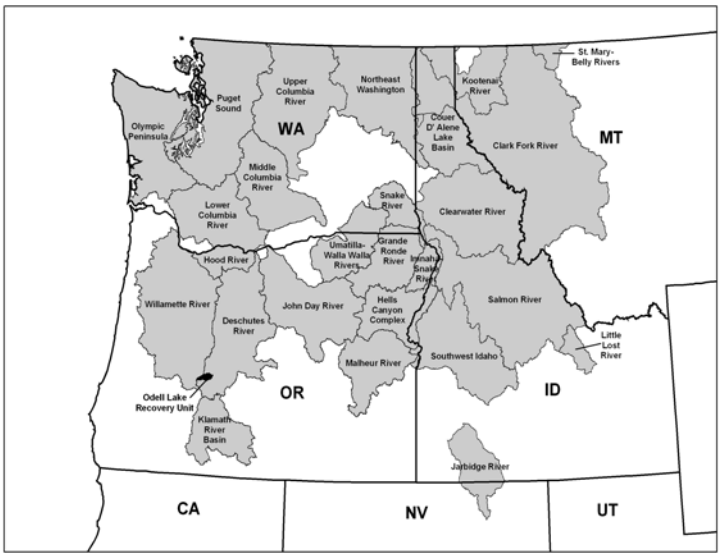
INTRODUCTION

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

---

1

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.