Chapter: 8

State(s): Oregon

Recovery Unit Name: Odell Lake

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

DISCLAIMER

Recovery plans delineate reasonable actions that are believed necessary to recover and protect listed species. 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 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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ACKNOWLEDGMENTS

The Odell Lake bull trout working group was established in the early 1990's for the purpose of determining the status of bull trout in Odell Lake. The formation of the working group originally consisted almost totally of area biologists from ODFW and the USFS. It was expanded to include other affected interests in 1996 and to develop a conservation strategy for Odell Lake bull trout. The Odell Lake bull trout working group became the Recovery Unit Team when bull trout were listed in 1998.

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ODELL LAKE RECOVERY UNIT CHAPTER OF THE BULL TROUT RECOVERY PLAN

EXECUTIVE SUMMARY

CURRENT SPECIES STATUS

The U.S. Fish and Wildlife Service issued a final rule listing the Columbia River populations of bull trout (*Salvelinus confluentus*) as a threatened species under the Endangered Species Act on June 10, 1998 (63 FR 31647). The Odell Lake Recovery Unit encompasses an area of approximately 302 square kilometers. It is located within the Deschutes National Forest in Deschutes and Klamath Counties, Oregon. The Odell Lake Recovery Unit consists of Odell and Davis Lakes, and their tributaries, and Odell Creek, that flows downstream from Odell Lake to Davis Lake. The lakes were isolated from the Deschutes River by a lava flow about 5,500 years ago that impounded Odell Creek and formed Davis Lake. The lava flow isolated bull trout in Odell Lake from bull trout in the rest of the upper Deschutes Basin.

HABITAT REQUIREMENTS AND LIMITING FACTORS

A detailed discussion of bull trout biology and habitat requirements are provided in Chapter 1 of this recovery plan. The limiting factors discussed here are specific to the Odell Lake Recovery Unit chapter. Within the recovery unit, historical and current land use activities have impacted bull trout local populations. Limiting factors include competition with other fish species for resources, hybridization with brook trout, limited spawning and rearing habitat in the tributaries of Odell Lake, partial barriers created at railroad crossings of the spawning tributaries, and habitat degradation due to large woody debris removal, intentional channelization of streams, and loss of riparian cover.

RECOVERY GOALS AND OBJECTIVES

The goal for bull trout recovery is to **ensure the long-term persistence of self-sustaining complex, interacting groups of bull trout distributed across the species native range, so that the species can be delisted.** To accomplish this goal the following four objectives were identified for bull trout in the Odell Lake Recovery Unit.

- Maintain the current distribution of bull trout and restore distribution in previously occupied habitats within the Odell Lake 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 forms.

- Conserve genetic diversity and provide opportunity for genetic exchange.

RECOVERY CRITERIA

Recovery criteria for the Odell Lake Recovery Unit reflect the stated objectives, evaluation of population status, and recovery actions necessary to achieve the overall goal. Recovery criteria identified for the Odell Lake Recovery Unit are as follows.

1. **Bull trout are distributed among one or more local populations in the recovery unit, depending on whether fish are found to exhibit homing fidelity to individual streams**. In a recovered condition the Odell Lake Recovery Unit would include Trapper Creek and at least one additional local population. 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. Addition of at least one more local population would demonstrate that suitable habitat is being restored and maintained.

2. **Estimated abundance of adult bull trout is 200 or more adults distributed in one core area**. Recovered abundance was derived using the professional judgement of the Team and estimation of productive capacity of identified local populations. Increased abundance will reduce the risk of genetic complications in the Odell Lake population due to extremely small population size.

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 recovery unit providing opportunity for genetic exchange and diversity**. Barriers to connectivity within the Odell Lake Recovery Unit will be addressed by eliminating entrainment in diversions (for example, the Willamette Pass ski area) and providing passage at dams (for example, in Crystal Creek and Odell Creek). Maintaining access to Odell Lake for recovered local populations will ensure opportunities for genetic exchange (see tasks # 1.2.1 and 1.2.2).

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 and access to conditions that allow for the expression of various life-history forms. Seven categories of actions are discussed in Chapter1; tasks specific to this recovery unit are provided in this chapter.

ESTIMATED COST OF RECOVERY

Total estimated cost of bull trout recovery in the Odell Lake Recovery Unit is estimated at about $1.6 million spread over a 25-year recovery period.

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. These costs are attributed to bull trout conservation but other aquatic species will also benefit.

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. It may be 3 to 5 bull trout generations (15 to 25 years), or possibly longer, may be necessary before significant reductions can be made in the identified threats to the species and bull trout can be considered eligible for delisting.

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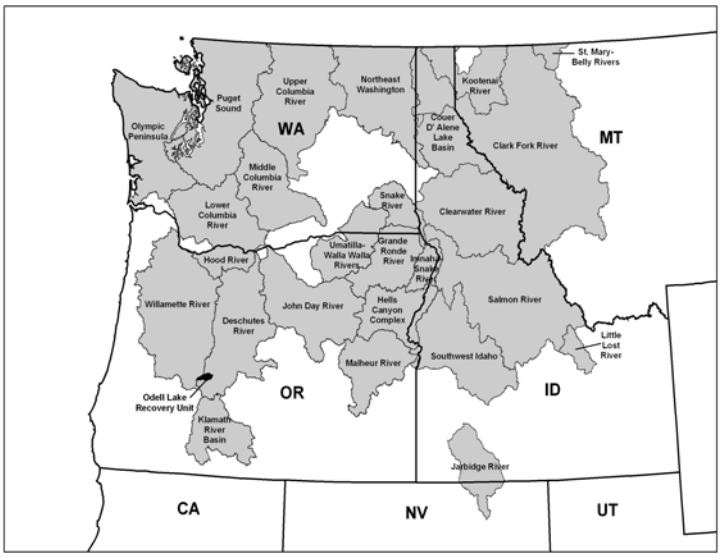
INTRODUCTION

Recovery Unit Designation

The Odell Lake Recovery Unit consists of Odell and Davis Lakes, the streams draining into them, and Odell Creek, that flows downstream from Odell Lake to Davis Lake (Figure 1). The lakes were isolated from the Deschutes River by a lava flow about 5,500 years ago that impounded Odell Creek and formed Davis Lake (U.S. Forest Service (USFS)1994). The lava flow isolated bull trout in Odell Lake from bull trout in the rest of the upper Deschutes Basin.

Although Odell Lake bull trout are included in the Deschutes Gene Conservation Group (GCG) by Oregon Department of Fish and Wildlife, due to their natural isolation from other Deschutes River bull trout populations and for administrative and logistical reasons, Odell Lake bull trout are considered a

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



separate recovery unit. At the time of listing Odell Lake and Deschutes River bull trout populations were managed in different Oregon Department of Fish and Wildlife administrative units, as well as different U.S. Forest Service ranger districts.

Geographic Description

The Odell Lake watershed[1] drains an area of approximately 302 square kilometers (117 square miles) of the slope of the Cascade Mountains crest in Central Oregon (USFS 1999a). Elevations range from 2,667 meters (8,748 feet) Diamond Peak to 1,459 meters (4,786 feet) at Odell Lake to 1,337 meters (4,385 feet) at Davis Lake (Johnson *et al.* 1985). The entire watershed lies within the Deschutes National Forest in Deschutes and Klamath Counties, Oregon. Diamond Peak Wilderness occupies the western portion of the watershed from Diamond Peak to the western shore of Odell Lake, approximately 15 percent of the recovery unit. In non-wilderness areas, two resorts, five campgrounds and over sixty summer homes have been developed on the shores of Odell Lake, while Davis Lake has three campgrounds. Recreational use in the area includes such activities as skiing, fishing, camping, hiking, and other activities common to National Forest areas. Crescent Lake Junction, just outside of the watershed boundaries, is the nearest community (Fies *et al*. 1999).

The Odell Lake watershed is part of the High Cascades Ecoregion and consists of basalt, andesite, and basaltic eruptive complexes that have formed volcanoes. Associated lava fields and the volcanoes themselves have been eroded over time by glaciers. Glacial landforms include cirques, valleys, and various types of moraines. Soils are highly influenced by ash and pumice deposits from the Mount Mazama eruption, which occurred approximately 6,700 years ago (USFS 1999a; U.S. Forest Service and Bureau of land Management (USFS and

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The Odell watershed as defined in this document includes the three subwatersheds included in the Odell Watershed Analysis (U.S. Forest Service (USFS) 1999a), *i.e.*, Odell Lake, Odell, and Moore subwatersheds. Mapping units are based on the sixth field hydrologic units (170703010802 and 170703010803) mapped for the Interior Columbia Basin Ecosystem Management Process.

BLM) 1999). The lava flow that dammed Odell Creek and gave rise to Davis Lake occurred after the eruption of Mount Mazama, and is not covered by its pumice (Johnson *et al.* 1985).

The Odell Lake watershed is affected by moist low pressure weather systems approaching from the Pacific Ocean. However, these systems lose much of their moisture as they pass over the Coast and Cascade Mountain ranges; as a result, the watershed represents a drier modified continental climate. Up to 203 centimeters (80 inches) of precipitation occurs annually on the slopes of Diamond Peak; precipitation decreases with distance from the crest of the Cascade Mountains range to about 66 centimeters (26 inches) annually at Davis Lake, about 6 to 9 kilometers (10 to 14 miles) northeast of the eastern shores of Odell Lake. Summers are characterized by fair, dry weather with temperatures rarely exceeding 32 degrees Celsius (90 degrees Fahrenheit), and low humidity. Winters reflect the high altitude, with snowfall ranging from 76 to 305 centimeters (30 to 120 inches) annually and temperatures as low as -6 degrees Celsius (-20 degrees Fahrenheit) (USFS 1999a).

Odell Lake is a natural lake, approximately 1,457 hectares (3,600 acres) in surface area, with an average depth of 40 meters (131 feet) and a maximum depth of 86 meters (282 feet) (Johnson *et al.* 1985). Water temperatures range from summer surface temperatures approaching 21 degrees Celsius (70 degrees Fahrenheit) to 2 degrees Celsius (39 degrees Fahrenheit) at deeper levels year-around. The lake surface occasionally freezes. Approximately 38 kilometers (24 miles) of tributary streams flow into Odell Lake, the largest is Trapper Creek. Trapper Creek drains a glacial till zone and is the only tributary of Odell Lake that responds to runoff events. Because of the porosity of the soils, most of the basin exhibits little fixed drainage patterns. Instead, precipitation is absorbed into the ground and subsequently released through springs. Odell Lake is bound on the east by a glacial moraine. Odell Creek is the sole outlet from Odell Lake, running northeast to Davis Lake. Maklaks Creek, a tributary to Odell Creek, is an important cold water source to Odell Creek (USFS 1999a; U.S. Forest Service and Bureau of land Management (USFS and BLM) 1999). Other cold water tributaries to Odell Creek include NoName and McChord Cabin Creeks.

Davis Lake is about 1,578 hectares (3,900 acres) and is quite shallow with a maximum depth of 6.1 meters (20 feet). It receives inflow from Odell, Ranger, and Moore Creeks, as well as subsurface springs. Davis Lake has no surface outlet, however, many seeps in the lava flow allow water into Wickiup Reservoir, which drains to the northeast of Davis Lake. During the summer the outflow exceeds inflow causing the lake level to drop by as much as 1 meter (about 3 feet) between spring and fall (Johnson *et al.* 1985).

Plant communities upslope of Odell Lake are predominantly mountain hemlock (*Tsuga mertensiana*) or mountain hemlock/lodgepole pine (*Pinus contorta*). Other plant association groups upslope of the lake are mixed conifer wet and mixed conifer dry. The dominant riparian vegetation is mountain alder (*Alnus incana*) with some Engelmann spruce (*Picea engelmannii*) and grand fir (*Albies grandis*). Other riparian conifers include Douglas fir (*Pseudotsuga menziesi*), sub-alpine fir (*Abies lasiocarpa*), grand fir, and mountain hemlock. The subdominant shrub association is huckleberry (*Vaccinium* spp.) and sedges (*Carex spp*.). Riparian vegetation conditions throughout the watershed are excellent, except in localized recreation sites where human influences have altered the form and function of riparian and floodplain areas (USFS and BLM 1999).

The Odell Lake watershed includes many recreation sites, and its water features have attracted users from prehistoric times to the present. During prehistoric times, the watershed was part of a vast territory shared by several nomadic Indian tribes. Data suggest human presence and utilization of local resources up to 7,550 years ago (prior to the eruption of Mount Mazama approximately 6,700 years ago). The area later became part of the territory of the Klamath Tribe. The area is rich in archaeological resources, but many have been degraded as a result of intensive development and recreational use around Odell Lake. The Klamath Tribe is concerned about the retention of the integrity of Odell Lake and other sites in the area, which may have been used as vision quest sites (USFS 1999a).

During the late 1800's, the flat terrain around Odell Lake and low elevation of Willamette Pass were utilized to route railroads and highways

through the Cascades to the Willamette Valley. This opened up the area to commercial traffic through and recreation. By the late 1920's there were railroad stations, two resorts, and several summer homes around Odell Lake. In 1939, the Willamette Pass Ski Area was developed. These facilities make the area a destination for many people, providing a stable flow of income for resorts, businesses in Crescent Lake Junction, campground concessionaires, and the Willamette Pass Ski Area (USFS 1999a).

Historical management of Odell Lake watershed has centered around transportation routes through the Cascades, accommodating recreational use and the fishery at Odell Lake. The Deschutes National Forest Land and Resource Management Plan (U.S. Forest Service (USFS) 1990) allocates the majority of the area for intensive summer and winter recreational use. In 1994, the Record of Decision for the Northwest Forest Plan (USFS and BLM 1994) amended the Deschutes Forest Plan and designated this area to three allocations: Administratively Withdrawn Areas, Late-Successional Reserves, and Riparian Reserves. Other areas potentially important to bull trout recovery are similarly allocated: Odell Creek to Late-Successional Reserves and Riparian Reserves, and Davis Lake to Administratively Withdrawn Areas, Late-Successional Reserves, and Riparian Reserves. These actions shifted the priority for the watershed from one of providing recreational use sites in riparian areas to protecting riparian areas from degradation (USFS 1999a).

Fish Species. Bull trout, mountain whitefish (*Prosopium williamsonus*), and redband trout (*Oncorhynchus mykiss*) are native to Odell and Davis Lakes. As a result of several introductions, the species inhabiting Odell Lake now include rainbow and lake trout (*Salvelinus namaycush*), kokanee salmon (*Oncorhynchus nerka*), and tui chub (*Gila bicolor*). Brook trout (*Salvelinus fontinalis*) have been stocked in tributary streams to Odell and Davis Lakes, but have not been documented in the lakes. Tui chub were introduced sometime before 1940. Lake trout may have been introduced into Odell Lake as early as the 1900's. Historical accounts indicate that rainbow trout were stocked in 1913 to 1914. According to available Oregon Department of Fish and Wildlife records, rainbow trout were first stocked in 1926. Numerous releases occurred until 1962, when stocking was discontinued. Sockeye salmon were planted into Odell Lake in 1932; kokanee

salmon were stocked annually between 1950 and 1971, and 1981 to 1983 (Fies *et al*. 1996). Odell Lake supports a large fishery, including kokanee salmon and lake trout. Odell Lake is considered to be one of the best deep water, recreational fisheries in Oregon (USFS 1999a).

A variety of fish species have been stocked in Davis Lake over the years beginning in 1936, including rainbow trout, kokanee, coho, fall chinook, and Atlantic salmon (Fies *et al*. 1996). Species currently found in Davis Lake and its tributaries include rainbow trout, mountain whitefish, Atlantic salmon, brook trout, tui chub, and largemouth bass. The largemouth bass were the result of an unauthorized introduction (Fies *et al*. 1996). Bull trout are occasionally reported in Davis Lake, but lake conditions in the summer are considered hostile for most salmonids and they are restricted to cold water refuges.

DISTRIBUTION AND ABUNDANCE

Status of Bull Trout at the Time of Listing

Buchanan *et la* (1997) classified bull trout in Odell Lake as at "High Risk" of extinction. At the time of listing, the U.S. Fish and Wildlife Service considered the Odell Lake population to be at risk of extirpation from random naturally-occurring events, due to its inability to be refounded and single life-history form and spawning area (63 FR 31647).

Current Distribution and Abundance

Bull trout are occasionally encountered in Odell Creek (U.S. Forest Service *in litt.* 2001), but are not known to spawn there. Bull trout were encountered in Davis Lake as recently as 1950 (USFS 1999a; USFS and BLM 1999; Northwest Power Planning Council (Northwest Power Planning Council (NPPC) 2001), and one was caught by an angler in June of 2000, at the Davis Lake inlet of Odell Creek (S. Marx, ODFW, pers. comm., 2001). Bull trout historically used Crystal Creek (Oregon State Game Commission (OSGC) 1947), but have not been observed there in recent years (USFS 1994). Crystal Creek is a spring-driven system containing approximately one mile of low gradient fish habitat. Historically, bull trout used Crystal Creek (OSGC 1947), but currently it is used extensively by kokanee salmon during the spawning season. Redband trout are present, but in low numbers. The lower 0.8 kilometer (0.3 mile) of stream contains excellent rearing habitat for fish, because of the low gradient, extensive pool formation, and an abundant large wood supply (USFS and BLM 1999). Ideal spawning gravels in Crystal Creek are low due to the contribution of source material from the watershed into the stream and the gradient alteration created by a culvert at a railroad crossing. The spawning gravels and the jump and rest pool at the culvert crossing were improved in 1994 (USFS 1994). The shallow bay into which Crystal Creek empties may be a thermal barrier to bull trout. Biologists continue to investigate limiting factors in Crystal Creek.

Odell Lake is the only remaining natural adfluvial population of bull trout in Oregon. Little is known about its life history (USFS and BLM 1999). Spawning has been observed only in Trapper Creek during the months of August, September, and October (Sanchez 1998, Dachtler and Sanchez 2000, Oregon Fish and Wildlife (ODFW) 1999) Trapper Creek is the only tributary to Odell Lake with a known rearing and spawning population of bull trout. This habitat occurs in the lower 1.3 kilometers (0.8 mile) of Trapper Creek between the mouth and a 2.3 meter (7.5 feet) barrier waterfall. A 1996 USFS habitat survey found 35 percent of the total habitat units in Trapper Creek had bull trout-size spawning gravels; however, this is not all suitable spawning habitat because other factors, such as water depth and velocity, were not appropriate for spawning. In addition, large numbers of kokanee salmon redds may be superimposed on bull trout redds, which may have an effect on bull trout egg survival (USFS and BLM 1999). The 1996 survey found only five side channels for rearing, constituting only 5 percent of the total habitat area in the 1.3 kilometer (0.8 mile) reach of Trapper Creek (USFS and BLM 1999).

Bull trout population size in the Odell Lake Recovery Unit remains unknown. Angler observations of bull trout incidentally caught have been increasing since the harvest of bull trout was prohibited in 1991 (Buchanan *et al*. 1997). Bull trout captured incidentally have been estimated at 16 in 1996, 0 in 1997, 14 in 1998, and 30 in 1999 (ODFW *in litt.*, 2001b). Data on incidental catch were not collected in 2000 or 2001.

Night snorkeling surveys conducted in Trapper Creek in 1996 found 26 juvenile bull trout ranging from age 0 or greater (20 to 40 millimeters (.79 to 1.57 inches)) to age 3 or greater (over 160 millimeters (6.3 inches)), and no adults. Seventy-six juvenile bull trout and eight adult spawners were observed 1997; 76 juveniles and 4 adults in 1998, and 82 juveniles and 3 adults in 1999 (USFS 1999a). In 2000, 121 juveniles and 2 adults were observed; in 2001, 208 juveniles and no adults were observed (USFS *in litt.*, 2001).

In 1998, redd surveys between August 28 and October 8 found a total of 9 redds and 11 adult bull trout. A fyke trap placed in Trapper Creek in 1999 captured 48 adult bull trout (23 females, 22 males, 3 undetermined) between

August 19 and September 26. That same year, a total of 24 redds were counted on October 8. In 2000, the fyke trap captured 39 adult bull trout (20 males and 19 females). Twelve redds were observed that year. The fyke trap was not operated in 2001; 11 redds were observed in that year (ODFW *in litt.,* 2001b).

REASONS FOR DECLINE

The U.S. Forest Service Crescent Ranger District conducted a pilot watershed analysis in 1994 (USFS 1994). Results of the Odell Lake Watershed Analysis Guide were based of the review of the pilot watershed analysis and updates, and on the terms in the Federal Watershed Analysis Guide (USFS 1999a).

The Odell Lake Watershed Analysis identified the following factors as suspected reasons for the low bull trout population levels in the Odell Lake watershed:

1. Angling mortality
2. Competition with other fish species for food, space, and spawning habitat
3. Hybridization with brook trout
4. Limited spawning and rearing habitat in the tributaries of Odell Lake (naturally high percentage of fine sediments in Crystal Creek, and low gravel and large wood levels in Trapper Creek)
5. Partial barriers created at the railroad crossings of the spawning tributaries, limiting access to upstream habitat
6. Historic poaching in tributaries
7. Kokanee superimposing redds on the bull trout redds

At the time of listing, the U.S. Fish and Wildlife Service considered harvest, predation, non-native species, *e.g.*, lake trout, brook trout, and water quality to be the primary threats to bull trout in the Odell Lake watershed (U.S. Fish and Wildlife Service (USFWS) 1998). Habitat degradation is also a threat to bull trout in this recovery unit. The sole known spawning area for Odell Lake adfluvial bull trout populations is Trapper Creek. Large woody debris removal, intentional channelization to accommodate a campground and protect bridges, and riparian cover removal have negatively impacted the habitat values of Trapper Creek. Currently, bull trout are known to spawn only in a 1.3 kilometer (0.8 mile) reach of Trapper Creek below a natural waterfall that forms a potential passage barrier. Since the size of the Odell Lake bull trout population is

unknown, it is uncertain as to whether spawning habitat is a limiting factor for the continued survival of these fish. Only one percent of the total area was composed of good spawning habitat and fair spawning habitat accounted for less than three percent of the area. Good bull trout fry rearing habitat comprised less than three percent while fair fry rearing habitat comprised less than 2 percent. Any loss of these key habitats has the potential to have a large effect on the bull trout population in Odell Lake (USFS 1999b).

The discussion that follows addresses, in general, these categories of threats and additional categories identified by the Odell Lake Recovery Unit Team. A separate section on water quality was added because some of the water quality issues are attributed to more than one category and not easily isolated.

Water Quality

Odell Lake was characterized as oligotrophic in 1940 (Fies *et al*. 1996). By the 1960's, it had become mesotrophic, apparently as a result of increased development around the lake (Johnson *et al*. 1985). As recreation use increases, the potential for eutrophication of Odell Lake is expected to increase, but this may be somewhat offset by improvements to septic systems at summer homes (USFS 1999a).

Increased nutrients stimulated an increased phytoplankton growth, contributing to increased pH and chlorophyll *a* levels (USFS1999a). The State of Oregon, in compliance with Section 303(d) of the Clean Water Act (33 USC 1313), listed Odell Lake as water quality limited for pH and of potential concern for chlorophyll *a*. Monitoring by U.S. Forest Service and Oregon Department of Environmental Quality personnel during 2001 found summer pH levels consistently exceeding the upper limit of 8.5 standard established by Oregon Department of Environmental Quality. This may pose a threat to bull trout but our lack of understanding of bull trout use in the lake makes it difficult to know its significance. The combination of elevated temperatures and pH may interfere with adult migration from the lake.

Water in the lake remains cool throughout the summer, with surface temperatures rarely exceeding 20 degrees Celsius (68 degrees Fahrenheit). Odell Lake becomes stratified by June, producing a summer thermocline near 10 to 15 meters (33 to 49 feet). Water temperatures in the epilimnion reached 21 degrees Celsius (67 degrees Fahrenheit) during July and August of 2001 (USFS *in litt.,* 2001). Dissolved oxygen is generally near saturation (Fies *et al*. 1996). This temperature is at the maximum where adult bull trout might be expected to occur and exceeds the temperature range considered optimal for juveniles (Buchanan and Gregory 1997). U.S. Forest Service personnel measured the percent dissolved oxygen saturation at 100 per cent or greater in 2001 (USFS *in litt.,* 2001).

Dams

Bull trout access is potentially impeded by human-made barriers (USFS and BLM 1999). Small dams in the watershed may reduce habitat quality for bull trout. The outlet of Odell Lake at Odell Creek is partially controlled by a low rock weir, which maintains the lake level at a depth 0.30 meter (one foot) higher than normal for a short time each summer until the lake level reaches the level of the dam and flows equalize. This rock weir can potentially hold back 3,600 acre feet or more of water to Davis Lake and may be important to Davis Lake during low water years such as 2001, when Davis Lake was about 10 percent of normal size. There may be some water quality and nutrient cycling implications for Odell Lake, and implications of the modified flows into Odell Creek. Effects on bull trout movement are unknown, but it poses a passage barrier to fish moving upstream from Odell Creek into Odell Lake.

On Crystal Creek, the Southern Pacific Railroad constructed a small dam in the wilderness area to divert water to provide for steam power. The dam is no longer used. The dam has since filled in and no longer stores water. The concrete apron has prevented jump pools from forming and reduced the possibility of access to habitat above the dam. The potential effects of the dam on bull trout will be evaluated in 2002 (B. Houslet, pers. comm., 2001).

Forest Management Practices

Current silviculture generally does not pose a threat in the Odell Lake watershed; the main threats related to forest management are those that result from recreational use, especially around Trapper Creek. Trapper Creek was identified as an important concern in an otherwise generally healthy watershed (USFS 1994).

Trapper Creek is most negatively affected by channelization and habitat simplification of the lower 0.8 kilometers (0.5 mile), and riparian damage in this area. Approximately 40 percent of the stream bank in this lower reach was channelized after a 1964 flood, when gabion baskets were installed to stabilize the banks of Trapper Creek adjacent to the campground and protect the campground from future flooding (USFS 1999b). Gabions were installed on approximately 163 meters (534.8 feet) of stream bank between the mouth of Trapper Creek and the County Road 5810 (USFWS 2000). The railroad and roads have also contributed to channelization (see section on Transportation Networks).

Berming, channelizing, and adding gabion baskets have prevented Trapper Creek from accessing the adjacent floodplain, riparian areas, and old side channels in areas where bull trout rear and spawn. Without access to a floodplain and high water channels during high water periods, water flows do not spread out and energy does not dissipate (USFWS 2000). Because of the velocity resulting from the concentrated flows, spawning and rearing habitat available in the channel is at risk of being lost or damaged during floods (USFS 1999b).

Fire suppression over the past 150 years has reduced the proportion of open meadows in some sites (USFS and BLM 1999), and localized recreation sites have altered both form and function of some riparian and floodplain areas. Riparian vegetation has also been adversely altered or destroyed in the high concentration use zones (resorts and campgrounds). The impacts associated with concentration of people in riparian zones include trampled vegetation; slight increases in runoff, erosion, and sediment delivery to the water body; and damage to the streambanks (USFS 1999a). Bull trout are at risk from the proximity of

campsites to spawning areas. The fish are vulnerable to illegal harvest and harassment, which may impede successful spawning.

Rain on snow events and high intensity summer thunderstorms are the primary mechanisms for sediment transport in the watershed. Natural erosion rates have been accelerated in the managed portion of the area through such activities as road construction, timber harvesting, dispersed recreation, off-road vehicles, etc. (USFS 1999a).

Livestock Grazing

No grazing issues were identified in this recovery unit.

Agricultural Practices

No agricultural issues were identified in this recovery unit.

Transportation Network

Road density in the Odell Lake watershed is relatively low (0.5 miles/square mile), but localized disturbance is pronounced with historic channelization that was designed to accommodate major transportation routes (USFS and BLM 1999). Odell Lake is bounded by the Southern Pacific Railroad on the southwest side and State Highway 58 on the northeast side. County Road 5810 bisects Trapper Creek between the railroad track and Odell Lake. These major transportation routes have several implications for bull trout habitat. Road crossings channelize tributaries feeding into Odell Lake, and may create erosion problems. Road maintenance operations, such as brush and hazard tree removal, removes large wood and shade elements and may cause short term turbidity. The use of cinders for winter maintenance may inundate redds and could affect habitat through minor aggradation, pool filling and channel widening (R. Rivera, USFS, pers. comm., 2001). There is potential for spills of hazardous or toxic materials resulting from highway or railroad accidents. The effects from chemical de-icers used on Highway 58 are unknown.

When the railroad was built along the south shore of Odell Lake in 1926, the hydrologic functions of the wilderness draining streams were disrupted. The railroad crossing on Trapper Creek created a fish barrier which eliminated access to 0.4 kilometer (.25 mile) of bull trout spawning and rearing habitat (a third of the accessible habitat within the creek). The barrier was removed in 1994 (USFS 1994). The construction of the railroad over pumice soils may have been the source of sediment in Crystal Creek and a continuing contributor to sediments in the stream. The road constructed by the railroad to access their diversion dam was a "cut and fill" and runs next to the stream near the dam. Cinders and fine material eroding from the railroad fill degrades the quality of spawning gravel in Crystal Creek (Fies *et al*. 1996). Fine sediment less than 2.0 millimeters diameter was measured on Crystal Creek by stream surveyors during the summer of 1999. On average, pebble counts were estimated at greater than 40 percent sand size or smaller particles (Dachtler 1999).

Trapper Creek has been channelized and thus become more entrenched from modifications made to it for the railroad trestle crossing and the County Road 5810 bridge crossing in the lower 0.8 kilometers (0.5 miles). Other problems at Trapper Creek include the channelization of the creek above County Road 5810 (USFS 1999b). Trapper Creek's stream banks are eroding upstream of County Road 5810 where berms were constructed to channel water under the bridge (USFWS 2000).

Channelizing the lower 0.8 kilometer (0.5 mile) of Trapper Creek has increased velocities in the main channel, decreased retention of large wood and spawning gravels, and simplified habitat composition. A 1996 stream survey found that Trapper Creek had over 60 percent habitat units as riffles and only 20 percent of the habitat composed of pools. Trapper Creek also lacks cover. The dominant cover type in 1996 was turbulence with the sub-dominant cover being overhanging vegetation in the lower part of the reach and boulders in the upper high gradient portions. Off-channel habitats are lacking in Trapper Creek. Juveniles rearing in Trapper Creek need such areas for refugia during high water events. The 1996 habitat survey found only five side channels constituting of only 5 percent of the total habitat area. Channel condition and dynamics are currently functioning at an unacceptable risk (USFWS 2000).

Mining

No mining issues were identified in this recovery unit.

Residential Development

Developments on Odell Lake include five U.S. Forest Service campgrounds and a resort at each end of the lake. There also are about 70 private homes on the lake under permit from the Forest Service (Fies *et al*. 1996). These developments create potential risks from water quality impairment, especially from sewage effluents.

Although some residences pump water from Odell Lake, the amount is probably not a problem. The issue is whether the pumps are equipped with screens that meet current criteria for protecting fish. The Willamette Pass Ski Area also withdraws water from Odell Lake for operating snow-making equipment during the ski season. The intake is through an infiltration gallery, *i.e.*, the pipe is buried in the gravel and water is drawn into the pipe through the gravel. Effects of the ski area diversion on bull trout have not been assessed, nor have possible effects from biological or chemical agents used in management of the ski area. An inventory of pumps using Odell Lake water is also needed. Without further knowledge of how bull trout use the lake, *e.g.*, shoreline use by juveniles, it is difficult to determine extent of the threat.

The number of boats using the lake has increased over the years. Effects on bull trout from noise and wave action, particularly in the vicinity of Trapper Creek, are unknown.

Fisheries Management

Nonnative fish have been stocked in Odell Lake from the early 1900's to the mid 1960's. Self-sustaining nonnative populations of lake trout, kokanee, and brook trout reside in the lake and/or tributaries. As of 1999, Oregon Department of Fish and Wildlife manages Odell Lake primarily for kokanee and lake trout. In 1977 an aborted airstocking flight dumped fingerling rainbow and brook trout

into the lake. There is also a risk of illegal introductions of nonnative fish as happened in Davis Lake with largemouth bass and tui chub.

Nonnative fish species have had a negative impact on bull trout in the Odell Lake watershed. Lake trout are known to compete with bull trout for limited resources such as forage. Brook trout have been found hybridizing with bull trout in Trapper Creek (USFS 1999a). Kokanee salmon spawning occurs at a similar time as bull trout and have been observed spawning over bull trout redds in Trapper Creek (USFS *in litt.,* 1979). The degree of competition and hybridization with introduced fish is unknown. However, both pose serious risks to Odell Lake bull trout because the population is so small and already at high risk of extinction.

There also is a risk to bull trout from incidental harvest by anglers fishing for kokanee and lake trout, and mortality from catch and release (Fies *et al.* 1996). Most bull trout are caught during the kokanee fishery. Incidental captures from 1996 to 1999 ranged from 0 to 30 (Table 1). The size limit (762 millimeters (30 inches) minimum) on lake trout was implemented to protect bull trout. The regulation needs to be evaluated for its effectiveness.

Table 1. Incidental bull trout catch from creel surveys.

Year	Number of bull trout caught
1999	30
1998	14
1997	0
1996	16

There are no significant fish disease issues in the recovery unit at this time, although the need to remain vigilant for pathogens and follow preventive measures is constant. Odell Lake bull trout, although less abundant than desired, are generally in good health.

Bull trout may be inherently resistant to some diseases that are more devastating to other salmonids. In studies conducted by Oregon State University

researchers, Metolius (Deschutes) bull trout exposed to high and low doses of the infectious stages of *Myxobolus cerebralis* (causative agent in whirling disease) showed no signs of infection as measured by presence of spores, clinical disease signs, or histopathology. Rainbow trout exposed simultaneously showed high infection prevalence and disease severity. Nor were infections detected in Metolius (Deschutes) bull trout exposed to infection by *Ceratomyxa shasta* (Bartholomew 2001). *Ceratomyxa shasta* has been detected in cutthroat trout from Odell Creek during routine monitoring (H. Engleking, ODFW, pers. comm., 2002). Disease studies conducted on bull trout from the Deschutes River Basin showed them to be relatively resistant to all strains of Infectious Hematopeietic Necrosis Virus tested. Bull trout had detectable levels of antigen to *Renibacterium salmoninarum* (bacterial kidney disease) but no evidence of the disease.

Isolation and Habitat Fragmentation

Odell Lake bull trout have been isolated from the Deschutes River local populations by a lava flow that impounded Odell Creek and formed Davis Lake approximately 5,500 years ago. The sole known spawning area for Odell Lake adfluvial bull trout local populations is Trapper Creek. Another small tributary to Odell Lake, Crystal Creek, has habitat conditions that may be suitable for bull trout spawning and rearing, but no bull trout have been found there in recent years. Isolation and lack of any natural recolonization potential is a significant concern for bull trout in the Odell Lake Recovery Unit. Even if recovery criteria are met, the Odell Lake bull trout local population may always be considered at a high risk of extinction because of its small size, *i.e.*, fewer than 1,000 adult spawners is considered the minimum needed to minimize inbreeding effects and maintain an ability to adapt to changing environmental conditions (Rieman and Allendorf 2001). Nevertheless, the population has persisted in isolation for the last 5,000 years, as have many other small bull trout populations across their range.

The recovery unit would benefit from establishment of additional local populations either through volitional movement or, if necessary, through artificial reintroduction into suitable habitat, *e.g.*, Crystal, Maklaks, and Noname Creeks.

ONGOING RECOVERY UNIT CONSERVATION MEASURES

There has been a high level of cooperation among the Oregon Department of Fish and Wildlife, U.S. Forest Service, and U.S. Fish and Wildlife Service to recover bull trout in the Odell Lake Recovery Unit. The following list of ongoing measures is by no means complete, but is representative of ongoing efforts within the recovery unit.

Oregon Department of Fish and Wildlife

Oregon Department of Fish and Wildlife adopted changes in angling regulations to prohibit take of bull trout, modified regulations on other fisheries to reduce incidental take, and developed and distributed bull trout identification posters to aid anglers. Fishing for bull trout in Odell Lake has been closed since 1992. Bull trout caught incidental to other fisheries must be released unharmed. All fishing in Trapper Creek has been prohibited since 1993. Brook trout removal takes place annually in Trapper Creek.

As of 2000, stocking by Oregon Department of Fish and Wildlife was discontinued in Odell and Davis Lakes. Brook trout are no longer stocked in the high lakes of the Odell watershed.

Oregon Department of Fish and Wildlife hired a bull trout coordinator in 1995 to complete a statewide bull trout status assessment, map bull trout distribution, and develop conservation strategies for bull trout. When bull trout were listed under the Endangered Species Act in 1998, the effort shifted to recovery planning.

Oregon Department of Fish and Wildlife has a section 6 cooperative agreement with the U.S. Fish and Wildlife Service. Funding through section 6 has helped support spawning and creel surveys.

Oregon Department of Fish and Wildlife has also made changes to statewide in-water work periods to better address bull trout needs.

U.S. Forest Service

The U.S. Forest Service issued a Decision Notice and Finding of No Significant Impact for the Trapper Creek Restoration Project on January 12, 2001, clearing the way for implementation of a comprehensive restoration project in Lower Trapper Creek (the portion below the railroad tracks). This project proposes to provide a more naturally functioning stream that retains wood and spawning gravels, improving spawning and rearing habitat. A movable weir will be placed in Trapper Creek to reduce competition with kokanee, and a monitoring program implemented to evaluate the effects of the weir on bull trout and kokanee. The U.S. Forest Service collected pH, chlorophyll *a*, and water temperature data on Odell Lake in 2001. A summary of results is pending. The potential effects of the dam on Crystal Creek on bull trout will be evaluated in 2002. The jump and rest pool at the culvert crossing on Crystal Creek were improved in 1994 and three cubic yards of spawning size gravel was added to Crystal Creek below the railroad bridge culvert (USFS 1994).

Multi-agency Efforts

Oregon Department of Fish and Wildlife and U.S. Forest Service staff, through the Odell Lake Recovery Unit Team, work cooperatively on bull trout population and habitat surveys, education efforts, habitat projects, and other recovery actions identified in this document.

RELATIONSHIP TO OTHER CONSERVATION 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.

Oregon Department of Fish and Wildlife and 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). 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. 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, such as 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 land owners for conversion to instream water rights.

Through the Upper Deschutes 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 as identified on the Section 303d list (see previous section on Water Quality). The Oregon Department of Environmental Quality has been cooperating with U.S. Forest Service in data collection in preparation for determinations during the process. The process is expected to be completed in 2002, and will include Odell Lake (http://waterquality.deq.state.or.us/wq/TMDLs/TMDLs.htm).

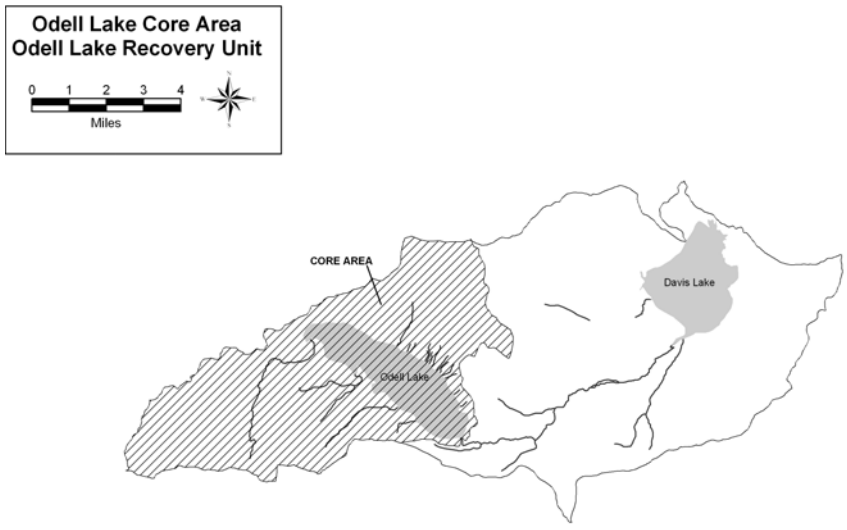
Under current forest management a 107 meter (350 feet) riparian reserve was established under the 1994 Record of Decision for Northwest Forest Plan (USFS 1999a). Although protected from logging, some areas may be actively managed to reduce fuel and stocking to encourage new growth. This management strategy is anticipated to benefit bull trout by increasing quality and quantity of riparian habitat.

STRATEGY FOR RECOVERY

A core area represents the closest approximation of a biologically functioning unit for bull trout. The combination of core habitat (*i.e.*, habitat that could supply all the necessary elements for the long-term security of bull trout including both spawning and rearing as well as 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.

Current distribution of bull trout in the Odell Lake Recovery Unit consists of spawning and juvenile rearing in Trapper Creek and subadult and adult rearing in Odell Lake. Some foraging activity may occur in Odell Creek and an occasional bull trout has been observed in Davis Lake.

For purposes of recovery, the Odell Lake Recovery Unit has a single core area encompassing Odell Lake and its tributaries (including Odell Creek and its tributaries) and Davis Lake and tributaries containing local populations (both current or potential as identified by the recovery unit team) (Figure 2).



Recovery goals and Objectives

The goal for bull trout recovery is to **ensure the long-term persistence of self-sustaining complex, interacting groups of bull trout distributed across the species native range, so that the species can be delisted.** To accomplish this goal the following four objectives were identified for bull trout in the Odell Lake Recovery Unit.

- Maintain current distribution of bull trout and restore distribution in previously occupied habitats within the Odell Lake 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 forms.

- 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, to consider 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 Odell Lake Recovery Unit Team classified bull trout into relative risk categories based on the best available data and the professional judgment of the team.

The Odell Lake 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 Odell Lake 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 Odell Lake Recovery Unit, the recovery unit team relied heavily on the professional judgment of its members.

Local Populations. Metapopulation theory is an important consideration 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. Distribution of local populations in such a manner is, in part, an indicator of a functioning core area. Based in part on guidance from Rieman and McIntyre (1993), bull trout core areas with less than five local populations are at increased risk; core areas with between 5-10 local populations are at intermediate risk; and core areas which have more than 10 interconnected local populations are at diminished risk. For the Odell Lake Core Area, there is currently one known local population. Based on the above guidance, bull trout in the Odell Lake Core Area are in an increased risk category.

Adult Abundance. The recovered abundance levels in the Odell Lake 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 was needed to minimize potential inbreeding effects within local populations. Furthermore, a population size between 500 and 1,000 adults in a core area is needed to minimize the deleterious effects of genetic variation due to 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 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 Odell Lake Core Area was estimated (based on redd counts) at 100 adult spawners per year in the known local population. Based on the aforementioned abundance guidance, bull trout in the Odell Lake Core Area were considered at an increased risk of genetic drift.

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 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 from generation 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 depressed and likely declining population trend and highly variable annual productivity, bull trout in the Odell Lake Core Area are currently at increased risk of extirpation.

Connectivity. The presence of the migratory life history form within the Odell Lake 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 still persist in the Odell Lake Core Area and are therefore considered at a diminished risk.

Recovery Criteria

Recovery criteria for bull trout in the Odell Lake Recovery Unit are the following:

1. **Bull trout are distributed among one or more local populations in the recovery unit, depending on whether fish are found to exhibit homing fidelity to individual streams**. In a recovered condition the Odell Lake Recovery Unit would include Trapper Creek and at least one additional local population. 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. Addition of at least one more local population would demonstrate that suitable habitat is being restored and maintained.

2. **Estimated abundance of adult bull trout is 200 or more adults distributed in one core area**. Increased abundance is expected to come from expansion of spawning and juvenile rearing habitat to the extent possible in Trapper Creek and re-establishment in historic habitat, *e.g.*, Crystal Creek. Recovered abundance was derived using the professional judgement of the Team and estimation of productive capacity of identified local populations. Increased abundance will reduce somewhat the risk of genetic complications in the Odell Lake population due to extremely small population size.

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**. Barriers to connectivity within the Odell Lake Recovery Unit will be addressed by eliminating entrainment in diversions (Willamette Pass ski area) and providing passage at dams (Crystal Creek and Odell Creek). Maintaining access to Odell Lake for recovered local populations will ensure opportunities for exchange of genetic material (see tasks 1.2.1 and 1.2.2).

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 Odell Lake Recovery Unit. However, the team recognizes that many uncertainties exist regarding bull trout population abundance, distribution, and recovery actions needed. The Recovery Unit Team believes that if effective management and recovery are to occur, the recovery plan for the Odell Lake Recovery Unit should be viewed as a "living" document, to be updated as new information becomes available. As part of this adaptive management approach, the Odell Lake 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 preliminary 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, ODFW, pers. comm. 2001).

The recovery unit team has identified the following additional research needs for bull trout in the Odell Lake Recovery Unit.

1. Analysis of factors limiting the abundance and distribution of bull in the Odell Lake Recovery Unit. This includes identifying sources of bull trout mortality by life stage.

2. Analysis of interactions among aquatic species in Odell Recovery Unit as they relate to bull trout. For example, assess competition between bull and lake trout in Odell Lake, competition and hybridization between bull and brook trout in Trapper Creek, food-web interactions with nonnative fishes, and Kokanee redd superimposition. Although Kokanee may be superimposing redds they add nutrients to the creek and their flesh and eggs are most likely a source of food for juvenile bull tout in Trapper Creek.

3. Assessment of feasibility of re-establishing bull trout to Crystal Creek, Odell Creek, or Davis Lake tributaries.

4. Determine how to effectively survey the bull trout in Odell Lake in order to establish abundance estimates for this segment of the bull trout population.

The Role of Artificial Propagation and Transplantation

As described in Chapter 1, section 3(3) of the Endangered Species Act lists artificial propagation and transplantation as methods that may be used for the conservation of listed species. While artificial propagation has played an important role in the recovery of other listed fish species, the overall recovery strategy for bull trout in the Odell Lake Recovery Unit will emphasize identifying and correcting threats affecting bull trout and bull trout habitats, where possible. If artificial propagation is determined to be necessary for bull trout recovery

within the Odell Lake Recovery Unit and if a feasibility study identifies a host of streams capable of supporting bull trout, the joint policy of the U.S. Fish and Wildlife Service and the National Marine Fisheries Service regarding controlled propagation of listed species will be followed (65 FR 56916). Also, an appropriate plan would need to be approved to consider the effects of transplantation on other species as well as on the donor bull trout populations. Transplanting listed species must be authorized by the U.S. Fish and Wildlife Service through a 10(a)(1)(A) recovery permit and must meet applicable State fish-handling and disease policies.

The findings of the Montana Bull Trout Scientific Group support the possible use of artificial propagation and transplantation. The group concluded that hatcheries are one of many potential tools that could be used in bull trout recovery and that hatcheries are appropriate for establishing genetic reserves for declining populations and some research strategies (MBTSG 1996). The Montana Bull Trout Scientific Group identified seven strategies for using artificially propagated fish, evaluated the strategies relative to recovery criteria and objectives, and provided recommendations. The group also concluded that transplantation into areas where bull trout have been extirpated should be considered only after the causes of extirpation have been identified and corrected.

To achieve the time frame for recovery as specified in Chapter 1 and in this Odell Lake Recovery Unit chapter, some form of artificial propagation or transplantation may be anticipated in the Odell Lake Recovery Unit. Such strategies may also be necessary to establish a genetic refugia since the population within this recovery unit is seriously imperiled. Before the implementation of any artificial propagation or transplant program, a feasibility study would be completed to identify streams (either the priority streams or any new streams) having the greatest potential to support local populations of bull trout.

ACTIONS NEEDED

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 Odell Lake Recovery Unit. They appear in the implementation schedule that follows this section and are identified by three numerals separated by periods.

The Odell Lake Recovery Unit chapter should be updated as recovery tasks are accomplished, or revised as environmental conditions change, and monitoring results or additional information become available. The Odell Lake 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 Reduce general sediment sources. Stabilize roads, crossings, and other sources of sediment delivery, *e.g.*, railroad crossing on Crystal Creek. Use U.S. Forest Service road assessments in watershed analyses for a list of sediment sources. Review, prioritize and take necessary action.

1.1.2 Assess water quality in Odell Lake. Assess water quality in Odell Lake and tributaries and mitigate where limiting to bull trout. Investigate possible impacts from Willamette Pass ski area maintenance operations, road maintenance operations, and residential septic systems. Coordinate water quality studies with bull trout lake life history studies to target life stages that may be affected.

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

1.2.1 Eliminate entrainment in diversions . Determine if water diversion for the Willamette Pass ski area intake entrains juvenile bull trout and screen, if necessary. Inventory residential pumps and install screens where needed.

1.2.2 Provide passage at dams. Evaluate effects of the railroad dam on Crystal Creek on potential bull trout habitat and take action as necessary. Investigate the rock weir at outlet of Odell Creek to determine if it is a passage barrier to bull trout.

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

1.3.1 Restore riparian habitat. Revegetate to restore shade and canopy, riparian cover, and native vegetation along Trapper

Creek and Odell Lake lakeshore camp sites in areas that adversely impact bull trout recovery.

1.3.2 Restore stream channels. Implement the Trapper Creek channel restoration project.

1.3.3. Assess stream habitat restoration potential. Assess other areas of the recovery unit for stream restoration potential and implement restoration where needed, *e.g.*, Crystal Creek, Odell Creek, Davis Lake and tributaries.

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

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

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 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.

2.5.1 Implement management actions wherever feasible and biologically supportable to control nonnative fishes. Continue removing brook trout from Trapper Creek and other creeks where brook trout populations pose a risk to bull trout. Evaluate effectiveness of removal program.

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 existing plans. Incorporate bull trout recovery plans into Oregon Department of Fish and Wildlife Deschutes Basin Fish Management Plans and the Oregon Plan for Salmon and Watersheds.

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

3.2.1 Increase angler education and outreach efforts. Provide educational material to anglers on bull trout identification, habitat needs, special regulations, methods to reduce hooking mortality of bull trout caught incidentally, and the value of bull trout and their habitat. Utilize kiosks at campground, posters, camp host, creel surveyor when available to distribute information.

3.2.2 Develop fish management strategies to achieve a sustainable Odell Lake adfluvial bull trout population. The working group will review current fish management (*e.g.*, angling regulations, enforcement, etc.), when the opportunity or need arises and provide input when needed.

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.

3.3.1 Evaluate site-specific conflicts with introduced sport fish. Determine site-specific level of competition and hybridization with introduced sport fish and assess impacts of those interactions; especially lake trout, brook trout, and largemouth bass (Davis Lake). For example, assess competition between bull and lake trout in Odell Lake, competition and hybridization between bull and brook trout in Trapper Creek, impacts of superimposition of Kokanee salmon redds on bull trout production, and food-web interactions with nonnative fishes. Take action based on findings.

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

3.4.1 Determine effects of existing sport fishing regulations in Odell lake on bull trout. Assess effectiveness of existing sport angling regulations that minimize incidental mortality of bull trout. For example, determine the effectiveness of the closure of angling of bull trout in Trapper Creek and compliance with no harvest in the Odell Lake fishery. Develop a compliance index of angling regulations specific to 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.

4.2 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.*

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

5.2.1 Determine factors limiting bull trout recovery in the Odell Lake Recovery Unit. Identify habitat factors limiting bull trout use in Crystal Creek. Assess habitat potential in Odell Creek and tributaries to support spawning and rearing bull trout.

5.2.2 Protect and restore habitat in the Odell Lake Recovery Unit. Identify essential areas and insure they are adequately protected, and implement strategies to restore and protect habitat in the recovery unit. Ensure that human use in the recovery unit, *e.g.*, Trapper Creek Campground, is compatible with bull trout recovery.

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 fish pathogens. Continue to monitor for effects of fish pathogens on Oregon bull trout populations. Follow 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 Survey for bull trout presence/absence. Conduct regular, every five years for example, surveys in potential habitat where bull trout status is unknown or re-colonization is anticipated. For example, Odell Creek, Crystal Creek, Odell Lake, and spring areas.

5.5.2 Identify and map bull trout spawning habitat. Identify and map bull trout spawning habitat, present and potential, within the Recovery Unit. Explore Odell Lake Recovery Unit for all available and potential spawning areas, *e.g.*, lakeshore spawning by bull trout. Use information in feasibility analysis for reintroducing bull trout into potential habitat.

5.5.3 Establish abundance estimates. Establish abundance estimates for existing population (age class, composition, condition). Determine how to best survey the bull trout in Odell Lake and expand creel effort to establish an index of abundance.

5.5.4 Determine juvenile life history of bull trout in the Odell Lake Recovery Unit. Continue snorkel surveys on Trapper and Crystal Creeks and explore other areas, *e.g.*, shoreline near Trapper Creek. Explore feasibility of using screw traps to determine juvenile timing and abundance. Have bull trout scales read.

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 Support watershed group restoration efforts. Promote and support collaborative efforts to establish or support existing local watershed groups to accomplish site specific protection/restoration activities. Integrate watershed analyses and restoration activities on public lands in Odell Lake Recovery Unit.

6.1.2 Develop an outreach program to share information. Disseminate information to a wide variety of interest groups and educational institutions via publications, world wide web, and presentations. Present papers at professional meetings, *e.g.*, American Fisheries Society, *Salvelinus confluentus* Curiosity Society meetings. Provide a mechanism, *e.g.*, working group, to facilitate consultation among state, federal, and private entities on habitat issues. Develop a public information program with broad emphasis on bull trout identification and life history requirements and more specific focus on regionally or locally important recovery. For example, continue the census as an education effort; enlist the aid of volunteers (*e.g.*, Oregon State Police volunteers), provide bull trout, lake trout and brook trout identification cards to anglers, and develop and distribute educational materials on bull trout and their habitat needs (*e.g.*, watershed form and function, riparian and side channel restoration, large wood placement). Maintain a database of affected interests.

6.1.3 Secure funding and cooperation to implement recovery strategies. Obtain financial and personnel support from management agencies; pursue cooperative funding, partnerships, challenge cost share opportunities, and other private and governmental grants; and utilize mitigation and natural resource damage settlement funds as available. Seek funding solutions to address Road 5810 and railroad bridge work.

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

6.3 Enforce 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.

7.2 Assess effectiveness of recovery efforts.

7.3 Revise scope of recovery as suggested by new information.

7.3.1 Periodically review progress towards recovery goals and assess recovery task priorities. Annually review progress toward population and adult abundance criteria and recommend changes, as needed, to the Odell Lake Recovery Unit chapter. In addition, review tasks, task priorities, completed tasks, budget, time frames, particular successes, and feasibility within the Odell Lake Recovery Unit.

IMPLEMENTATION SCHEDULE

The following are definitions to column headings and keys to abbreviations and acronyms used in the Implementation Schedule:

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 impact 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 action 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 may 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 task. **Bold type** indicates the agency or agencies that have the lead role for task implementation and coordination, though not necessarily sole responsibility. Identified parties include:

USFWS	U.S. Fish and Wildlife Service
USFS	U.S. Forest Service
ODFW	Oregon Department of Fish and Wildlife
UPR	Union Pacific Railroad

RUT	Recovery Unit Team
EPA	U.S. Environmental Protection Agency
DEQ	Oregon Department of Environmental Quality
OSP	Oregon State Police
USDOT	U.S. Department of Transportation

Cost Estimates: Cost estimates are rough approximations and provided only for general guidance. Total costs are estimated for the duration of the task and also itemized annually for the next five years.

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.

Double asterisk (**) in the total cost column indicates that estimated costs for these tasks are not determinable at this time. Input is requested to help develop reasonable cost estimates for these tasks.

Triple asterisk (***) indicates costs are combined with or embedded within other related tasks.

Implementation schedule for the Odell Lake bull trout recovery unit chapter										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimates (in $1,000 units)**					**Comments**
					Total Costs	**Year 1**	**Year 2**	**Year 3**	**Year 4**	
1	1.2.1	Eliminate entrainment in diversions	2	**ODFW** USFS private parties	200		50	150		Covered partially under existing programs.
1	1.2.2	Provide passage at dams	2	**RUT** UPR	30		10	20		Cost are for evaluation only. Cost for action unknown at this time.
1	1.3.2	Restore stream channels	2	**USFS**	250	150	100			Cost are for Phase I of Trapper Creek Project .
1	2.5.1	Implement management actions wherever feasible and biologically supportable to control nonnative fishes	25	**ODFW** USFS	250	10	10	10	10	Ongoing
1	3.3.1	Evaluate site-specific conflicts with introduced sport fish	5	**ODFW**	250		50	50	50	

Implementation schedule for the Odell Lake bull trout recovery unit chapter										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimates (in $1,000 units)**					**Comments**
					Total Costs	**Year 1**	**Year 2**	**Year 3**	**Year 4**	
1	5.2.1	Determine factors limiting bull trout recovery in the Odell Lake Recovery Unit	4	**USFS, ODFW**	100		25	25	25	USFS hopes to study how water quality and stratification affect bull trout distribution and access to tributaries during spawning.
1	5.5.2	Identify and map bull trout spawning habitat	8	**USFS, ODFW**	40		5	5	5	Covered under existing programs.
1	6.1.3	Secure funding and cooperation to implement recovery strategies	25	**RUT, USFWS**	*					Ongoing, covered under existing programs.
2	1.1.1	Reduce general sediment sources	5	**UPR, RUT**	200		60	40	40	

Implementation schedule for the Odell Lake bull trout recovery unit chapter										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimates (in $1,000 units)**					**Comments**
					Total Costs	**Year 1**	**Year 2**	**Year 3**	**Year 4**	
2	1.1.2	Assess water quality in Odell Lake	2	**DEQ**, USFS, ODFW, EPA	25	5	20			May be completed as part of TMDL process for pH and algae. USFS collected water quality data in 2001.
2	1.3.1	Restore riparian habitat	25	**USFS**	*					Ongoing, most covered under existing programs. Trapper Creek covered under 1.3.2.
2	1.3.3	Assess stream habitat restoration potential	3	**USFS,** ODFW	*					Covered under existing programs.
2	3.2.1	Increase angler education and outreach efforts	5	**ODFW**, USFS, RUT	50	10	10	10	10	May be combined with other similar actions in other RUs.
2	3.2.2	Develop fish management strategies to achieve a sustainable Odell Lake adfluvial bull trout population	25	**RUT**	*					Ongoing

Implementation schedule for the Odell Lake bull trout recovery unit chapter										
Task Priority	**Task Number**	**Task Description**	**Task Duration (years)**	**Responsible Parties**	**Cost Estimates (in $1,000 units)**					**Comments**
					Total Costs	**Year 1**	**Year 2**	**Year 3**	**Year 4**	
2	3.4.1	Determine effects of existing sport fishing regulations in Odell Lake on bull trout	1	**ODFW**	50	50				Covered under existing programs, but subject to available funding.
2	5.2.2	Protect and restore habitat in the Odell Lake Recovery Unit	25	**USFS**	*					Ongoing, covered under existing programs.
2	5.5.1	Survey for bull trout presence/absence	5	**USFS, ODFW**	50	10	10	10	10	Covered under existing programs.
2	5.5.3	Establish abundance estimates	5	**ODFW**	*					Covered under existing programs.
2	5.6.2	Determine juvenile life history of bull trout in the Odell Lake Recovery Unit	25	**ODFW, USFS**	*					Ongoing, covered under existing programs.
2	5.6.3	Identify sources of bull trout mortality by life stage	1	**ODFW**, USFS	40	40				

Implementation schedule for the Odell Lake bull trout recovery unit chapter

Task Priority	Task Number	Task Description	Task Duration (years)	Responsible Parties	Cost Estimates (in $1,000 units)					Comments
					Total Costs	Year 1	Year 2	Year 3	Year 4	
2	6.1.1	Support watershed group restoration efforts	25	**RUT**	*					Ongoing, covered under existing programs.
3	3.1.1	Incorporate bull trout recovery actions into existing plans	25	**ODFW**	*					Ongoing, rule changes to ODFW basin plans will require approval by Fish and Wildlife Commission.
3	5.4.1	Monitor for fish pathogens	25	**ODFW**	*					Ongoing, covered under existing programs.
3	6.1.2	Develop an outreach program to share information	4	**USFS, ODFW**	20	15	5			Could be part of a statewide or regional outreach program.
3	7.3.1	Periodically reassess priorities	25	**RUT**	*					Reassess periodically, costs covered under existing programs.

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APPENDIX A: List of Chapters