvelinus fontinalis*).

The Deschutes River above the Pelton Round Butte dams once supported runs of native anadromous salmon such as sockeye, steelhead, and several races of chinook. The Confederated Tribes of the Warm Springs, Portland General Electric, and many State agencies, Federal agencies, and non-governmental organizations are

participating in an effort to reintroduce anadromous species above the dams. When successful, this action will help restore the historic species assemblage in the lower Deschutes Core Area.

DISTRIBUTION AND ABUNDANCE

Status of Bull Trout at the Time of Listing

In the final bull trout listing rule (FR 63:31647) the U.S. Fish and Wildlife Service identified three subpopulations of bull trout in the Deschutes River basin: 1) Odell Lake on the upper Deschutes River basin, 2) Metolius River-Lake Billy Chinook complex, and 3) lower Deschutes River. Historically bull trout were distributed throughout the Deschutes River basin from the headwaters and headwater lakes to the Columbia River (Newton and Pribyl 1994; Buchanan et al. 1997), allowing access to the Columbia River for juvenile rearing and adult foraging. The subpopulations are isolated by Pelton Round Butte Project dams on the Deschutes River, between river kilometers 161and 177 (River Mile 100 and 110), and Big Falls, a natural barrier at about River kilometer 212 (River Mile 132). Bull trout are thought to be extirpated in up to seven reaches or tributaries within the Deschutes River basin (Buchanan et al. 1997). At the time of listing bull trout had been extirpated from their historic habitats in the upper Deschutes above Big Falls, and bull trout in the Deschutes basin had been reduced to five populations. These are located in Shitike Creek, Warm Springs River, Whitewater River, Jefferson/Candle/Abbot river complex, and Canyon/Jack/Heising/mainstem Metolius river complex. Although subpopulations were an appropriate unit upon which to base the 1998 listing decision, the recovery plan has revised the biological terminology to better reflect the current understanding of bull trout life history and conservation biology theory. Therefore, subpopulation terms will not be used in this chapter.

The Odell Lake subpopulation is presently limited to Odell Lake, which contains the last extant native lake migratory (adfluvial) bull trout in Oregon (Ratliff and Howell 1992; Buchanan et al. 1997). Odell Lake was isolated from other bull trout populations in the upper Deschutes by a lava flow that dammed Odell Creek about 5,000 to 6,000 years ago. Because of its geographic isolation Odell Lake subbasin has been defined as a separate recovery unit, and will not be discussed further in this document.

Current Distribution and Abundance

Current bull trout distribution is limited to the lower Deschutes Core Area, which includes the five local populations in Shitike Creek, the Warm Springs River, and the three Metolius River population complexes. Bull trout currently inhabit most riverine habitats of the Metolius Subbasin. This includes First, Jack, Canyon, Roaring, Brush, Abbot, Candle, and Jefferson creeks, and Whitewater River. Some juvenile bull trout apparently expanded rearing habitat to Abbot Creek in 1994, as they were not observed in an earlier study (Ratliff and Fies 1989). The Metolius River, Lake Billy Chinook Reservoir, the Deschutes River above Lake Billy Chinook upstream to Big Falls, the Crooked River above Lake Billy Chinook upstream to Opal Springs Dam, and the lower Deschutes River below the Pelton Round Butte dams support bull trout. Subadult bull trout also use lower Squaw Creek, a tributary to the Deschutes River 4.8 kilometers (2.9 miles) above Lake Billy Chinook. The Crooked River upstream of the Opal Springs Dam may also be used by bull trout; operators at Opal Springs Dam have reported seeing large fish moving upstream over the dam crest during periods of high flow (McRostie, B. pers. comm. 2002).

The Metolius River-Lake Billy Chinook local population includes migratory bull trout that use the Metolius River and Lake Billy Chinook as seasonal foraging habitat and as a migration corridor (Buchanan et al. 1997). Bull trout spawn in Jack, Canyon, Roaring, Candle, and Jefferson creeks and in the Whitewater River. The local population has exhibited a positive trend in spawning numbers, based on numbers of redds observed, from 27 in 1987 to 330 in 1994 (Ratliff et al. 1996). The Shitike Creek and Warm Springs River have averaged about 232 and 202 spawners respectively between 1998 and 2001. Estimated population numbers for adult fish system-wide increased from 818 in 1993 to 1,895 in 1994 (Buchanan et al. 1997). Collectively the three Metolius basin populations have averaged 786 spawners between 1998 and 2000, though in 2000 there were an estimated 1,263 spawners.

Bull trout are found in the lower Deschutes River above Sherars Falls, Shitike Creek, and Warm Springs River. In 1998, Oregon Department of Fish and

Wildlife and the Confederated Tribes of the Warm Springs estimated the population of bull trout in a 1.8 kilometer (3 mile) river reach of the Deschutes near North Junction at seven fish per 0.6 kilometer (1 mile) greater than 20 centimeters (8 inches) long. One or two adult bull trout are caught in the Pelton fish trap each year. The trap is located at the base of the Reregulating Dam. In 24 years of operation of a steeppass trap at Sherars Falls, one bull trout was recently captured; in addition, two bull trout were captured in the tribal dipnet fishery at Sherar's Falls during 2001 (Pribyl, S. pers. comm. 2001). Anglers have recently reported higher incidental hooking of bull trout in the Deschutes River, which may indicate that the population is increasing. Subadult and adult fish are seasonally present in the lower Deschutes River (Newton and Pribyl 1994).

In the Metolius, most spawning occurrs between August 15 and October 1. However, spawning has been observed as early as July 13 and as late as mid-October (Ratliff et al. 1996). In Shitike Creek, spawning was observed from August 20 through early November, when water temperature averaged 6.2 degrees Celsius (43 degrees Fahrenheit) between River kilometer 30 to 45 (River Mile 18 to 27); this was the mean 7-day average from thermographs. In the Warm Springs River, temperatures averaged 6.6 degrees Celsius (44 degrees Fahrenheit) between River kilometer 52 to 59 (River Mile 31 to 35) during the late-August to early November spawning period (Brun 1999).

In the lower Deschutes River below the Pelton Round-Butte dams, bull trout spawn and rear in Shitike Creek and the Warm Springs River. Migratory bull trout are the primary life-history form present. In Shitike Creek the numbers of redds and juveniles appears to be stable. In the Warm Springs River there have been large fluctuations in redd counts and juvenile observations. During 1972 through 1988, low numbers of bull trout (0 to 27 fish) were recorded during surveys on the mainstem lower Deschutes River, and redd counts on Shitike Creek varied from 15 in 1990 to 6 in 1992 (Newton and Pribyl 1994). However, by 1998 redd counts had increased to 100; there were 115 and 76 redds counted in 1999 and 2000, respectively (Brun and Dodson 2000). In the Warm Springs River, 100 redds were counted in 1998, while 84 and 78 redds were counted in

1999 and 2000, respectively (Brun and Dodson 2000). Redd counts have averaged 101 redds in Shitike Creek, and 88 redds in the Warm Springs River from 1998 to 2001 (Brun and Dodson, in press). Juvenile bull trout densities in a 3.6 kilometer (2.2 miles) reach of the Warm Springs River were calculated at 0.005 per square meter (0.054 per square foot), while a density of 0.025 juvenile bull trout per square meter (0.27 per square foot) was calculated for the 1.1 kilometer (0.7 miles) surveyed in Shitike Creek (Brun 1999).

Deschutes basin bull trout exhibit both fluvial and adfluvial life histories. Fluvial bull trout migrate from their smaller natal stream to a larger river to rear, and then back to their natal stream to spawn. Adfluvial bull trout migrate from their smaller natal stream eventually entering a lake or reservoir to rear. After several years of growth, and with the onset of maturity, adfluvial bull trout retrace their earlier migration back to their natal stream to spawn.

In one recent study (Brun and Dodson 2000), radio-tagged adults began their migration in mid-May. They initially made short runs up and down stream runs into spawning streams. Later, one specimen moved upstream some 73 kilometers (44 miles) in Shitike Creek to reach spawning areas, and then moved quickly downstream after spawning. Other tagged fish showed similar behavior. In the Metolius, maturing bull trout moving from Lake Billy Chinook into the Metolius were captured from May through August. Peak upstream movement occurred between August 20 and September 15.

Juveniles moved downstream during both the spring and fall months. The majority were trapped during May and early June, while the remainder were captured during September. The mean fork-length of fish captured in Shitike Creek in the spring was 131 millimeters (5.2 inches), while fall migrants averaged 214 millimeters. Age two (120 to140 millimeters or 4.7 to 5.5 inches) fish accounted for 83 percent of spring catch, and the remaining were assumed to be age three (160 to 200 millimeters or 6.2 to 7.8 inches). One age four fish (399 millimeters (15.7 inches)) was also captured. No juvenile fish were captured in the Warm Springs River Humphrey trap (Brun 1999).

Other studies (Ratliff et al. 1996) reported that approximately 2,900 juveniles moves downstream from Jacks Creek in the Metolius between April 24 and October 13. Most were captured in May and June. Over 93 percent were found when the trap was checked in the morning, indicating that they were moving at night. Over half were age two.

REASONS FOR BULL TROUT DECLINE

Land and water management activities that currently depress bull trout populations and degrade habitat in this recovery unit include operation and maintenance of dams and other diversion structures, and the introduction of nonnative species. Impassable dams and diversion structures isolate and fragment bull trout local populations. Introduced brook trout threaten bull trout through hybridization, competition, and possible predation.

Dams

Lower Deschutes. The construction of the Pelton Round-Butte Hydroelectric Project created a barrier to the upstream movement of bull trout in the mainstem Deschutes River, and is also an obstacle to downstream movement. This project has had some effects to flows in the lower Deschutes River such as reducing dissolved oxygen levels immediately below this project. However, it is not known whether or not these effects alter how bull trout use the mainstem Deschutes River (Newton and Pribyl 1994).

In the Metolius River subbasin losses can occur when bull trout migrate from Lake Billy Chinook to Lake Simtustus through the turbines at Round Butte Dam. From there, bull trout may pass into the Reregulating Reservoir through Pelton Dam, and through the Reregulating Dam into the lower Deschutes River. Individuals may be killed or injured in the turbines, while survivors are unable to return to spawning areas because upstream passage facilities at the three dams are no longer operated. Until recently, bull trout may have had limited or reduced access to Suttle Lake, Blue Lake, and Link Creek due to barriers on Link Creek (Ratliff et al. 1996). A passage structure is planned for the barrier on Link Creek at the Suttle Lake Lodge.

In the Crooked River subbasin, Opal Springs Dam may mark the current upstream limit of bull trout on the Crooked River at about 1 kilometer (0.6 miles) upstream of Lake Billy Chinook, though anecdotal reports indicate that fish move upstream over the dam during high flows (McRostie, B., pers. comm. 2002).

Bowman Dam at river kilometer 113 (river mile 68) was completed in 1960 without fish passage; Ochoco Dam on Ochoco Creek also lacks passage (Stuart *et al.* 1996). Bowman and Ochoco Dams definitively mark the upstream limit of bull trout. Passage at these dams has not been identified as necessary for bull trout recovery.

Limiting factors in the Crooked River, should fish passage be realized, include operation of Prineville Reservoir. The reservoir causes periodic nitrogen supersaturation or gas bubble disease in fish, as well as turbidity, and a reversal of the flow regime in which high flows occur in summer to meet the irrigation demand and low flows occur during winter (Stuart et al. 1996). There are also high summer water temperatures due to reduced instream flows, as well as degraded riparian and watershed conditions.

Upper Deschutes. Dams were constructed at Crane Prairie in 1922, Crescent Lake in 1928, and Wickiup Reservoir in 1947 (Buchanan *et al.* 1997). These dams blocked fish passage, reduced instream flows and caused subsequent increases in water temperatures, altered streamflow regimes, and inundated spawning and juvenile rearing areas in the upper Deschutes subbasin (Buchanan et al. 1997). Colorado Street Bridge and North Canal Dam were constructed without fish passage (Fies et al. 1996a). The Bend hydroelectric dam was constructed with fish passage, but the wooden ladder deteriorated and was removed. Flow manipulations, which are described in the Wild and Scenic Plan/Geology Section (USFS) 1996), also affect water quality. The low instream flows associated with dam operations at Wickiup, Crane, Bowman, and Crescent dams impact bull trout by reducing habitat quantity and quality.

In conclusion, dams have been a major factor affecting bull trout in the lower and upper Deschutes River. They have interrupted or eliminated passage and population interconnections, as well as access to historic habitats. Some historic habitats have been lost to inundation, or have been significantly reduced in quantity and quality due to reduced instream flows. These factors contributed to the eventual extirpation of bull trout in the upper Deschutes. Dams have also altered water quality, though it is not known to what extent this affects bull trout

Forest Management Practices

Lower Deschutes. There has been some habitat degradation in the Metolius River subbasin from past logging and road-building. However, current management on public lands has corrected some of the problem areas (Ratliff et al. 1996). Proposed and ongoing timber harvests to address forest health issues have the potential to increase fine sediment input to bull trout spawning and rearing habitat. Recommendations to address high-risk areas have been proposed (Riehle *et al.* 1997), and road obliterations and drainage repair projects are being implemented. Other habitat limitations include low amounts of large woody material in the Metolius River (Fies et al. 1996b). Roads, skid trails, and general ground disturbance may be the leading causes of sedimentation in the basin and represent the greatest risk to bull trout habitat; potential for increasing sedimentation while thinning over-stocked stands of timber poses a continuing risk (Ratliff et al. 1996). The Warm Springs River and Shitike Creek have also experienced similar effects from forest management activities (Brun, C., pers. comm. 2002).

Upper Deschutes. Large wood was lost from the Deschutes River from Wickiup to Benham Falls from several factors, including wood removal and log drives (Oregon Department of Fish and Wildlife (ODFW) 1996). The Deschutes River above Crane Prairie Reservoir, Little Deschutes below Gilchrist, lower Crescent Creek, Fall River, Spring River, Tumalo Creek, and Squaw Creek below Sisters experienced similar impacts.

In conclusion, forest management has historically been a moderate factor affecting bull trout. However, forest practices have generally been improved in recent years, which has reduced effects to areas that support sensitive spawning and rearing habitats.

Livestock Grazing

Lower Deschutes. Habitat degradation from excessive grazing includes loss of riparian vegetation bordering the river, which reduces juvenile hiding and escape cover. This could impact aquatic and terrestrial insect production, increase water

temperature, as well as increase bank erosion and substrate sedimentation. These effects occur in some migratory corridors and overwintering areas (Newton and Pribyl 1995). There appears to be very little habitat degradation associated with grazing in the Metolius River basin. However, Canyon Creek and Lake Creek are somewhat affected by grazing from horses, while the Metolius River is affected by both horses and cattle (Ratliff et al. 1996).

In the Crooked River basin habitat degradation is severe and long-term. By 1860 over 350,000 people had entered the region using the Oregon Trail. By 1897 approximately 320,000 sheep, 40,000 cows, and 10,500 horses were in the area now occupied by Crook, Deschutes, and Jefferson counties. (Nehlsen 1995). However, since historic reports do not indicate that bull trout were present above the city of Prineville, grazing may have only affected bull trout using the lower reaches of the Crooked River for foraging or overwintering. Some grazing occurred in the Shitike Creek and Warm Springs River basins, which negatively affected bull trout.

Upper Deschutes. There are degraded riparian areas associated with grazing in the Little Deschutes River, lower Crescent Creek, Deschutes River from Wickiup Dam downstream to Benham Falls, Paulina Creek, Spring River, Tumalo Creek, and Squaw Creek. Some areas have not yet recovered from grazing that occurred over 100 years ago (ODFW 1996). Grazing practices may have been an additional factor in extirpating bull trout from the upper Deschutes River.

In conclusion, grazing effects to bull trout in the Metolius River appear to be low. However, effects to the Warm Springs River and Shitike Creek were probably more significant. The most notable habitat degradation from grazing appears to have

occurred in the Crooked River drainage. However, the apparently limited distribution of bull trout in the Crooked River reduced grazing effects to bull trout. In the upper Deschutes River, grazing may have had moderate effects to bull trout and contributed to their extirpation

Agricultural Practices

Lower Deschutes. Limiting factors include low flows from stream diversions, barriers created by diversion dams, high stream temperature, lack of instream cover, and sedimentation from agricultural practices (ODFW 1997). Effects to headwater spawning streams in the Metolius, Shitike, and Warm Springs river drainage were minimal due to the relatively protected status of these streams. However, there have been some chemical pond treatments for aquatic vegetation, as well as water diversions on Lake and Jack creeks (Ratliff et al. 1996). The suitability of Squaw Creek and the mainstem Deschutes River for foraging and rearing have been reduced due to irrigation withdrawals. Trout Creek is a perennial tributary of the lower Deschutes River; bull trout were documented there prior to 1990.

Habitat degradation in the Crooked River subbasin is so severe that it has been described as the most degraded river system in the State (Stuart et al. 1996). The most significant effects are the result of water quality problems, including flow reduction, temperature, sedimentation, and turbidity. Water temperatures in headwater streams often exceed 21 degrees Celsius (70 degrees Fahrenheit), and can reach 28 degrees Celsius (83 degrees Fahrenheit). There are numerous irrigation diversions and poor quality agricultural return water.

There are no screens on the Squaw Creek agricultural diversions. The Pelton Round Butte and Opal Springs hydroproject facilities are also unscreened. Some bull trout are entrained at Pelton Round Butte and mortalities have been reported. However, the overall level of entrainment appears to be low, and some bull trout survive turbine passage (Portland General Electric (PGE) 1999).

Upper Deschutes. Seasonally low water or complete dewatering resulting from agricultural irrigation diversions is the most significant factor limiting fish production in the upper Deschutes River subbasin (ODFW 1996). Water diversions reduced flows and increased water temperatures, which probably reduced the river's suitability for bull trout foraging and rearing. High stream temperatures of up to 27

degrees Celsius (80 degrees Fahrenheit) have been reported in the upper Deschutes River between North Canal's Steidle Dam at Bend and at Lower Bridge near Terrebonne. Temperatures in Crescent and Squaw creek are also excessively high.

Other affected areas include the Deschutes River from Wickiup Dam to Squaw Creek upstream of Lake Billy Chinook, the Little Deschutes River below the mouth of Crescent Creek, and Crescent, Paulina, Tumalo and Squaw creeks (Fies et al. 1996a). The high flows released during the summer irrigation season discourages establishment of vegetation on streambanks and facilitates bank erosion (USFS 1995). Degraded riparian areas include the Little Deschutes River, lower Crescent Creek, Deschutes River from Wickiup Dam downstream to Benham Falls, Paulina Creek, Spring River, Tumalo Creek, and Squaw Creek.

Four irrigation diversions on upper Deschutes either do not have screens or are equipped with ineffective louvers. These include the Lone Pine Irrigation District's and the Central Oregon Irrigation District's North Canal and Swalley Canal (Fies 1996a). However, all have proposed to install screening in the near future. There are also two hydroproject diversions without screening; these are the Bend Hydroelectric and Cline Falls. It is not known if these facilities are currently in operation. There are also no screens on the Tumalo Creek or Little Deschutes River diversions. The Crane Prairie and Wickiup Dam outlets are not screened.

In conclusion, in the lower Deschutes agricultural practices have been a minor factor affecting bull trout in the Metolius, but are somewhat more significant in Shitike Creek and the Warm Springs River. In the upper Deschutes these practices probably contributed bull trout extirpation, and would need to be addressed in any reintroduction plan. The effects of unscreened diversions on bull trout appearto have been minor. However, the recovery unit team has recommend that screening be pursued for these facilities to eliminate their effects.

Transportation Network

Railroad access to the Deschutes region was established by 1911. Road and railway networks create opportunities for toxic spills such as those that have occurred in the John Day River basin. Roads have also been constructed for residential areas and forest activities. In conclusion, the Deschutes River basin's transportation network has been a minor factor affecting bull trout in the Metolius River and Shitike Creek, but a more significant factor in the Warm Springs River drainage.

Mining

There is some mining in the upper Deschutes River. The Deschutes Recovery Unit Team concluded it does not appear to have been a factor causing decline, or would be a factor impeding recovery.

Residential Development

In the lower Deschutes River, residential development in the upper 6.7 kilometers (4 miles) of the Metolius River has reduced wood recruitment due to recreation, residences, roads, and resort development. Impacts include loss of riparian vegetation through land clearing, loss of streambank habitat, instream structures, as well as water surface area from construction of retaining walls and boat docks. Water quality degradation also occurs due to use of fertilizers, pesticides, and failed septic systems (Fies 1996a). The transition from agricultural use of water to its use for small farms and golf courses has changed the timing of withdrawal, return flows, and water quality. In the upper Deschutes basin development is heavy on the Little Deschutes River, while the Spring and Fall rivers have also been impacted by development. In conclusion, in the lower Deschutes River effects have been low in the Metolius and the Warm Springs river, but more significant in Shitike Creek. Effects in the upper Deschutes River have been moderate.

Fisheries Management

Fisheries management in the Deschutes River basin is highly influenced by the absence of fish passage at the Pelton Round-Butte Hydroelectric Project, as well as low stream flows and passage impediments on many tributaries due to irrigation diversions. The Confederated Tribes of the Warm Springs and Oregon Department of Fish and Wildlife co-manage fisheries throughout the Deschutes River basin.

Lower Deschutes. Bull trout harvest is illegal in the lower Deschutes River, and is mainly an historic issue (Newton and Pribyl 1995). Historically, anecdotal information suggests that European-Americans harvested large numbers of bull trout from the lower Deschutes. Protective bull trout angling regulations have been implemented since 1980, which culminated in the closure of the Metolius River tributaries below Lake Creek to angling in 1994. Some illegal harvest of bull trout may still occur in the lower Metolius River (Ratliff *et al.* 1996).

In addition to harvest by anglers, the Oregon Game Commission operated traps for bull trout on Lake, Jack, and Canyon creeks. Similarly, bull trout were trapped and killed using a weir at the U.S. Fish and Wildlife Service's fish hatchery on the Warm Springs River.

Brook trout inhabit Squaw Creek, the Warm Springs River, and Shitike Creek. Brook trout are a major threat to bull trout in the Warm Springs River due to competition for limited rearing habitat. In Mill Creek, which is a Warm Springs tributary, brook trout have displaced bull trout. Brook trout do not appear to be limiting bull trout abundance in Shitike Creek (Brun, C., pers. comm., 2002).

In the Metolius River basin introduced brook and brown trout may be limiting for some bull trout populations in the Metolius River basin due to their potential for interaction. Brook trout are found in Abbot, Brush, and Canyon creeks. Brown trout occur in Suttle Lake and may have been partially responsible for the demise of that bull trout population. Overharvest may be a factor in a mixed fishery with brown trout (Ratliff *et al.* 1996).

Upper Deschutes. Overfishing was a factor in the decline of bull trout in Crescent Lake and Wickiup Reservoir above the dams. Historical records indicate that European-Americans harvest large quantities of bull trout. Bull trout have been extirpated from the area; however, overfishing could be a factor affecting bull trout should they be reintroduced.

Brook trout and brown trout were introduced in the early 1900's. Brook trout are now widely distributed in the upper portion of the basin. Brown trout are found in the Deschutes River mainstem downstream of Crane Prairie Dam, in Wickiup Reservoir, East Lake, Crescent Lake, Spring River, Tumalo Creek, and the Fall River. They are also present in the Little Deschutes River basin, where they occur high in the system above Highway 58 (Fies *et al.* 1996a). Bull trout have been extirpated from the area; however, introduced species could be a factor affecting bull trout should they be reintroduced.

In conclusion, fisheries management was a moderate to major factor affecting bull trout in the lower Deschutes River. While harvest was historically a significant factor in bull trout decline, current fishing regulations have reduced this effect. Introduced species have been and continue to be a significant effect to bull trout due to interbreeding and competition. Though bull trout populations are less abundant than we would like, the fish are generally in good health. Fisheries management was also a moderate to major factor affecting bull trout in the upper Deschutes river. Harvest and introduced species both contributed significantly to bull trout decline and eventual extirpation. These factors must be addressed in any plan to reintroduce bull trout into the upper Deschutes River.

Isolation and Habitat Fragmentation

Lower Deschutes. Historic bull trout populations in the lower Deschutes River appear to have been robust and interconnected (Goetz 1989). Currently, the Pelton Round Butte dams prevent upstream gene flow from the populations in Shitike Creek and the Warm Springs River, and nearly eliminate downstream gene flow from the Metolius River. Until recently, bull trout may have had limited orreduced access to Suttle Lake, Blue Lake, and Link Creek due to barriers on Link

Creek and Lake Creek (Ratliff et al. 1996). However, the barrier on Lake Creek at Lake Creek Lodge no longer inhibits bull trout movement, while a passage structure is planned for the barrier on Link Creek at the Suttle Lake Lodge. In the Crooked River basin Opal Springs Dam was constructed without fish passage. Stream diversions for irrigation reduced or eliminated flows, and resulted in higher water temperatures and thermal barriers which further isolated or fragmented populations.

Upper Deschutes. Before they were extirpated, bull trout here were first isolated by several dams which were constructed without fish passage. These dams include the Bureau of Reclamation's Crane Prairie, Wickiup, and Crescent Lake dams, as well as several privately owned irrigation dams. The dams also isolated populations through their effects on water quality instream flow. Populations were further isolated as they were outcompeted for their historic habitats by brown trout and lake trout. Interbreeding with brook trout further increased fragmentation. Chemical treatment projects in historic habitats such as Big Lava Lake, Davis Lake, and the Fall River contributed to isolation and fragmentation (Fies 1996a) through the creation of water quality barriers.

In conclusion, isolation and fragmentation have had moderate effects to lower Deschutes bull trout. However, in the upper Deschutes these effects have been major. In general, bull trout populations in the Deschutes Recovery Unit are at greater risk ofextinction due to isolation and fragmentation. This is due to their isolation by dams, small population sizes associated with reduced habitat, and extirpation in large areas of their historic range. Each of the five remaining Deschutes Basin bull trout populations are below the effective population size of 1,000 spawners suggested by Reiman and Allendorf (2001). This does not mean that the existing populations are not viable. However, aggressive management and immediate attention to factors causing decline are even more important for small populations. Maximizing adult bull trout abundance in the local populations is essential for their long-term genetic health. Even in a recovered state, habitat for some populations may remain limited, resulting in small population size.

ONGOING RECOVERY UNIT CONSERVATION MEASURES

Efforts to recover native species are ongoing in the Deschutes Recovery Unit, with a high level of cooperation between fishery entities on various projects. Spawning surveys have been a cooperative effort for many years. The Deschutes, Crooked, Metolius, rivers and Squaw creek basins have active local watershed groups dedicated to finding workable solutions to restoring native fish runs. The following list is by no means complete, but is representative of ongoing efforts within the recovery unit.

Oregon Department of Fish and Wildlife has reduced or eliminated some stocking programs. Hatchery trout have not been stocked in the lower Deschutes River since 1978. Oregon Department of Fish and Wildlife adopted changes in angling regulations to prohibit take of bull trout, and modified regulations on other fisheries to reduce incidental take. The lower 170 kilometers (100 miles) of the Deschutes River is closed to the retention of bull trout by anglers. Anglers are required to use artificial flies and lures only. Sport angling in the lower Deschutes River tributaries is either closed or limited to catch and release with artificial flies and lures. That portion of the lower Deschutes River bordering the Warm Springs Reservation is closed to sport angling from January 1 to late April.

Oregon Department of Fish and Wildlife has developed and distributed bull trout identification posters, and undertaken educational and law enforcement efforts to enforce harvest restrictions. Oregon State Police annually assigns five cadets and one trooper to patrol the lower Deschutes. Their primary responsibility is education of river users and enforcement when needed. Oregon Department of Fish and Wildlife typically assigns up to four people to monitor sport and Tribal fishing pressure and catch. Both Bureau of Land Management and local sheriff deputies also patrol the river to conduct education and enforcement activities.

Oregon Department of Fish and Wildlife, the Confederated Tribes of the Warm Springs, Portland General Electric, and U.S. Forest Service staff work

cooperatively on spawning and habitat surveys, research, and habitat enhancement projects.

Oregon Department of Fish and Wildlife hired a bull trout coordinator in 1995 to complete Statewide bull trout status assessment, map bull trout distribution, and develop conservation strategies for bull trout. When bull trout were listed the effort shifted to recovery planning. Oregon Department of Fish and Wildlife initiated bull trout research projects in 1993. Research results have been published in a number of reports, which are available at http://www.dfw.state.or.us/. The Oregon Department of Fish and Wildlife coordinates with five irrigation districts to minimize adverse habitat effects associated with water unscreened water diversions. Habitat enhancement efforts, funded by a Federal Energy Regulatory Commission license holder and implemented by the Oregon Department of Fish and Wildlife, are also being implemented to restore stream function and fish habitat. Oregon Department of Fish and Wildlife has made changes to in-water work periods to better address bull trout needs and reduce effects.

Bonneville Power Administration has provided funding for anadromous and bull trout habitat restoration and research projects of the Oregon Department of Fish and Wildlife. This included a research project, No. 9405400, which performed genetic analysis of Oregon bull trout including samples from the Deschutes populations. This research established the genetic baseline for Oregon bull trout and confirmed Oregon Department of Fish and Wildlife's designation of Deschutes bull trout as a separate gene conservation group (Spruell and Allendorf 1997).

The Confederated Tribes of the Warm Springs has been actively involved in bull trout research and conservation efforts since 1998. This work has been focused mostly on the Warm Springs River and Shitike Creek. Both streams are on Tribal land and have bull trout populations. The Confederated Tribes of the Warm Springs has collected data on juvenile bull trout abundance, and has radio-tagged adult bull trout to track their seasonal migration. They plan to continue these activities in the future. The Bonneville Power

Administration has provided funding to the Confederated Tribes of the Warm Springs to determine bull trout life history, genetics, and abundance in the lower Deschutes. The project began in 1998 and is ongoing.

The U.S. Forest Service has performed stream bank stabilization and instream habitat construction projects (NPPC 2001). The Bureau of Land Management has reviewed its livestock allotment management plans and modified them to protect and enhance riparian and aquatic resources. Both the U.S. Forest Service and Bureau of Land Management have fenced some stream margins to exclude livestock. The Confederated Tribes of the Warm Springs has funded many restoration and enhancement projects on Tribal streams, including fencing, bank stabilization, and constructing instream structure. The Oregon Department of Fish and Wildlife has worked to restore portions of Trout Creek and to fence off riparian areas.

As part of the Pelton Round-Butte relicensing, Portland General Electric and the Confederated Tribes of the Warm Springs have conducted valuable predator/prey studies, and collected data on bull trout migration, spawning, and rearing. Portland General Electric and the Confederated Tribes of the Warm Springs have also studied the effects of the Pelton Round-Butte Project on water quality, algae, zooplankton, and kokanee. In the lower Deschutes River, research has been done on bull trout, as well as steelhead and redband trout. The major survey and experimental phase of Portland General Electric's fish health risk assessment was completed in 2001. Barring any changes it is likely that bull trout movement will have a low risk of introducing pathogens of concern. The 5-year period of monitoring and evaluation of pathogens which began in 2001 and ends in 2006 is a necessary requirement of passage of all these stocks. There will have to a reevaluation of passage after this five-year period.

RELATIONSHIP TO OTHER CONSERVATION/PLANNING/RECOVERY EFFORTS

On January 14, 1999, Governor Kitzhaber expanded the Oregon Plan for Salmon and Watersheds (Oregon 1997) to include all at-risk wild salmonids throughout the State through Executive Order 99-01. The goal of the Oregon Plan is to "restore populations and fisheries to productive and sustainable levels that will provide substantial environmental, cultural, and economic benefits." Components of this plan include: 1) coordination of efforts by all parties, 2) development of action plans with relevance and ownership at the local level, 3) monitoring progress, and 4) making appropriate corrective changes in the future. It is a cooperative effort of State, local, Federal, tribal and private organizations, and individuals.

The Oregon Department of Fish and Wildlife and the Oregon Water Resources Department have established priorities for restoration of streamflow as part of the Oregon Plan for Salmon and Watersheds, Measure IV.A.8. The Oregon Department of Fish and Wildlife has prioritized streamflow restoration needs by ranking biophysical factors, water use patterns, and the extent that water limits fish production in a particular area. The Oregon Water Resources Department watermasters will incorporate the priorities into their field work activities as a means to implement flow restoration measures. The needs priorities will be used by the Oregon Watershed Enhancement Board as one criterion in determining funding priorities for enhancement and restoration projects. Watershed councils and other entities may also use the needs priorities as one piece of information to determine high priority restoration projects. Bull trout occupied streams in the recovery unit are included in the highest priority designation for streamflow restoration (NPPC 2001).

Opportunities to convert existing out of stream flows to instream flows in Oregon are available through a variety of legislatively mandated programs administered by Oregon Water Resources Department, e.g., transfers of type and place of use (ORS 536.050(4), voluntary written agreement among water users to rotate their use of the supply to which they are collectively entitled

(ORS 540.150 and OAR 690-250-0080), allocation of "conserved water" to instream use (ORS 537.455 to 537.500), lease all or a portion of consumptive water rights to instream purposes (ORS 537.348, OAR 690-77-070 to 690-77-077, exchange of a water right for an instream purpose to use water from a different source, being stored water, surface or ground water (ORS 540.533 to 540.543), and substitute a ground water right for a primary surface water right (ORS 540.524). Oregon Water Trust provides purchase of water rights from willing landowners for conversion to instream water rights.

Through the Deschutes Basin Total Maximum Daily Load process a Water Quality Management Plan will be developed to address forest, agricultural, urban, and transportation sources of water quality impairment. The Water Quality Management Plan will include implementation plans from Federal land management agencies such as the U.S. Forest Service and Bureau of Land Management, State forestry and agriculture, cities, and counties. The upper mainstem Deschutes and little Deschutes should be completed in 2002, while the lower Crooked, upper Crooked, and Beaver South Fork will be finished in 2004. The lower Deschutes and Trout Creek are scheduled for completion in 2006. For more information, see under Deschutes basin at http://waterquality.deq.state.or.us/wq/TMDLs/TMDLs.htm).

The Agricultural Water Quality Management Program, established through the Senate Bill 1010 process (ORS 568.900 through 568.933), addresses water pollution associated with agricultural lands and activities. This program will address riparian conditions related to temperature and channel morphology in its plan and rules. Plans have been completed in the lower and middle Deschutes River. The upper Deschutes River plan is still in process, while the Crooked River plan will begin in the fall of 2002. For information on Senate Bill 1010 and water quality plans go to http://www.oda.state.or.us/Natural_Resources/wqal.htm.

The Deschutes Resources Conservancy is a community based nonprofit corporation dedicated to restoring streamflows and improving water quality in the Deschutes basin. The objective of the Deschutes Resources Conservancy is

to restore stream flows sufficiently to restore the natural hydrograph in all streams to the extent environmentally, socially, and economically practicable. The Deschutes Resources Conservancy has prioritized the following streams: Squaw Creek, Tumalo Creek, the Deschutes River between the city of Bend and Lake Billy Chinook, and Trout Creek. The Deschutes Resources Conservancy has established an Exchange Bank to facilitate water transfers. The Exchange can help promote stream restoration measures. Revenue earned through the Exchange will be invested in further conservation. The Deschutes Resources Conservancy and local irrigation districts have offered an Annual Water Leasing Program since 1998. In 2001, the Deschutes Resources Conservancy and the Irrigation District's leased 8,792 acre-feet of water instream for a flow of about 0.69 cubic meters per second (25 cubic feet per second) in sections of streams and rivers of the Deschutes basin that typically experience low flow conditions.

There are a number of watershed councils and Soil and Water Conservation Districts in the Deschutes River basin. They include the upper Deschutes, middle Deschutes, lower Deschutes, Squaw Creek, Trout/Willow Creek, and Crooked River Watershed Councils, and the Hood, Wasco, Sherman, Jefferson, Crook, and Deschutes Soil and Water Conservation Districts. Theses entities are involved in a variety of conservation efforts to improve water quality, quantity, stream habitat, and natural resource management.

The Oregon Water Trust works cooperatively with willing water right holders to acquire senior water rights and convert them to legally-protected instream water rights. They have worked with the Deschutes Resources Conservancy, Upper Deschutes Watershed Council, and other partners to restore flows to Squaw Creek, Trout Creek, and Buck Hollow Creek.

The Deschutes Basin Land Trust has begun a planning process called "Back to Home Waters." This initiative seeks to identify, prioritize, and pursue

voluntary efforts to protect and enhance critical habitat needed to reintroduce native fish to the upper Deschutes. It includes efforts within the Metolius, Squaw Creek, lower Crooked, Ochoco, and Mckay creeks. As noted above, various Deschutes basin watershed councils are also involved in conservation activities. In January 2002, the Land Trust acquired an option to purchase 502 hectares (1,240 acres) of forestland in the Metolius watershed. The property includes over 5 kilometers (3 miles) of Lake Creek, which is an important tributary to the Metolius River. The land is currently owned by Willamette Industries, and faces continued timber removal or perhaps sale to resort developers. Lake Creek is used seasonally by bull trout, and provides important water quality benefits by reducing warm summer water temperatures from Suttle Lake outflows.

As part of the Pacific Northwest Electric Power Planning and Conservation Act of 1980, the Bonneville Power Administration has the responsibility to protect, mitigate and enhance fish and wildlife resources affected by operation of Federal hydroelectric projects in the Columbia River and its tributaries. The Northwest Power Planning Council develops and implements the Columbia River Basin Fish and Wildlife Program that is implemented by the Bonneville Power Administration, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and Federal Energy Regulatory Commission. Coordination of Bonneville Power Administration's responsibilities for protection, enhancement, and mitigation and incorporation of recommendations by Northwest Power Planning Council is in part done through the development of subbasin summaries, which identify status of fish and wildlife resources, limiting factors, and recommended actions at the subbasin level.

The draft Deschutes River Subbasin Summary (NPPC 2001) is consistent with bull trout recovery planning efforts to identify limiting factors. The draft subbasin summary identifies temperature, channel conditions, instream habitat diversity, flow, riparian, and passage as contributing to the decline of bull trout. The overall fisheries goal of the draft subbasin plan is to:

"Protect, maintain, and restore or enhance riparian watershed ecosystems to sustain an abundant, productive, and diverse community of fish and wildlife." According to the subbasin plan this goal will be achieved by assisting in developing recovery plans, supporting agencies to restore threatened and endangered fish populations, and by protecting riparian corridor habitats. The draft Deschutes subbasin summary on page 56 identifies loss of instream flows, riparian vegetation, increased sedimentation, other water quality effects as factors limiting bull trout. The Deschutes Recovery Unit Team will continue to utilize this planning process to identify and seek funding for projects to aid bull trout recovery.

STRATEGY FOR RECOVERY

A core area represents the closest approximation of a biologically functioning unit for bull trout. The combination of both core habitat (*i.e.*, habitat that could supply all the necessary elements for the long-term security of bull trout, including for both spawning and rearing, as well as for foraging, migrating, and overwintering) and a core population (*i.e.*, bull trout inhabiting a core habitat) constitutes the basic core area upon which to gauge recovery within a recovery unit. Within a core area, many local populations may exist.

The Deschutes Recovery Unit Team identified one core area, and one core habitat which could become a core area if bull trout are reestablished there. The lower Deschutes Core Area and upper Deschutes core habitat are separated by Big Falls on the mainstem Deschutes River at about River kilometer 212 (River Mile 132). The lower Deschutes Core Area is generally described as the mainstem Deschutes and its tributaries from Big Falls to the Columbia River and contains five local populations. The mainstem Columbia River is not considered part of the lower Deschutes Core Area, but is identified as a primary research need due to the uncertainty of its current or potential use by bull trout as overwintering and migration habitat (see Chapter 1 for a discussion on the mainstem Columbia River).

The upper Deschutes core habitat is generally described as the upper Deschutes and its tributaries upstream from Big Falls at about River kilometer 212 (River Mile 132). The upper Deschutes core habitat does not currently support bull trout populations, but had bull trout historically. The recovery unit team determined that it likely has the necessary habitat elements to support reestablishment of bull trout. However, since some uncertainties remain regarding possible bull trout reestablishment in the upper Deschutes, and feasibility studies have been identified as a priority one research need.

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 with spawning and rearing habitat in Shitike Creek, Warm Springs River, Whitewater River, Jefferson/Candle/Abbot river complex, and Canyon/Jack/Heising/mainstem Metolius river complex. Foraging, migrating, and overwintering habitats are also present in the core area.

Upper Deschutes Core Habitat. Bull trout are currently extirpated in this basin. Historic information indicates that bull trout were present in the upper Deschutes River, North Davis Creek, the Little Deschutes River, Crescent Lake, and Crescent Creek. Suitable but undocumented habitat was also identified in the Fall River, Browns Creek, Snow Creek, the Little Deschutes River, Whitefish Creek, Big Marsh Creek, Refrigerator Creek, Hemlock Creek, and Spruce Creek (Riehle and Nolte 1992). Recent preliminary investigations by U.S. Fish and Wildlife Service indicate that the Fall River, North Davis Creek, Browns Creek, Snow Creek, Quinn River, Cultus River, and the Little Deschutes River tributaries may contain suitable habitat for bull trout.

Recovery Goals and Objectives

The goal of the bull trout recovery plan is to **ensure the long-term persistence of self-sustaining complex interacting groups of bull trout distributed throughout the species' native range, so that the species can be delisted**. To achieve this goal the following objectives have been identified for bull trout in the Deschutes Recovery Unit:

- Maintain current distribution of bull trout within the lower Deschutes Core Area and restore distribution in previously occupied areas within the Deschutes Recovery Unit.

- Maintain stable or increasing trends in abundance of adult bull trout.

- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.

- Conserve genetic diversity and provide opportunity for genetic exchange. Rieman and McIntyre (1993) and Rieman and Allendorf (2001) evaluated the bull trout population numbers and habitat thresholds necessary for long-term viability of the species. They identified four elements, and the characteristics of those elements, toconsider when evaluating the viability of bull trout populations. These four elements are 1) number of local populations; 2) adult abundance (defined as the number of spawning fish present in a core area in a given year); 3) productivity, or the reproductive rate of the population (as measured by population trend and variability); and 4) connectivity (as represented by the migratory life history form and functional habitat). For each element, the Deschutes Recovery Unit Team classified bull trout into relative risk categories based on the best available data and the professional judgment of the team.

The Deschutes Recovery Unit Team also evaluated each element under a potential recovered condition to produce recovery criteria. Evaluation of these elements under a recovered condition assumed that actions identified within this chapter had been implemented. Recovery criteria for the Deschutes Recovery Unit reflect 1) the stated objectives for the recovery unit, 2) evaluation of each population element in both current and recovered conditions, and 3) consideration of current and recovered habitat characteristics within the recovery unit. Recovery criteria will probably be revised in the future as more detailed information on bull trout population dynamics becomes available. Given the limited information on bull trout, both the level of adult abundance and the number of local populations needed to lessen the risk of extinction should be viewed as a best estimate.

This approach to developing recovery criteria acknowledges that the status of populations in some core areas may remain short of ideals described by conservation biology theory. Some core areas may be limited by natural attributes or by patch size and may always remain at a relatively high risk of extinction. Because of limited data within the Deschutes Recovery Unit, the recovery unit team relied heavily on the professional judgment of its members.

Local Populations. Metapopulation theory is important to consider in bull trout recovery. A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994). Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events. In part, distribution of local populations in such a manner is an indicator of a functioning core area. Based in part on guidance from Rieman and McIntyre (1993), bull trout core areas with fewer than 5 local populations are at increased risk, core areas with between 5 and 10 local populations are at intermediate risk, and core areas with more than 10 interconnected local populations are at diminished risk. For the lower Deschutes Core Area, there are currently 5 known local populations. Based on the above guidance, bull trout in the Deschutes Recovery Unit is at an intermediate threat category.

Adult Abundance. The recovered abundance levels in the Deschutes Recovery Unit were determined by considering theoretical estimates of effective population size, historical census information, and the professional judgment of recovery team members. In general, effective population size is a theoretical concept that allows us to predict potential future losses of genetic variation within a population due to small population sizes and genetic drift (see Chapter 1). For the purpose of recovery planning, effective population size is the number of adult bull trout that successfully spawn annually. Based on standardized theoretical equations (Crow and Kimura 1970), guidelines have been established for maintaining minimum effective population sizes for conservation purposes. Effective population sizes of greater than 50 adults are necessary to prevent inbreeding depression and a potential decrease in viability or reproductive fitness of a population (Franklin 1980). To minimize the loss of genetic variation due to genetic drift and to maintain constant genetic variance within a population, an effective population size of at least 500 is recommended (Franklin 1980; Soule 1980; Lande 1988). Effective population sizes required to maintain long-term genetic variation that can serve as a reservoir for future adaptations in response to natural selection and changing environmental conditions are discussed in Chapter 1 of the recovery plan.

For bull trout, Rieman and Allendorf (2001) estimated that a minimum number of 50 to 100 spawners per year is needed to minimize potential inbreeding effects within local populations. In addition, a population size of between 500 and 1,000 adults in a core area is needed to minimize the deleterious effects of genetic variation from drift.

For the purposes of bull trout recovery planning, abundance levels were conservatively evaluated at the local population and core area levels. Local populations containing fewer than 100 spawning adults per year were classified as at risk from inbreeding depression. Bull trout core areas containing fewer than 1,000 spawning adults per year were classified as at risk from genetic drift.

Adult abundance in the lower Deschutes River Core Area was estimated at 1,500 and 2,000 adult spawners per year in the 5 known local populations. Based on the aforementioned abundance guidance, bull trout in the Deschutes Recovery Unit was considered to be at an intermediate risk of inbreeding depression.

Productivity. A stable or increasing population is a key criterion for recovery under the requirements of the Endangered Species Act. Measures of the trend of a population (the tendency to increase, decrease, or remain stable) include population growth rate or productivity. Estimates of population growth rate (*i.e.*, productivity over the entire life cycle) that indicate a population is consistently failing to replace itself also indicate an increased risk of extinction. Therefore, the reproductive rate should indicate that the population is replacing itself, or growing.

Since estimates of the total population size are rarely available, the productivity or population growth rate is usually estimated from temporal trends in indices of abundance at a particular life stage. For example, redd counts are often used as an index of a spawning adult population. The direction and magnitude of a trend in the index can be used as a surrogate for the growth rate of the entire population. For instance, a downward trend in an abundance indicator may signal the need for increased protection, regardless of the actual size of the population. A population that is below recovered abundance levels, but that is moving toward recovery, would be expected to exhibit an increasing trend in the indicator.

The population growth rate is an indicator of probability of extinction. This probability cannot be measured directly, but it can be estimated as the consequence of the population growth rate and the variability in that rate. For a population to be considered viable, its natural productivity should be sufficient for the population to replace itself fromgeneration to generation. Evaluations of population status will also have to take into account uncertainty in estimates of population growth rate or productivity. For a population to contribute to recovery, its growth rate must indicate that the population is stable or increasing for a period of time.

Based on the intermediate level of adult abundance and local populations, bull trout in the lower Deschutes Core Area is considered at intermediate risk due to an apparent population trend that is not declining and has low to moderate annual variability (based on 10 years of data).

Connectivity. The presence of the migratory life history form within the Deschutes Recovery Unit was used as an indicator of the functional connectivity of the recovery unit. If the migratory life form was absent, or if the migratory form is present but local populations lack connectivity, the core area was considered to be at increased risk. If the migratory life form persists in at least some local populations, with partial ability to connect with other local populations, the core area was judged to be at intermediate risk. Finally, if the migratory life form was present in all or nearly all local populations, and had the ability to connect with other local populations, the core area was considered to be at diminished risk.

Migratory bull trout may persist in some local populations in the lower Deschutes Core Area and therefore are considered at an intermediate risk.

Recovery Criteria

Recovery criteria for the Deschutes Recovery Unit are the following:

1) **Bull Trout are distributed among five or more local populations in the Deschutes Recovery Unit, with five or more local populations in the**

lower Deschutes Core Area. In a recovered condition the lower Deschutes Core Area would have spawning and rearing populations in the Whitewater River, Jefferson/Candle/Abbot river complex, Canyon/Jack/Heising/mainstem Metolius river complex, Warm Springs River, and Shitike Creek. Existing foraging, migrating, and overwintering habitats in these and other streams in the core area must also be maintained.

The upper Deschutes core habitat could also contain one or more local populations as yet to be identified. Feasibility analyses are needed to assess the potential for reintroducing bull trout into historic habitat in the upper Deschutes core habitat. This is a high priority research need, and should be accomplished by 2003. Additional population studies and a better understanding of bull trout fidelity to their natal streams is needed to better define local populations in the recovery unit.

Bull trout are currently extirpated in the upper Deschutes River. Historic information indicates that bull trout were present in the upper Deschutes River, North Davis Creek, the Little Deschutes River, Crescent Lake, and Crescent Creek. Suitable but undocumented habitat was also identified in the Fall River, Browns Creek, Snow Creek, the Little Deschutes River, Whitefish Creek, Big Marsh Creek, Refrigerator Creek, Hemlock Creek, and Spruce Creek (Riehle and Nolte 1992). Suitable but undocumented habitats are those in which there are no historical records of bull trout use, but which have water temperatures and substrate suitable for bull trout. Recent preliminary investigations by U.S. Fish and Wildlife Service indicate that the Fall River, North Davis Creek, Browns Creek, Snow Creek, Quinn River, Cultus Creek, and the Little Deschutes River tributaries may contain suitable habitat for bull trout. Recovery criteria will be established, if necessary, based on the outcome of further study in the next 2 years.

2) **Estimated abundance of adult bull trout is 1,500 to 3,000 or more in the recovery unit's lower Deschutes Core Area.** Increased population abundance is expected to occur within existing population complexes.

There is potential to expand population abundance in the Warm Springs and Shitike river basins. Spawning habitat in the upper Metolius River, Warm Springs River, and Shitike Creek should to be restored and protected. There are opportunities to protect and expand year round rearing and migration habitat in the lower Deschutes River below the Pelton Round-Butte Project on private, Tribal and public lands. Increased population abundance in the lower Deschutes Core Area is expected to occur by securing the distribution in the Warm Springs River, securing and expanding seasonal distribution in the Crooked and Deschutes rivers above Lake Billy Chinook, and expansion of populations to additional basins such as historic habitat in Mill Creek, Link Creek, Suttle Lake, and Blue Lake.

Opportunities to protect spawning and rearing habitat on private lands through purchase, conservation easement, land exchange or other means should be pursued in the lower Deschutes Core Area. This will address previously identified threats associated with agricultural development, forest practices, grazing, and residential development. Restoration efforts to improve anadromous salmonid production in the lower Deschutes Core Area can be expected to benefit existing and potential migration corridors and overwintering habitat for bull trout as well as improve their prey base.

3) **Adult bull trout exhibit stable or increasing trends in abundance in the recovery unit**. Achievement of this recovery criteria will be based on a minimum of 10 years of monitoring data.

4) **Connectivity criteria will be met when migratory forms are present in all local populations, with intact migratory corridors among all local populations** in core areas providing opportunity for genetic exchange and diversity. In the lower Deschutes Core Area this means addressing upstream and downstream passage at Pelton Round-Butte's dams. Passage barriers at Opal Springs Dam, Link Creek, and upper Squaw Creek must also be addressed. Additional barriers may also be identified.

If reestablishment of bull trout is undertaken in the upper Deschutes core habitat upstream and downstream passage at Wickiup, Crane Prairie, and several privately owned hydropower and irrigation diversion dams must be addressed. Additional barriers may also be identified.Recovery criteria for the Deschutes Recovery Unit were established to assess whether recovery actions are resulting in the recovery of bull trout. The Deschutes Recovery Unit Team expects that the recovery process will be dynamic and will be refined as more information becomes available. While removal of bull trout as aspecies under the Endangered Species Act (*i.e.*, delisting) can only occur for the entity that was listed (Columbia River Distinct Population Segment), the criteria listed above will be used to determine when the Deschutes Recovery Unit is fully contributing to recovery of the population segment.

Research Needs

Based on the best scientific information available, the recovery unit team has identified recovery criteria, and actions necessary for recovery of bull trout within the Deschutes Recovery Unit. However, the recovery unit team recognizes that many uncertainties exist regarding bull trout population abundance, distribution, and needed recovery actions. As part of this adaptive management approach, the Deschutes Recovery Unit Team has identified essential research needs within the recovery unit.

Additional information is needed on bull trout life history and abundance to better estimate adult abundance, monitor genetic health, and assess population viability in the recovery unit. A tentative list includes: 1) annual abundance of breeders per local population and total for the recovery unit; 2) population structure and connectivity; 3) life history characteristics including age at first spawning, incidence, regularity and timing of repeat spawning, and total life span; 4) reproductive success in production of pre-adult offspring; 5) survival rates to breeding adult; and 6) reproductive success in replacement of breeders (K. Kostow, pers. comm., 2001).

Tributaries where there may be isolated bull trout populations, or where anecdotal reports of bull trout capture have occurred should be targeted to clarify bull trout distribution within the recovery unit. These areas include but are not limited to Tumalo Creek in the upper Deschutes core habitat.

Feasibility analysis is needed to assess the potential for reestablishment of bull trout into the upper Deschutes core habitat. Analysis should include: assessments of available habitat for spawning and rearing; subadult/adult foraging, overwintering, and migration corridors; passage barriers; exotic species, as well as the benefits and risks associated with reestablishment. The analysis is a priority one action, and should be completed by 2003.

ACTIONS NEEDED TO INITIATE RECOVERY

Recovery Measures Narrative

In this chapter and all other chapters of the bull trout recovery plan, the recovery measures narrative consists of a hierarchical listing of actions that follows a standard template. The first-tier entries are identical in all chapters and represent general recovery tasks under which specific (*e.g.*, third-tier) tasks appear when appropriate. Second-tier entries also represent general recovery tasks under which specific tasks appear. Second-tier tasks that do not include specific third-tier actions are usually programmatic activities that are applicable across the species' range; they appear in *italic type*. These tasks may or may not have third-tier tasks associated with them; see Chapter 1 for more explanation. Some second-tier tasks may not be sufficiently developed to apply to the recovery unit at this time; they appear in *a shaded italic type (as seen here)*. These tasks are included to preserve consistency in numbering tasks among recovery unit chapters and intended to assist in generating information during the comment period for the draft recovery plan, a period when additional tasks may be developed. Third-tier entries are tasks specific to the Deschutes Recovery Unit. They appear in the implementation schedule that follows this section and are identified by three numerals separated by periods.

The Deschutes Recovery Unit Chapter should be updated or revised as recovery tasks are accomplished, environmental conditions change, and monitoring results or additional information becomes available. The Deschutes Recovery Unit Team should meet annually to review annual monitoring reports and summaries, and make recommendations to the U.S. Fish and Wildlife Service.

1 Protect, restore, and maintain suitable habitat conditions for bull trout.

1.1 Maintain or improve water quality in bull trout core areas or potential core habitat.

1.1.1 Stabilize roads, crossings, and other sources of sediment delivery.

1.2 Identify barriers or sites of entrainment for bull trout and implement tasks to provide passage and eliminate entrainment.

1.2.1 Screen water diversions and irrigation ditches.

1.2.2 Restore connectivity and opportunities for migration by securing instream flows and/or water rights in Squaw Creek, Lake Creek, the middle Deschutes, and lower Crooked. (Using the Oregon Department of Fish and Wildlife's prioritization process.) Possible water rights applications through which instream rights could be secured include:

Application No. 70087 on the Deschutes
Application No. 70695 on the Deschutes
Application No. 71194 on the Deschutes
Application No. 73220 on the Metolius
Application No. 73221 on the Metolius
Application No. 73223 on Squaw Creek
Application No. 70693 on Canyon Creek
Application No. 70694 on Candle Creek
Application No. 70696 on Jack Creek
Application No. 70697 on Jefferson Creek
Application No. 70766 on Abbot Creek

1.2.3 Restore passage at Pelton Round-Butte and include a monitoring strategy. A Portland General Electric/Tribal proposal for experimental passage is currently being drafted as part of the long-term passage plan. If approved it would be implemented in 2006.

1.2.4 Restore passage at Opal Springs hydro project and include a monitoring strategy.

1.2.5 Restore passage to Blue Lake and include a monitoring strategy.

1.2.6 Restore passage to upper Squaw Creek and include a monitoring strategy.

1.3 Identify impaired stream channel and riparian areas and implement tasks to restore their appropriate functions.

1.3.1 Revegetate to restore shade and canopy, riparian cover, and native vegetation along mainstem lower Deschutes River, Crooked River and Squaw Creek.

1.3.2 Reduce grazing impacts with current, proven technology, e.g., fencing, changes in timing and use of riparian pastures, off-site watering, and salting along the mainstem lower Deschutes River, Crooked River, and Squaw Creek.

1.3.3 Increase or improve instream habitat by restoring recruitment of large woody debris or by using other methodologies; possibilities include lower Lake Creek and the upper mainstem Metolius.

1.4 Operate dams to minimize negative effects on bull trout in reservoirs and downstream.

1.4.1 Review reservoir operational concerns such as water level manipulation, entrainment, etc., such as at Pelton Round-Butte. Provide operating recommendations

through Federal Energy Regulatory Commission relicensing process and/or Federal consultation.

1.4.2 Maintain instream flows downstream from dams and Reservoirs, including Bowman Dam.

1.4.3 Meet Tribal, State, and Federal water quality standards downstream from hydropower dam, Federal dams, and irrigation diversions, e.g., temperature, nitrogen, etc.

1.5 Identify upland conditions negatively affecting bull trout habitats and implement tasks to restore appropriate functions.

1.5.1 Complete watershed assessment for applicable streams, such as the Crooked River.

1.5.2 Assess feasibility of reintroducing bull trout in the upper Deschutes, including an assessment of the capacity of habitat in the upper Deschutes to support self-sustaining populations of bull trout.

1.6 Identify where conditions outside of riparian areas such as uplands which are negatively affecting bull trout habitats and implement tasks to restore appropriate functions.

1.6.1 Assess current risk of catastrophic fire to bull trout populations. Take corrective action to reduce risk of catastrophic fire to bull trout populations.

2 Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.

2.1 Develop, implement, and enforce public and private fish stocking policies to reduce stocking of nonnative fishes that affect bull trout.

2.2 Evaluate enforcement of policies for preventing illegal transport and introduction of nonnative fishes.

2.3 Provide information to the public about ecosystem concerns of illegal introductions of nonnative fishes.

2.4 Evaluate biological, economic, and social effects of control of nonnative fishes.

2.5 Implement control of nonnative fishes where found to be feasible and appropriate.

2.6 Develop tasks to reduce negative effects of nonnative taxa on bull trout.

3 Establish fisheries management goals and objectives compatible with bull trout recovery, and implement practices to achieve goals.

3.1 Develop and implement State and Tribal native fish management plans integrating adaptive research.

3.1.1 Incorporate bull trout recovery actions into Oregon Department of Fish and Wildlife Deschutes basin fish management plans, the Oregon Plan for Salmon and Watersheds, and the Pacific Northwest Power Planning Council Subbasin plans. Request assistance with implementation of recovery strategies for bull trout through all three plans.

3.1.2 Coordinate and include bull trout recovery with recovery efforts, management plans, etc. of other species, e.g., chinook salmon.

3.2 Evaluate and prevent overharvest and incidental angling mortality of bull trout.

3.3 Evaluate potential effects of introduced fishes and associated sport fisheries on bull trout recovery and implement tasks to minimize negative effects on bull trout.

3.4 Evaluate effects of existing and proposed sport fishing regulations on bull trout.

4 Characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout.

4.1 Incorporate conservation of genetic and phenotypic attributes of bull trout into recovery and management plans.

4.1.1 Collect samples for genetic analysis to contribute to establishing a program to understand the genetic baseline and monitor genetic changes throughout the range of bull trout.

4.1.2 Manage local populations (numbers and life forms) to maintain long-term viability.

4.2 Maintain existing opportunities for gene flow among bull trout populations.

4.3 Develop genetic management plans and guidelines for appropriate use of transplantation and artificial propagation.

5 Conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks.

5.1 Design and implement a standardized monitoring program to assess the effectiveness of recovery efforts affecting bull trout and their habitats.

5.1.1 Coordinate bull trout recovery monitoring in the Deschutes basin with the Oregon Plan for Salmon and Watersheds monitoring program.

5.2 Conduct research evaluating relationships among bull trout distribution and abundance, bull trout habitat, and recovery tasks.

5.3 Conduct evaluations of the adequacy and effectiveness of current and past best management practices in maintaining or achieving habitat conditions conducive to bull trout recovery.

5.4 Evaluate effects of diseases and parasites on bull trout, and develop and implement strategies to minimize negative effects.

5.4.1 Monitor for effects of fish pathogens on Oregon bull trout populations. Follow Oregon Department of Fish and Wildlife pathology department protocols (in development) for handling and disposition of bull trout mortalities, e.g., submission to Oregon Department of Fish and Wildlife fish pathology laboratories for disease assessment.

5.5 Develop and conduct research and monitoring studies to improve information concerning the distribution and status of bull trout.

5.5.1 Conduct periodic surveys in potential habitat currently accessible to bull trout, but where bull trout status is unknown or recolonization is anticipated. This could include Link Creek and Mill Creek.

5.5.2 Determine movement and seasonality of use of different habitat types of adult and sub-adult migratory bull trout in multiple drainages, with emphasis on lakes, reservoirs, and mainstem rivers.

5.6 Identify evaluations needed to improve understanding of relationships among genetic characteristics, phenotypic traits, and local populations of bull trout.

6 Use all available conservation programs and regulations to protect and conserve bull trout and bull trout habitats.

6.1 Use partnerships and collaborative processes to protect, maintain, and restore functioning core areas for bull trout.

6.1.1 Develop an outreach program to guide interaction with watershed councils and other entities in the basin. Disseminate information to a wide variety of interests groups and educational institutions via publications, world wide web, and presentations. Develop and implement processes to involve interested public by promoting public involvement in recovery projects, and providing for public review of conservation strategies.

6.2 Use existing Federal authorities to conserve and restore bull trout.

6.2.1 Identify opportunities to incorporate bull trout recovery actions into hydro- relicensing projects in the Deschutes basin.

6.3 Evaluate enforcement of existing Federal, State, and Tribal habitat protection standards and regulations and evaluate their effectiveness for bull trout conservation.

7. Assess the implementation of bull trout recovery by recovery units, and revise recovery unit plans based on evaluations.

7.1 Convene annual meetings of each Recovery Unit Team to review progress on recovery plan implementation.

7.1.1 Develop a Participation Plan to support implementation in the recovery unit.

7.2 Assess effectiveness of recovery efforts.

7.3 Revise scope of recovery as suggested by new information.

IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows describes recovery task priorities, task numbers, task descriptions, duration of tasks, potential or participating responsible parties, total cost estimate and estimates for the next 5 years, if available, and comments. These tasks, when accomplished, will lead to recovery of bull trout in the coterminous United States as discussed in Chapter 1 of this Draft Bull Trout Recovery Plan.

Parties with authority, responsibility, or expressed interest to implement a specific recovery task are identified in the Implementation Schedule. Listing a responsible party does not imply that prior approval has been given or require that party to participate or expend any funds. However, willing participants will benefit by demonstrating that their budget submission or funding request is for a recovery task identified in an approved recovery plan, and is therefore part of a coordinated recovery effort to recover bull trout. In addition, section 7(a)(1) of the Endangered Species Act directs all Federal Agencies to use their authorities to further the purposes of the Act by implementing programs for the conservation of threatened or endangered species.

Priority Number: All priority 1 tasks are listed first, followed by priority 2 and priority 3 tasks.

Priority 1: All actions that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2: All actions that must be taken to prevent a significant decline in species' population or habitat quality, or to prevent some other significant negative effect short of extinction.

Priority 3: All other actions necessary to provide for full recovery (or reclassification) of the species.

Task Number and Task Description: Recovery tasks as numbered in the recovery outline. Refer to the Narrative for task descriptions.

Task Duration: Expected number of years to complete the corresponding task. Study designs can incorporate more than one task, which when combined can reduce the time needed for task completion.

Responsible or Participating Party: The following organizations are those with responsibility or capability to fund, authorize, or carry out the corresponding recovery tasks.

Recovery Unit Team (RUT)

Federal Agencies:

USFWS	U.S. Fish and Wildlife Service
NMFS	National Marine Fisheries Service
USCOE	U.S. Corps of Engineers
USFS	United States Forest Service
BIA	Bureau of Indian Affairs
USEPA	U.S. Environmental Protection Agency
USBOR	U.S. Bureau of Reclamation
BLM	U.S. Bureau of Land Management
NRCS	U.S. Natural Resources Conservation Service
USGS	U.S. Geologic Service

State Agencies:

ODFW	Oregon Department of Fish and Wildlife
ODEQ	Oregon Department of Environmental Quality
ODOF	Oregon Department of Forestry
OWRD	Oregon Water Resources Department
OSP	Oregon State Police

Other Agencies:

CTWS	Confederated Tribes of the Warm Springs Indian Reservation
CD	Conservation Districts

UPRR	Union Pacific Railroad
RUT	Recovery Unit Team TMDLWG Total Maximum Daily Load working group
WC	Watershed Councils
ID	Irrigation districts
DWC	Deschutes Watershed Council
PGE	Portland General Electric
ES	Extension Service
COID	Central Oregon Irrigation District
NGOs	Non-governmental organizations
LCDC	Oregon Land Conservation and Development Commission
DBLT	Deschutes Basin Land Trust
DRC	Deschutes Resources Conservancy

Bolded type indicates the agency or agencies that have the lead role for task implementation and coordination, though not necessarily sole responsibility.

Cost estimates: Cost estimates are rough approximations and are provided only for general guidance. Total costs are estimated for the duration of the task ad also itemized annually for the next five years. Total costs include estimates of expenditures by local, Tribal, State, and Federal governments and by private business and individuals. These costs are attributed to bull trout conservation but other aquatic species will also benefit. Cost estimates are not provided for tasks which are normal agency responsibilities under existing authorities.

An asterisk (*) in the total cost column indicates ongoing tasks that are currently being implemented as part of normal agency responsibilities under existing authorities. Because these tasks are not being done specifically or solely for bull trout conservation, they are not included in the cost estimates. Some of these efforts may be occurring at reduced funding levels and/or in only a small portion of the watershed.

Implementation schedule for the Deschutes Recovery Unit										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimates (in $1,000 units)**					**Comments**
					Total Costs	**FY 1**	**FY 2**	**FY 3**	**FY 4**	
2	1.2.3	Restore passage at Pelton/Round Butte, include monitoring strategy. PGE/WSPE proposal for experimental passage currently being drafted. If approved it would be implemented in 2006.	10 years	**PGE/WSPE**	*					Covered under existing programs *
2	1.3.3	Increase or improve instream habitat by restoring recruitment of large woody debris or other means; mainstem Metolius.	25 years	**USFS**, landowners	250	10	10	10	10	Covered under existing programs; action needs funds due to USFS funding reductions
2	6.2.1	Identify opportunities to incorporate bull trout recovery actions into hydro-relicensing projects in the Deschutes basin.	25 years	**FWS**, NMFS, ODFW	*					Covered under existing programs *
2	7.1.1	Develop a Participation Plan to support implementation in the recovery unit.	25 years	**RUT**	*					Covered under existing programs *
3	1.1.1	Stabilize roads, crossings, and other sources of sediment delivery.	25 years	**RUT**	200	60	60	60	60	Covered under existing programs

Implementation schedule for the Deschutes Recovery Unit										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimates (in $1,000 units)**					**Comments**
					Total Costs	**FY 1**	**FY 2**	**FY 3**	**FY 4**	
3	1.2.1	Screen water diversions and irrigation ditches.	10 years	**ODFW**	200	20	20	20	20	Covered under existing programs
3	1.2.2	Restore connectivity and opportunities for migration by securing instream flows and/or water rights in Squaw Creek, Lake Creek, middle Deschutes, and lower Crooked.	25 years	**ODFW**, OWRD, ID, BOR, Private Irrigators	400	100	100	100	100	Covered under existing programs
3	1.2.4	Restore passage at Opal Springs Dam, including monitoring strategy.	5 years	**DVWD**, BOR, FWS	*					Covered under existing programs *
3	1.2.6	Restore passage to upper Squaw Creek, include a monitoring strategy.	10 years	**ODFW**, ID, Private Irrigators	100	UK	UK	UK	UK	Covered under existing programs
3	1.3.1	Revegetate to restore shade and canopy, riparian cover, and native vegetation along mainstem lower Deschutes River, Crooked River and Squaw Creek.	25 years	**BLM**, DEQ, BIA, USFS, DRC, landowners	250	20	20	20	20	Covered under existing programs

Implementation schedule for the Deschutes Recovery Unit										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimates (in $1,000 units)**					**Comments**
					Total Costs	**FY 1**	**FY 2**	**FY 3**	**FY 4**	
3	1.3.2	Reduce grazing impacts with current, proven technology, e.g., fencing, changes in timing and use of riparian pastures, off-site watering, and salting along the mainstem lower Deschutes River, Crooked River, and Squaw Creek.	25 years	**BLM**, DEQ, BIA, USFS, DRC, landowners	250	20	20	20	20	Covered under existing programs
3	1.4.1	Review reservoir operational concerns such as water level manipulation, entrainment, etc., such as at Pelton Round-Butte. Provide operating recommendations through FERC relicensing process and/or Federal consultation.	25 years	**PGE/WSPE**	*					Covered under existing programs *
3	1.4.2	Maintain instream flows downstream from dams and reservoirs, including Bowman Dam.	25 years	**BOR**, FWS, NMFS, ODFW	*					Covered under existing programs *
3	1.4.3	Meet Tribal, State, and Federal water quality standards downstream from hydropower dam, Federal dams, and irrigation diversions, e.g., temperature, nitrogen, etc.	25 years	**EPA**/CTWS/ BIA, ID, DEQ, OWRD	*					Covered under existing programs *

Implementation schedule for the Deschutes Recovery Unit										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimates (in $1,000 units)**					**Comments**
					Total Costs	**FY 1**	**FY 2**	**FY 3**	**FY 4**	
3	1.5.1	Complete watershed assessment for applicable streams, such as the Crooked River.	2 years	**USFS**, **UDWC**	100	25	25	25	25	Covered under existing programs
1	1.5.2	Assess feasibility of reestablishing bull trout in the upper Deschutes core habitat, including an assessment of the capacity of habitat in the upper Deschutes to support self-sustaining populations of bull trout.	2 years	**RUT**, USFWS, BOR, ODFW	200	100	100	0	0	BOR consultation with FWS and NMFS is ongoing.
3	1.6.1	Assess current risk of catastrophic fire to bull trout populations. Take corrective action to reduce risk of catastrophic fire to bull trout populations.	25 years	**USFS**	*					Covered under existing programs *
3	3.1.1	Incorporate bull trout recovery actions into ODFW Deschutes basin fish management plans, the Oregon Plan for Salmon and Watersheds, and the Pacific Northwest Power Planning Council Subbasin plans. Request assistance with implementation of recovery strategies for bull trout through all three plans.	25 years	**RUT/ODFW**	*					Covered under existing programs *

Implementation schedule for the Deschutes Recovery Unit										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimates (in $1,000 units)**					**Comments**
					Total Costs	**FY 1**	**FY 2**	**FY 3**	**FY 4**	
3	3.1.2	Coordinate bull trout recovery with recovery efforts, management plans, etc. of other species, e.g., chinook salmon.	25 years	**RUT**	*					Covered under existing programs *
3	4.1.1	Collect samples for genetic analysis to contribute to establishing a program to understand the genetic baseline and monitor genetic changes throughout the range of bull trout.	25 years	**FWS**	*					Covered under existing programs *
3	4.1.2	Manage local populations (numbers and life forms) to maintain long-term viability.	25 years	**FWS**	*					Covered under existing programs *
3	5.1.1	Coordinate bull trout recovery monitoring in the Deschutes Basin with the Oregon Plan for Salmon and Watersheds monitoring program.	25 years	**ODFW**	*					Covered under existing programs *
3	5.4.1	Monitor for effects of fish pathogens on Oregon bull trout populations. Follow ODFW pathology department protocols (in development) for handling and disposition of bull trout mortalities, e.g., submission to ODFW fish pathology laboratories for disease assessment.	25 years	**ODFW**, RUT PGE, WSPE	*					Covered under existing programs *

Implementation schedule for the Deschutes Recovery Unit										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimates (in $1,000 units)**					**Comments**
					Total Costs	**FY 1**	**FY 2**	**FY 3**	**FY 4**	
3	5.5.1	Conduct periodic surveys in potential habitat currently accessible to bull trout, but where bull trout status is unknown or recolonization is anticipated. This could include Link Creek and Mill Creek.	25 years	**RUT**	120	30	30	30	30	Covered under existing programs
3	5.5.2	Determine movement and seasonality of use of different habitat types of adult and subadult migratory bull trout in multiple drainages, with emphasis on lakes, reservoirs, and mainstem rivers.	25 years	**RUT**	*					Covered under existing programs *
3	6.1.1	Develop an outreach program to guide interaction with watershed councils and other entities in the basin. Disseminate information to a wide variety of interests groups and educational institutions via publications, world wide web, and presentations. Develop and implement processes to involve interested public by promoting public involvement in recovery projects, and providing for public review of conservation strategies.	4 years	**RUT,** DRC	20	5	5	5	5	

* Ongoing tasks are currently being implemented as part of normal agency responsibilities that may benefit bull trout. Because these actions are not specifically or solely being done to address bull trout conservation, they are not included in the cost estimates. Some of these efforts may be occurring at reduced funding levels and / or in only a small portion of the watershed.

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APPENDIX A: LIST OF CHAPTERS