METOLIUS RIVER SUBBASIN FISH MANAGEMENT PLAN

UPPER DESCHUTES FISH DISTRICT

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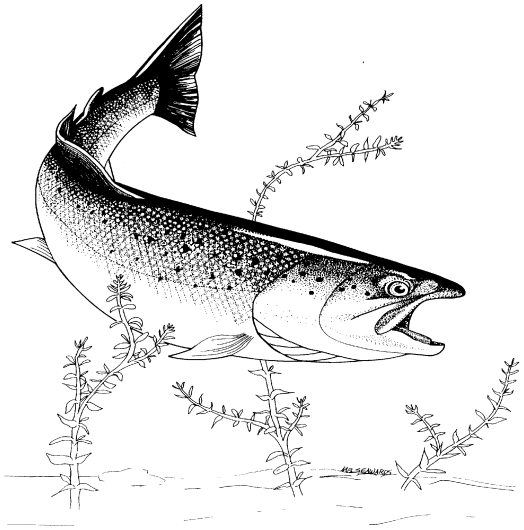

ACKNOWLEDGMENTS

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FOREWORD

The Fish Management Policy of the Oregon Department of Fish and Wildlife (ODFW) requires that management plans be prepared for each basin or management unit. The Metolius River Subbasin Fish Management Plan was developed to direct management of fish resources of the Metolius River, its tributaries, and the Cascade Mountain high lakes within the Metolius River subbasin.

ODFW is committed to the planning process as an integral part of all current and future management by the agency. The Metolius River Subbasin Fish Management Plan is one element in the department's planning efforts. Species plans for chinook and coho salmon, steelhead, trout, and warmwater game fish have been adopted. These statewide plans guide the development of more localized plans for individual river basins and subbasins.

These plans serve several needed functions. They present a logical, systematic approach to conserving our aquatic resources. They establish management priorities and direct attention to the most critical problems affecting our fisheries so that the department's funds and personnel can be used accordingly. They inform the public and other agencies about the department's management programs and provide them with the opportunity to help formulate those programs.

Plan Scope

Fish management in the waters of the Metolius River Subbasin, which flows into the Deschutes River above Pelton Reregulating Dam, is addressed by this plan. A companion document, the Crooked River Fish Management Plan, has been written and was presented at the April 1996 meeting of the Oregon Fish and Wildlife Commission. A fishery management plan for the waters of the Upper Deschutes River Subbasin Fish Management Plan (upstream of Lake Billy Chinook) was presented at the September 1996 meeting of the Oregon Fish and Wildlife Commission.

Plan Development Process and Participants

This plan was developed by the Oregon Department of Fish and Wildlife (ODFW) and the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) with the help of two committees. The Public Advisory Committee, representing non-treaty user groups and other interested members of the public, helped identify a range of objectives and actions for managing the fishery resources in the upper Deschutes River basin. The Technical Advisory Committee, composed of representatives of state and federal fishery agencies, tribes, land and water management agencies, and utilities, developed specific fishery and other technical information and described and assessed potential actions for managing the fisheries.

Members of the Public Advisory Committee and their affiliations are:

Byron Beach, Metolius River Lodges
Charlie Brown, Deschutes Basin Resource Committee and Swalley Irrigation District
Bob Griffin, Central Oregon Flyfishers
John Hofferd, East Lake Resort and Paulina Lake Resort
Phil Horton, Warmwater Angler
John Judy, Angler and Guide
Craig Lacy, Oregon Trout
Len Mathisen, Deschutes River Mitigation and Enhancement Committee
Dave Nolte, Trout Unlimited and Bring Back the Natives
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Pat Schatz, Crane Prairie Resort
Mavis Shaw, Confederated Tribes of the Warm Springs
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Members of the Technical Committee and their affiliations are:

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Principal authors are Ted Fies, Brenda Lewis, Mark Manion and Steve Marx.

Purpose of Plan

This plan is intended to set fish management direction for the next five to ten years within the specified water bodies of the basin. The policies and objectives within each section provide the core of the management program and describe the fundamental direction that will be pursued. These are implemented through specific actions, which may include (but are not limited to) acquiring habitat, developing angling regulations, and stocking fish. Because of funding uncertainties, a wide variety of actions are described, but not all may be implemented.

Organization of Plan

This plan is divided into three major sections: one which addresses the fish management in the Metolius River proper and its tributaries, including Lake Creek; one which addresses fish management in Link Creek and in Blue and Suttle Lakes; and one which addresses fish management in the 21 Cascade Mountain Lakes that are within the Metolius River basin.

Each of these sections is, in turn, divided into sub-sections that address habitat, the major fish species or groups of species, and angling access, within major water bodies of the river basin. Each of these sub-sections contains:

1. Background and status: historical and current information which helps explain the context of the policies, objectives, and actions.

2. Policies: constraints or principles developed specifically for management activities in the subbasin related to that species or topic.

3. Objectives: what is intended to be accomplished.

4. Assumptions and Rationale: support and justification for objectives.

5. Actions: individual tasks and activities needed to be carried out to progress toward attainment of objectives.

For each significant water body either one management direction, or two or more management alternatives were developed. This document contains only the direction chosen by the Fish and Wildlife Commission.

All of the management options, including specific actions, are governed by Oregon Administrative Rules (OARs) currently in place which relate to fish management. A partial list of those OARs is given in Appendix C.

Procedures developed by ODFW are incorporated in the Manual for Fish Management (1977) and A Department Guide for Introductions and Transfers of Finfish into Oregon Waters (1982), and Habitat Protection Policies and Standards (1991).

Oregon Fish and Wildlife Commission Action

The entire plan is presented to the Oregon Fish and Wildlife Commission (OFWC), which reviews the management direction and management alternatives described within the plan. After considering staff recommendations and public comments, the Commission chooses management directions for each significant water body. After a period of 60 days, in which further public review may take place, the entire plan is finalized to reflect the OFWC decisions, and is adopted as an Oregon Administrative Rule.

GENERAL CONSTRAINTS

Legal Considerations

Besides the statewide species plans, the Metolius River Subbasin Fish Management Plan must also conform to other established constraints, such as federal acts (e.g., Wilderness, Endangered Species), state statutes, administrative rules, memoranda of understanding, and other policies.

ODFW interacts with other agencies primarily in dealing with fish habitat issues. Although the U.S. Forest Service is the major public land manager in the planning area, several federal and state entities have jurisdictions over activities that affect fish habitat. These include the U.S. Fish and Wildlife Service (USFWS), the U.S. Department of the Interior's Bureau of Land Management (BLM), Oregon State Police (OSP), Natural Resource Conservation Service (NRCS), U.S. Army Corps of Engineers (COE), Oregon Division of State Lands (DSL), the Oregon Department of Environmental Quality

(ODEQ), the Oregon Department of Water Resources (ODWR), and the Department of Geology and Mineral Industries (DOGAMI).

State regulatory actions that affect habitat

The Oregon Water Resources Commission regulates water use throughout the state. The Oregon Department of Environmental Quality (ODEQ) has developed state water quality standards that are in compliance with federal water quality standards. ODEQ administrative rules (Chapter 340, Division 41) address water quality standards for individual basins.

The Oregon Forest Practices Act (ORS 527.610 to 527.730) was adopted in 1972. Commercial timber operations on state and private lands are regulated by the act, which is administered by the Oregon Department of Forestry. Forest management activities on U.S. Forest Service and Bureau of Land Management lands are designed to comply with Forest Practices Act rules and state water quality standards.

The Oregon Division of State Lands oversees the Oregon Removal-Fill Law. A permit is required for the removal or filling of 50 cubic yards or more of material in natural waterways.

ODFW goals and policies for commercial and sport fishing regulations, fish management, hatchery operation, and the Natural Production and Wild Fish Management policies are adopted as Oregon Administrative Rules (OAR). ODFW's Natural Production and Wild Fish Management policies (OAR 635-07-521 through 635-07-529) provide guidance on the development of fisheries management options for water bodies throughout the state.

The Oregon Riparian Tax Incentive Program of 1981 provides a tax exemption to land owners for riparian lands included in a management plan developed by the land owner and ODFW personnel. The Governor's Watershed Enhancement Board gives both private individuals and organizations an opportunity to become involved in watershed rehabilitation projects.

Wild and Scenic Waterway Issues

Sections of the Metolius River are designated a “scenic waterway” under the Oregon Scenic Waterways Program. The scenic waterway includes the river and its shoreline and all tributaries within a quarter of a mile of its banks, excluding the river and its tributaries within the boundaries of the Warm Springs Indian Reservation and off-reservation Indian trust land. The program protects the free-flowing character of designated rivers for fish, wildlife, and recreation. Dams, reservoirs, impoundments, and placer mining are not allowed on scenic waterways. The program is designed to protect and enhance scenic, aesthetic, natural, recreation, scientific, and fish and wildlife qualities

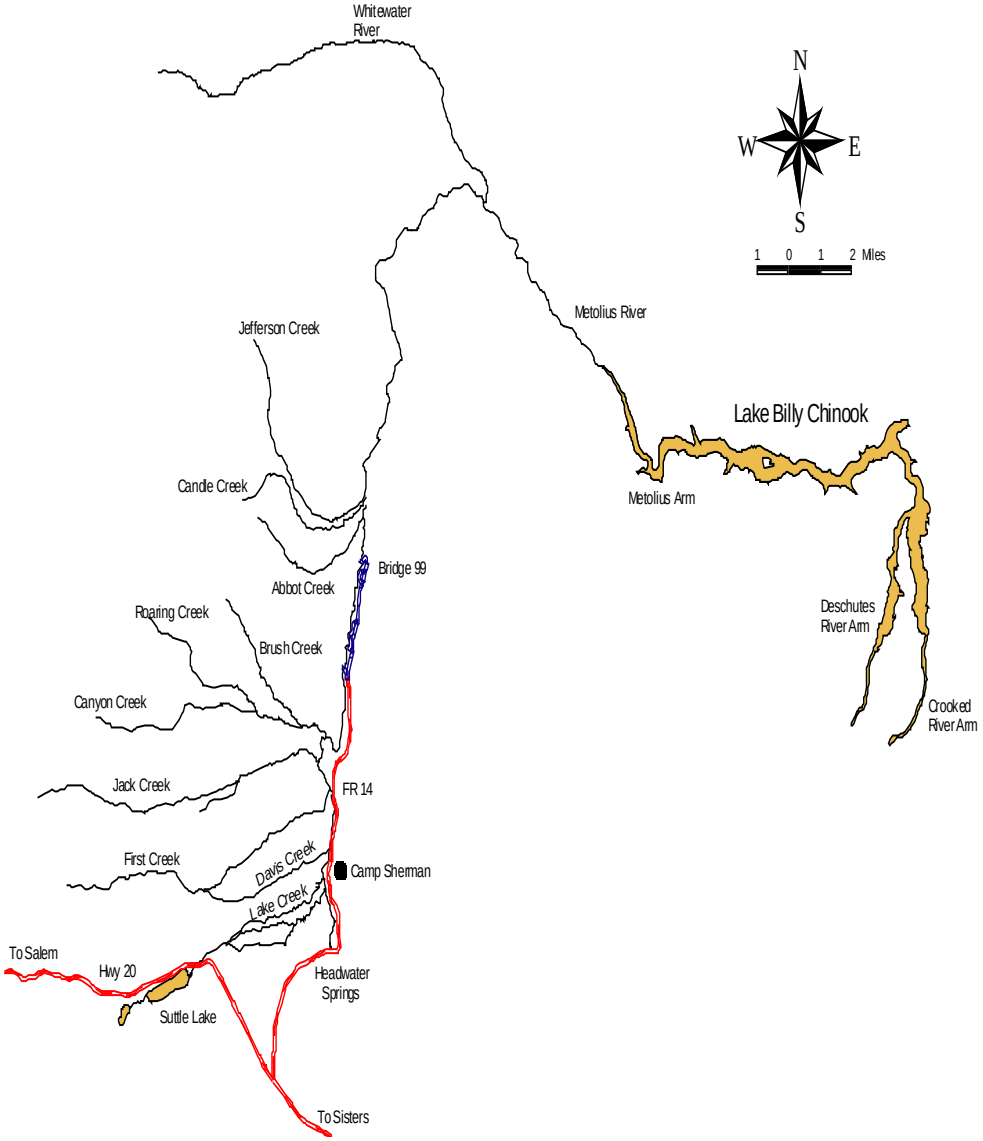
along scenic waterways. New development or changes in existing uses proposed within a scenic waterway are reviewed before they may take place.

The Metolius River was added to the national Wild and Scenic Rivers System in 1988. Wild and scenic river designation strengthens protection given under the state scenic waterways program. Timber harvest, road building, mining, and grazing can be regulated to reduce adverse impacts on the designated rivers. Designation of these rivers within the wild and scenic system provides access to increased federal funding for management of the rivers.

Tribal Authority to Co-Manage Fish and Wildlife in the Basin

The Confederated Tribes of the Warm Springs Reservation of Oregon is the modern-day political successor to the seven bands of Wasco- and Sahaptin-speaking Indians of the mid-Columbia area whose representatives were signatories to the Treaty with the Tribes of Middle Oregon of June 25, 1855, 12 Stats. 963. Article I of the treaty describes the 10 million acre area of eastern Oregon ceded by the tribes to the United States and sets out the boundaries of the Warm Springs Indian Reservation. Article I also contains the express reservation by the tribes to "the exclusive right of taking fish in the streams running through and bordering said reservation...and at all other usual and accustomed stations, in common with citizens of the United States."

Streams running through and bordering the reservation to which the tribes have exclusive fishing rights pursuant to Article I of the treaty include the Deschutes, Metolius, and Warm Springs River systems. Streams within the ceded area where the tribes have primary off-reservation rights at usual and accustomed fishing stations include the John Day River, Fifteenmile Creek, and Hood River. Additionally, the tribes claim off-reservation rights at usual and accustomed stations on streams outside of the ceded area, which may be primary, secondary, or co-equal with the treaty rights of other tribes. The Warm Springs Tribes' role as a management entity for purposes of subbasin planning in the upper Columbia River Basin is based on the tribes' exclusive fishing rights in the Deschutes, Warm Springs, and Metolius river systems; primary fishing rights in the John Day River, Fifteenmile Creek, and Hood River; and on the provisions of the recently executed Columbia River Fish Management Plan.



THE METOLIUS RIVER SUBBASIN

INTRODUCTION

The Metolius River basin is one of three subbasins in the upper Deschutes River basin above Round Butte and Pelton dams. The other two are the Crooked River subbasin and the upper Deschutes River subbasin. This plan covers fish management in all of the water bodies within the Metolius River subbasin. The plan is organized into this introduction and three major sections including; the Metolius River and its tributaries, Suttle and Blue lakes, and the twenty-one Cascade Mountain Lakes managed within the basin. Each of the major sections is broken into subsections which address location and ownership, habitat and habitat limitations, access, fish resources, fish stocking, fish management, and management issues. Following this background information is the management direction including policies, assumptions and rationale, objectives and actions.

Overview

The Metolius Basin is situated on the east side of the Cascade Mountains, and ranges in elevation between 10,497 (Mt. Jefferson) and 1,940 (at Lake Billy Chinook) feet above sea level. Geologic features in the basin include the Cascade Mountains, Black Butte, and Green Ridge. The basin is comprised of about 213 square miles of Deschutes NF, 87 square miles of Reservation, and 15 square miles of private lands (Deschutes NF recreation map 1981). The climate is characteristic of a transitional zone between the Cascade Mountains and the High Desert. Precipitation ranges between 10-50 inches per year, mostly in the form of snowfall, and temperatures range from -30^{o}F in the winter to 80^{o}F in the summer (USFS 1996). The Metolius River is the most prominent hydrologic feature in the subbasin and receives flows from three major sources; springs which include the headwaters, Lake Creek which drains Blue and Suttle lakes, and streams arising from the eastern slopes of the Cascade Mountains adjacent the subbasin.

From its springs and major tributary Lake Creek, the upper portion of the Metolius River flows along the base of the Green Ridge Fault. This steep-sided basin creates a variety of geologic features from green valley floors to vertical-walled volcanic canyons and igneous intrusions. The lower river flows between steep ridges. From Jefferson Creek, it flows north between Green Ridge and Walker Ridge. It then turns southeast and flows between Metolius Bench and the east side of Green Ridge. At Perry South, the valley opens up and the river drains into Lake Billy Chinook Reservoir (USFS 1990). The Metolius River subbasin landscape is characterized by forests of pine, fir, and cedar, grassy meadows in the upper river section, and some juniper and sagebrush downstream. Wet meadows are found in the upper portion with an association of alder, willows and various grasses.

Fur trappers and traders were the first non-native visitors to provide written descriptions of the Metolius River area. In 1843, Captain John Fremont explored and

mapped the Metolius River area. The Tribes of Middle Oregon ceded lands to the United States government under treaty signed June 25, 1855. Within the treaty language are descriptions of the lands ceded and those lands conferred in reservations to the bands of the Middle Oregon Indians: ..."thence southerly to Mount Jefferson; thence down the main branch of the De Chutes river heading in this peak, to a junction with the De Chutes River..." This legal description references the Metolius River as one of the first major political boundaries formed within the Oregon Territory.

The first documented non-native settlement of the Metolius River area began in approximately 1870 with the establishment of several homesteads. Several of these homesteads remain in private ownership today. The community of Camp Sherman was established during the 1890's and early 1900's primarily by ranchers and farmers from Sherman and Morrow counties as a retreat and vacation area following harvest of their crops at home.

Having been built between 1910 and 1940, many of the 108 summer homes on the upper portion of the river are potentially eligible for the National Register of Historic Places as either single properties or a historic district. In the area known as the Horn of the Metolius, several parcels of private property were settled as homesteads. Little remains of the homesteads except some fruit trees, and several chimneys constructed of unique rock-work which remain standing (USFS 1992).

Round Butte Dam and powerhouse were completed in 1964, just downstream from where the Metolius and the Crooked River entered the Deschutes River. The resulting Lake Billy Chinook inundated about 12 miles of the Metolius River.

The Metolius River subbasin area is known throughout Oregon, and to a lesser extent nationally, as a beautiful place to fish for trout. Many of the users who visit the Metolius River participate in variety of recreational activities including camping, picnicking, fishing, hiking, floating, tubing, rafting, kayaking, driving, sightseeing, viewing wildlife, nature study, bicycling and horseback riding. Whereas fishing, boating, sightseeing, and dispersed camping are predominant uses along the Metolius from Bridge 99 downstream, summer home properties, camping, and fishing are common uses of the river from Bridge 99 upstream. Fishing is the predominant recreation activity at Blue Lake. Both waterskiing and fishing are popular activities at Suttle Lake.

THE METOLIUS RIVER AND TRIBUTARIES INCLUDING LAKE CREEK

The Metolius River originates from three springs at the base of the north side of Black Butte, near the community of Sisters, and then flows south and east approximately 29 miles to its confluence with the Deschutes River in Lake Billy Chinook. Its major tributary, Lake Creek, originates at Suttle Lake and flows 5.2 RM in an east-northeast direction to its confluence with the Metolius River at RM 39.4 just south of Camp Sherman. The drainage area is 22.2 square miles. Access to Lake Creek is limited, but can be achieved via Highway 126 and Forest Roads 12 and 1419. Tributaries of Lake Creek and their respective lengths include its North (5.3 RM), South (4.5 RM), and Middle forks (2.4 RM). Land ownership is roughly 60% Deschutes National Forest and 40% private. Primary land uses include recreation, timber, farming, and residential.

Current Land Classification and Management

In 1988, Congress designated 28.6 miles of the Metolius River as Wild and Scenic under the Omnibus Oregon Wild and Scenic Rivers Act. The Deschutes National Forest Land and Resource Management Plan ensures that outstandingly remarkable values which allowed the Metolius to be eligible for Wild and Scenic designation will be preserved until that plan is finalized. Outstandingly remarkable values are fisheries, scenery, hydrology, geology, recreation, wildlife, and ecological values.

Under the federal Wild and Scenic Act the reach of river from 2,055 feet below Metolius Springs to Bridge 99 is classed as recreational (RM 41-29.1). The river reach from Bridge 99 to Lake Billy Chinook is classed as scenic (RM 29.1-12). This area includes 9,152 acres located within 1/4 mile on both sides of the river. The State of Oregon designated the Metolius as an interim Recreational Scenic Waterway in 1991 from Metolius Springs to the confluence with Candle Creek (RM 41.2- 29). State designated scenic lands are within the same 1/4 mile on both sides of the river and encompass 4,480 acres. Management of the Wild and Scenic section will be done in cooperation with the Confederated Tribes of Warm Springs and other state and federal agencies. The final Wild and Scenic plan is expected in May of 1996.

Residential lands include primarily single-family residences, many of which have been occupied since the early 1900's. Many of the dwellings visible along the Upper Metolius are private summer homes on long-term lease of USFS land. Jefferson County zoning ordinances limit further development to permitted uses and siting standards listed in the Jefferson County Comprehensive Plan. The State of Oregon has interim rules under the Oregon Scenic Waterways program which limit the type and scope of land development and use (ORS 390.805 and OAR 736-Division 40, Oregon Parks Division policies and other agency administrative rules).

Land on the Warm Springs Indian Reservation adjoining the Metolius is being managed under two different land classifications. A portion of the area is classified as "Forest" open to logging while the other portion is classed "Conditional Use" and is currently removed from the timber base (James Griggs, personal communication, 1993).

The majority of the other lands within the subbasin are administered by the Deschutes National Forest. Deschutes NF land surrounding the Metolius River has been established as the Metolius Conservation Area (Anonymous 1990). This area is divided into ten management areas each with its own standards and guidelines. The goals of the management areas are generally not forest product oriented but emphasize resource protection and enhancement. Some resource extraction is allowed in most management areas. However, the Deschutes National Forest Land and Resource Management Plan (LRMP), completed in 1990, is now out of date; it will be revised according to the resources management plans found in Option 9 (Tom Walker, personal communication, March 1994).

Access

The river can be waded in many areas and access is generally good. Angling from a boat is prohibited. There is a small amount of private property above Camp Sherman with restricted public access between the headwaters and Bridge 99. The opportunity for developed recreation use is provided by 12 campgrounds along the river. Three (day-use) facilities, including one at the Wizard Falls Fish Hatchery, are available. The fish-viewing platform at Camp Sherman Bridge attracts many visitors and affords the opportunity to see large fish that congregate in the river near the bridge. Estimated visitor use at this site in 1991 was 101,587 visits (Paul Engstrom, personal communication, April 1994). A wide variety of recreational opportunities are found at various locations along the length of the Metolius River (USFS 1992).

The upper river is readily accessible from National Forest roads. FR 14 follows along the scenic waterway and provides good access to the river. Many of the roads are open year-round. There are five vehicle bridges and one foot bridge across the river in the stretch between the river's headwaters to Bridge 99. User defined trails parallel both east and west banks of the river except where it passes through private property. There is currently a nine-mile developed trail on the west bank and plans call for an additional 11 mile trail system on the east bank of the river. The Forest Service permits leased homes on the upper river although this area is public property, so access is not restricted, the presence of these homes may discourage some members of the public from accessing this part of the river.

The segment from the river's headwaters to Bridge 99 is one of the more heavily used recreation areas on the Deschutes National Forest. The Camp Sherman to Bridge 99 area receives about 142,500 recreation visitor-days per year based on USFS estimates. A recreation visitor-day is one person visiting for 12 hours. Aesthetics, modern

campgrounds, pleasant water, paved access, summer homes, viewing of the springs at the head of the river, the large rainbow trout at Camp Sherman Bridge, Wizard Falls Hatchery, and challenging trout angling combine to create a tremendous amount of use along the Metolius, especially along the upper 10 miles. Forest Service managers estimate that this segment is receiving close to maximum recreation use for its present recreation environment (USFS 1990).

Recreational rafting on the lower Metolius River has increased in popularity in recent years. People generally put in near Bridge 99 and take out near Monty Campground on Lake Billy Chinook. This section of the river forms the boundary between National Forest lands and the Warm Springs Indian Reservation. The Warm Springs Tribal Council has expressed concern about increased trespass on adjacent reservation lands associated with recreational rafting on the lower river. In 1993 they took action by closing the river to boat traffic. Some state agencies oppose this action. As of this writing the issue has not been settled. No estimates of boating are available. Other recreation in this section include fishing, boating, dispersed camping, and sightseeing.

There is limited access past Bridge 99 via an unmaintained dirt road paralleling the river. A similar road can be found going upstream from Lake Billy Chinook but these two road segments are connected only by a foot trail. There are several small pieces of private land along this road below Bridge 99. The continued existence of the road indicates some use of the lower river but the majority of recreation takes place where access is less difficult and there are developed recreation sites. No road exists on the west bank below Bridge 99. This segment has three developed recreation sites on Forest Service lands (Lower Bridge, Candle Creek and Monty campgrounds). There is some private development in the form of single family residences.

Creating additional access is inconsistent with the draft Wild and Scenic Plan Alternatives. At this time ODFW does not recommend development of more access because most of the river can be reached by car or foot and additional access would likely negatively effect the quality of the riparian area.

Habitat and Habitat Limitations

The Metolius River

The Metolius River is one of the largest spring-fed streams in Oregon. Flows average 100 to 110 cfs at the source, and accrue an additional 1,300 cfs from the tributaries and springs (Kunkel and Marx 1991). Measured at the mouth of the river average high flow (1,653 cfs) occurs in June and average low flow (1,360 cfs) occurs in October (Figure 1). Average flows for a 69-year period from 1913, and 1922 to 1989 were 1,493 cubic feet per second (USGS 1990). The lowest discharge occurred on February 17, 1932 (1,080 cfs)and the highest discharge occurred on December 24, 1964 (7,530 cfs, USGS 1989). The low flow for the drought year 1992 occurred on September

15th (1,140 cfs). The gauge for this data is just above the river's confluence with Lake Billy Chinook (Figure 1).

Prior to formation of Lake Billy Chinook the Metolius River was 41 miles long. It is now 28.6 miles long and remains a swift-flowing stream with an average gradient drop of 35 feet per mile. The river above Bridge 99 has a lower gradient than areas below Bridge 99. Pool, riffle, and glide characteristics are not as well-defined as those of similarly sized rivers; this is due to the fact that it is spring-fed, the lack of flood events, and the relatively uniform gradient within a volcanic bed. The river width averages 50 feet and the water flows in a well-defined channel. There are few wetlands along the mainstem of the Metolius, but several tributaries have extensive marshy areas, particularly in the Lake Creek area.

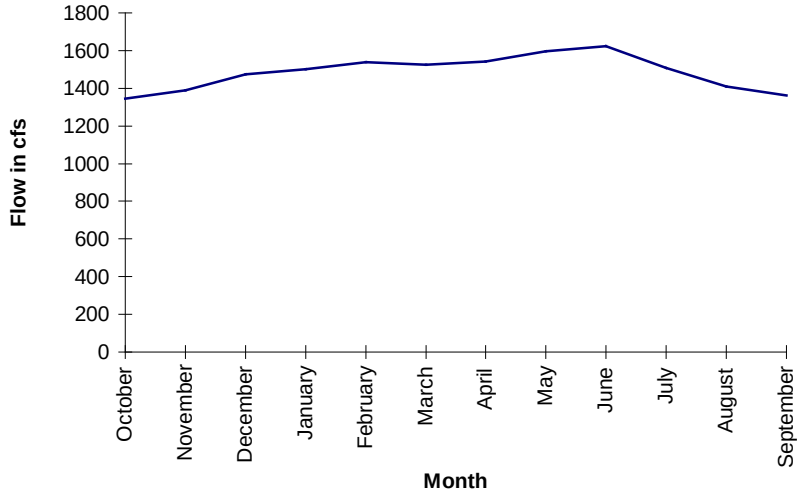


Figure 1. Average monthly flow in the Metolius River near Grandview, OR, 1912-1993.

Water quality is excellent throughout most of the Metolius system due to spring sources in the tributaries as well as in the mainstem. The river is noted for its stable flow pattern which promotes a stable riparian area.

During 1982-85 (average flow years) Fies and Robart (1988) found water temperatures fluctuating between 39 and 51^{o}F between the headwater springs and Bridge 99. The crystal clear water is characterized by conductivity averaging 80 microohms, as compared to 150 in the lower Deschutes River.

Recent measurements have shown that the temperature of the Metolius River downstream from its source springs varies between reaches any given time. It also varies seasonally within a reach of river (Hemmingsen et al. 1992). For example, during June through September 1992, daily maximum temperatures measured one quarter mile downstream from the source springs ranged between 49 and 52^{o}F whereas those at Gorge Campground ranged between 49 and 56^{o}F. Most days during that period, daily

maximum and minimum temperatures at Gorge campground exceeded those measured near the source springs. Measurements obtained from mid-May through July 1993 were similar. Temperatures at Gorge Campground are influenced by Lake Creek, and data suggest that from mid-May through September, warmest temperatures in the Metolius River may occur between Lake Creek and Gorge Campground. Daily maximum temperatures measured at the mouth of the Metolius River during June through September 1992 ranged from 47 to 54^{o}F.

Aquatic invertebrate species composition, abundance, and diversity are an indicator of water quality. Benthic invertebrate composition, abundance, and diversity are good to excellent in the Metolius. Sampling by ODFW in 1938 and again in 1982-83 showed similar results (Holloway 1938; Fies et al. 1988). The first study found 6 orders containing 16 families; the second found 5 orders and 26 families. Collections from the Metolius River and tributaries by the Sisters RD showed similar results (good to excellent abundance and diversity) and were conducted at the highest level of resolution found to date. Two recent samples by the Sisters Ranger District just above Lake Creek have shown an abundance of organisms tolerant to enrichment (Riehle 1993). The cause of this is not known and is under further investigation.

The Metolius has been withdrawn from further out-of-stream water appropriations (ODWR 1967). There is an instream water right for fish on Lake Creek and the Department has applied for these rights on nearly every stream in the Deschutes Basin. Domestic and irrigation water rights are minor. ODFW priorities for screening diversions have been concentrated on Jack Creek because of its importance to bull trout. All of those have now been screened.

Campgrounds and residences on the Metolius are very close to the water's edge. This has lead to a gradual degradation of the riparian habitat through tree and shrub removal for building space, view corridors, aesthetics, increased foot traffic, and safety.

Removal of large woody material from the river and riparian area began in the 1930's to facilitate log rafting. This practice has been continued today for the purposes of obtaining firewood, salvage logging, boating safety, and camping safety. The USFS continues to adjust the position of windfalls above Bridge 99 when boater safety is compromised. In addition to Forest Service management practices, the 1964 flood also caused a substantial loss of large wood from the river channel and riparian areas.

The recruitment of large woody debris into the Metolius is a slower process than in other rivers of similar flow because the river has a smaller watershed and fewer freshets. However, the typically stable flows and lack of freshets favor the retention of large woody material once it falls into the river. Woody material for trout habitat is very limited on the Metolius River because of past removal and the watershed's limited potential for transport of wood throughout the basin. In February 1996, a rain-on-snow event resulted in high flows and debris avalanches in the Metolius River below Bridge

99. Effects of these events are yet to be determined but are suspected to have resulted in significant movement of woody material.

It appears that the riparian area is adequately stocked with large conifers which will eventually improve fish habitat if allowed to enter and remain in the river (Deschutes NF 1991).

For most of its length the river is fast moving with few pools, and fish cover is less than optimal. A 1983 survey found only 4.9% cover suitable for fish over six inches in length from Metolius Springs to Camp Sherman bridge (Robart 1983). Binns et al. (1979) found that adequate cover must approach or exceed 55% of total wetted surface area to maximize trout production. Habitat projects by USFS, ODFW, Trout Unlimited, and PGE in 1983, '84, '85, and '87 have increased fish cover to 5.5% above Camp Sherman bridge but no surveys have quantified the amount of cover added below the bridge from the 1988-89 habitat restoration work (Fies 1993).

Habitat limitations in the Metolius River are:

1. High water velocities and poor pool-to-riffle ratios
2. Low amounts of suitable trout cover that are formed by large woody material
3. Water temperatures are not conducive for rapid trout growth
4. Unscreened irrigation diversions on Lake Creek
5. Partial barriers at Lake Creek Lodge and Suttle Lake outlets
6. Other limitations may be identified following completion of comprehensive stream surveys

A ten-year plan to improve the fish habitat was developed in 1987 (Gonzalez 1986) however, it has been suspended until Wild and Scenic Planning by the USFS is completed. This project is a partnership between ODFW, Deschutes National Forest, and Trout Unlimited. Past habitat enhancement projects have involved placement of boulders, trees and logs in the river to create cover, resting, and nursery areas for trout.

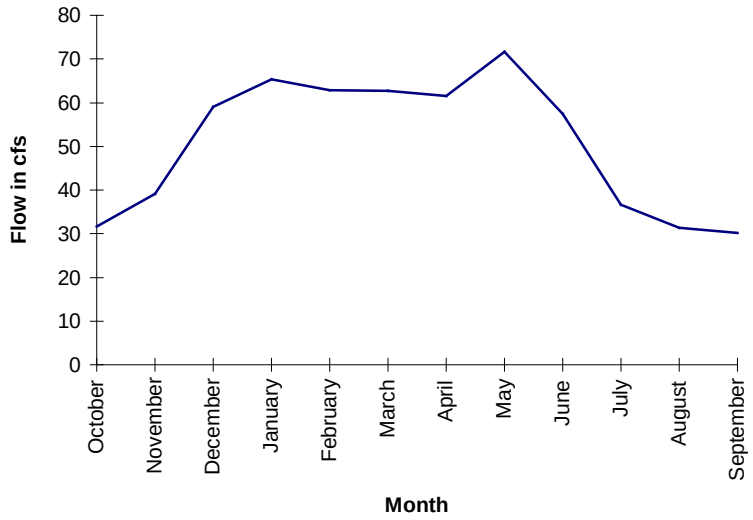
Lake Creek

Several small irrigation diversions exist along Lake Creek with combined water rights of 1.94 cfs. The earliest priority dates are 1911 and 1915 with withdrawal rights of 0.34 and 1.38 cfs.

Complete physical surveys of Lake Creek are lacking for recent years. ODFW surveyed the entire stream in 1966 and the Sisters Ranger District surveyed sections of the stream (1.5 RM for the mainstem) within their jurisdiction between 1989 and 1992. Lake Creek should be placed as a high priority for stream surveys using the R&E Survey Methodology due to its importance as a spawning area for Metolius River rainbow trout and its potential for use by bull trout and anadromous fish if they are reintroduced.

In 1966, ODFW surveyors characterized the spawning gravel composition through the entire stream length as 132 square yards of good gravel and 161 yards of marginal spawning gravel. The bulk of the gravel was found downstream of road 1419 and included 95 square yards of gravel rated as good and 161 square yards rated as marginal spawning gravel. The pool:riffle ratio was 30:70 for the entire stream length. USFS surveys for the upstream 1.5 river miles found a bankfull width/depth ratio of 8 with pools representing 3 percent of the total habitat area. Gradient through the section averaged 2 percent. Dominant substrate was sand and cobble subdominant. Wood material classified totaled 85 pieces per mile including 10 large pieces per mile. Riparian vegetation was dominated by alder and vine maple with white fir as the dominant species in the area. Special problems identified were culverts at Forest Road 12 and a 1.5 ft high concrete structure at the outlet of Suttle Lake. Another possible barrier exists just downstream of Rd 1419 at the diversion gate for Lake Creek Lodge. This is a seasonal barrier in place during the summer recreation season.

Hydrograph information indicates that flows increase in December and peak in May (Figure 2). Minimum flows typically occur in September.



Fgure 2. Average monthly flow in Lake Creek, 1966-1992.

Water temperatures recorded in 1994 by the USFS near the South Fork of Lake Creek found average temperatures of 59, 66.2, and 62.6^{0}F in June, July, and August with a maximum temperature of 75.2^{0}F in July.

USFS personnel surveyed 2.0 miles of the South Fork, 2.2 miles of the North Fork, and 2.0 miles of the Middle fork. Summaries include the following information:

	South Fork	North Fork	Middle Fork
Width/depth	6	7	6
Pool Percent	16	10	1
Wood/mile			
Total	240	322	136
Large	21	32	25
Substrate			
Dominant	Cobble	Gravel	Sand
Subdominant	Gravel	Gravel	Gravel

FISH RESOURCES

Anadromous

Historically, the Metolius basin produced runs of spring chinook and sockeye salmon. The spring chinook run was on the order of several hundred spawning adult fish annually (Wallis 1960). Counts of spawning salmon in the Metolius River and tributaries (Lake, Spring, and Jack creeks) and Squaw Creek, plus salmon trapped at the Fish Commission weir on the Metolius, totaled 765 fish in 1951 and 512 in 1953, the highest years recorded (Nehlsen 1994). These fish migrated as far as the headwaters, near where the springs surface, and into Lake Creek to spawn and rear.

Sockeye salmon also once migrated up the Metolius River and into the Lake Creek-Suttle Lake complex to spawn, but this anadromous run also no longer exists. The last sizable run of sockeye in the Metolius was 227 adults reported in 1955. However, most of these adults likely were hatchery returns from the Oregon Fish Commission's Metolius Hatchery on Spring Creek (Nehlsen 1994).

Although the sockeye run was suppressed by the 1930's due to passage problems on Lake Creek near the outlet of Suttle Lake, both the spring chinook and the sockeye salmon were eliminated from the basin with the construction of Pelton Dam (Lake Simtustus) in 1956 and Round Butte Dam (Lake Billy Chinook) in 1964 (Fulton 1970).

The presence of spring chinook was last documented by spawning ground counts in 1967. Although fish passage facilities were built into the Pelton-Round Butte Dam complex and adults were able to pass upstream to spawning grounds, downstream facilities for juvenile fish were never installed. Smolts migrating to the ocean were either not able to find the fishway or were killed in the turbines. Attempts were made to capture and transport migrating juveniles, but this was not successful.

A reference (Fulton 1970) was found stating that steelhead were native to the Metolius, but elders from the Confederated Tribe of Warm Springs do not believe they were indigenous (Terry Luther, personal communication, 1993). There is also no historic data within the Oregon Department of Fish and Wildlife's records to indicate that there were once steelhead in the basin. It is possible that steelhead may have been present, but in very small numbers.

Resident

Indigenous resident fish species in the Metolius basin are redband trout, mountain whitefish, bull trout, shorthead sculpin, longnose dace and largescale sucker. Introduced resident fish are brown trout, and brook trout. Suttle and Blue lakes were reported (Newcomb 1941) to contain an abundant population of indigenous land-locked blueback salmon (kokanee). These land-locked sockeye salmon were likely offspring of anadromous parents.

Resident fish are found throughout the basin. The mainstem of the Metolius and Lake Creek provide spawning and rearing habitat for redband, brown, and brook trout, kokanee, and whitefish. Bull trout and rainbow trout are present throughout most tributaries of the system with the exception of Lake Creek from which bull trout have been extirpated.

History and Status

Redband Trout

Rainbow trout are indigenous to the Metolius River and are classified as inland redband trout. Because of a lack of barriers, it is likely Metolius River rainbow were once a part of the Deschutes River rainbow/ redband trout complex of populations. Principal redband trout production areas above Lake Billy Chinook include the mainstem Deschutes up to Steelhead Falls, Squaw Creek, Crooked River and Metolius River. The amount of genetic interchange between these areas has not been studied, but historically there were no physical barriers to stop movement of fish. The Metolius River has long been known as a popular area to flyfish for rainbow trout. Beginning in the 1920's hatchery rainbow trout were used to supplement the sport fishing demand on the Metolius River.

In recent years there has been increasing concern about the status of redband trout in the Metolius River. In those sections which have been monitored the abundance of potential spawners is thought to be less than 500 fish. While it is not clear how these numbers compare to historical numbers or to the current habitat potential, densities of fish are very low - especially in the areas open to fishing. Factors which may be responsible for this condition include:

1. Competitive interaction with hatchery fish
2. Introduction of maladaptive genes into the wild population from naturally spawning hatchery fish
3. Loss of woody debris (habitat limitations)
4. Hooking mortality of catch and release angling - particularly on spawning fish
5. Illegal angler take of wild fish

This combination of factors suggests that wild Metolius redband trout are likely at significant risk and in a potential conservation crisis. Unfortunately, it is unknown what

the status of these fish is outside of the 4-mile stretch which has been monitored nor exactly how many populations and life history forms may currently co-exist within the basin.

In June 1992, a fish kill occurred on the North Fork of Lake Creek as a result of 25 to 30 lbs of copper sulfate being applied to a private pond along the creek. The treatment was made to control algae growth within the pond. An estimated 264 rainbow and brown trout were killed in approximately 1 mile of stream as a result of the treatment. Their are no known ongoing effects from this incident.

Bull Trout

Bull trout are indigenous to the Metolius River basin. Bull trout were historically found throughout most of the Deschutes River basin (Ratliff et al. 1994). A major native American and pioneer fishery occurred on the Upper Deschutes River at Pringle Falls (Ratliff and Fies 1989). There are many historical photos of large bull trout or "Dolly Varden" as they were called from both the Upper Deschutes River near Bend and from the Metolius River basin. Bull trout were extirpated from the Upper Deschutes River in the 1950's (Ratliff et al. 1994).

Up to about 1960, bull trout were trapped and removed from the Metolius River in conjunction with operation of a weir to collect salmon for hatchery brood, because of predation on spring chinook eggs and juveniles. Metolius River bull trout were at severely depressed levels as recently as the early 1980's. Recent redd counts (see Figure 3 and Table 1) on the entire known spawning area and trapping on Jack and Jefferson Creeks indicate a likely rebound of the population. Population estimates in Table 1 are equal to the total redd count for spawning areas in the basin multiplied by the adult-to-redd ratio. Two population estimates are presented for 1993, one using the Jack Creek adult to redd ratio, and one using the Jefferson Creek ratio. Since these counts index only a portion of the population, Metolius bull trout appear to be in compliance with the Wild Fish Management Policy with respect to population size criteria of 300 spawners. Work is continuing to obtain estimates of the bull trout population and confirm the upward trend in numbers. Data from 1993 trap counts and spawning ground surveys indicate an even higher population than previously recorded.

Tributaries such as Jefferson Creek, Canyon Creek, Roaring Creek, Jack Creek, and Candle Creek provide a majority of the known spawning and early rearing habitat in the Metolius Basin for bull trout. Abbot Creek is also reported to have supported bull trout (Foster 1957). Although juveniles are present, other fish do not use these tributaries for spawning or rearing to any notable degree.

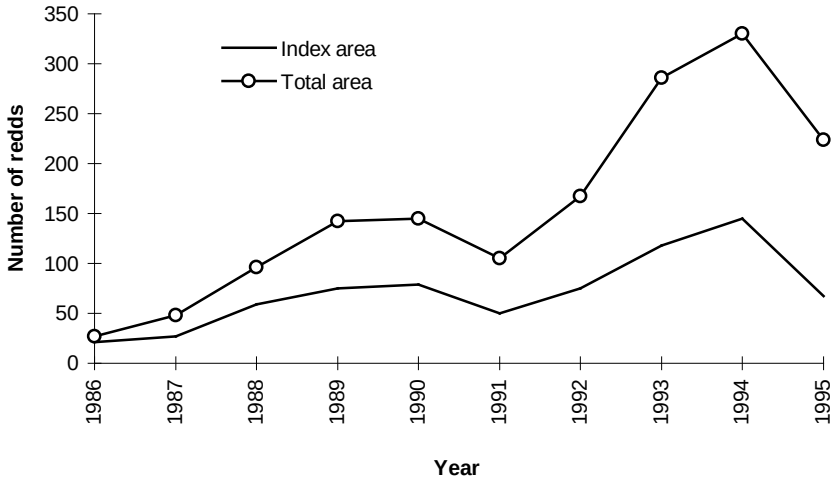


Figure 3. Total (15.9 RM) and index (6.1RM) bull trout redd counts in the Metolius River, 1986-1995.

Table 1. Number of adult bull trout and redds counted above upstream migrant traps in Jack and Jefferson creeks used to compute spawner population estimates, 1990-1994 (from Ratliff et al. 1994).

Year	*Redds	Adults	Adults/Redd	Total Redds	Population Estimate
	Jack Creek			Metolius River Basin	
1990	44	106	2.4	145	348
1991	#14	76	5.4	105	567
1992	37	91	2.5	159	397
1993	50	108	2.1	287	603
	Jefferson Creek			Metolius River Basin	
1993	109	252	2.3	287	660
1994	81	349	4.3	330	1,422@
	Canyon Creek			Metolius River Basin	
1994	110	241	2.19	330	723

* redds counted above traps # in 1991, the adult/ redd ratio is suspect due to unmonitored downstream movement of fish below the trap before spawning occurred @- barrier impassable in 1993 was passable in 1994 which opened 3 miles of potential habitat and likely accounts for high adults per redd

Deschutes River bull trout populations in Shitike Creek, Warm Springs and Metolius rivers were once likely part of a much larger fluvial metapopulation which included migration's down to the Columbia River. These populations quite possibly exchanged genetic material with bull trout from the nearby Hood and Klickatat rivers, as evidenced by angler catches of large bull trout in the mainstem Columbia near the mouths of these streams. Construction of the Pelton-Round Butte hydroelectric complex (RM 100) in the early 1960's fragmented this complex of populations, essentially isolating Metolius River spawners from bull trout utilizing Shitike Creek and Warm Springs River.

Pelton-Round Butte dams also blocked adult sockeye, lower river resident redband trout, and spring chinook salmon from accessing the Metolius basin. Juveniles

of these species were most likely important prey items for bull trout. However, an abundant kokanee population has developed in Lake Billy Chinook as a likely prey source.

In summary, due to restrictive angling regulations (Tables 2 and 3) and abundant kokanee as a food source, the adfluvial Metolius - Lake Billy Chinook bull trout appear to be increasing in number although potential hybridization with brook trout which occur in most spawning streams still pose risks to the bull trout population and persistence. The protection of stable spawning and rearing areas in the Metolius River and tributaries by the USFS has preserved the potential for the bull trout population to rebuild to near historic levels.

Table 2. Chronology of protective angling regulation changes enacted in the Metolius River/ Lake Billy Chinook system to prevent overharvest of native trout (from Ratliff et al, 1994).

Year	Location	Regulation change
1980	All Oregon streams	Trout bag limit reduced from 10/day to 5/day
1983	Metolius River	All wild trout including bull trout must be released unharmed
1988	Lake Billy Chinook	Trout bag limit reduced from 10/day to 5/day
1988	Metolius River tributaries	Closed to angling from August 15 through 3rd Saturday in April
1992	Lake Billy Chinook	Trout bag limit reduced to one bull trout/day
1994	Metolius River tributaries	All tributaries below Lake Creek closed to angling

Table 3. Estimated catch (kept and released) of bull trout from Lake Billy Chinook, 1990-1993 (from Ratliff et al, 1994).

Month	1990		1991		1992		1993	
	Kept	Released	Kept	Released	Kept	Released	Kept	Released
March	194	85	156	65	--	--	113	548
April	119	157	68	89	--	--	133	701
May	125	62	53	276	255	11	--	--
June	40	0	251	171	50	10	--	--
July	204	0	21	56	138	31	--	--
August	36	0	193	8	286	0	--	--
September	129	0	59	19	330	84	--	--
October	16	15	79	10	28	85	--	--
Total	863	319	880	694	1,087	221	246	1,249

Mountain Whitefish

The most abundant game fish in the Metolius subbasin are mountain whitefish. Although not actively sought by most anglers, adult mountain whitefish occupy most deep pools in the stream.

Whitefish may compete with trout for food and space. In the Deschutes River, rainbow trout and mountain whitefish share certain food habits. Immature insects of the orders Ephemeroptera, Trichoptera, Plecoptera, and Diptera were commonly found to be consumed by both fish species (Schroeder and Smith 1989). As pointed out by Schroeder and Smith (1989), mountain whitefish are primarily adapted as bottom feeders (Pontius and Parker 1973), and that competition may affect rainbow trout if both species foraged on limited food at the same time of year. However, aquatic invertebrates in the Metolius River do not appear to be limited. The estimated invertebrate standing crop in the Metolius River at Lake Creek and Bridge 99 ranged from 3.2 to 21.2 g/m^2 depending on location and time of year, and were judged to be an excellent level of abundance (Mangum 1988 and 1990).

Whitefish may have increased in abundance as habitat was vacated (and predation decreased) by declining bull trout and as chinook salmon were extirpated with the construction of the Pelton-Round Butte Dam complex.

Detailed population and distribution information on the entire Metolius River whitefish population is lacking. But maximum mountain whitefish numbers from the source springs to Gorge Campground, estimated by snorkel observation throughout 1991, 1992, and 1993, ranged between 100 and 800 individuals. The lowest number counted occurred during March or April whereas highest counts occurred during November each year. Although a few individuals were occasionally observed upstream from the Blue Hole, most were distributed throughout the reach of river from the Blue Hole to Gorge Campground.

Sculpins, Dace, and Suckers

Shorthead sculpin and longnose dace are present in the Metolius River and provide food for larger trout, especially bull trout and brown trout. Largescale sucker are found in small numbers in the lower Metolius and have thrived in Lake Billy Chinook with the inundation of the lower Metolius and Deschutes rivers. Little is known about abundance, distribution, or life history of these species in the Metolius Basin.

Kokanee

Kokanee were indigenous to the Suttle Lake-Link Creek-Blue Lake complex. Kokanee were also stocked in Suttle Lake. Kokanee are currently established in Suttle Lake and Lake Billy Chinook. A run of several thousand fish annually move upstream from Lake Billy Chinook to spawn in the Metolius River. It is not known what the present genetic makeup of the kokanee population is, but genetic samples have been taken in 1993 and are presently being analyzed.

Brown Trout

Brown trout are found in the mainstem Metolius River-Lake Creek-Suttle Lake-Link Creek complex. Suttle Lake maintains an abundant brown trout population through natural reproduction in Link Creek. There are no obstructions preventing brown trout from moving downstream to the Metolius via Lake Creek. Brown trout reproduction is also occurring in Lake Creek.

Information is lacking on brown trout distribution, spawning, rearing and contribution to the creel in the Metolius River. The 1988 study on wild trout (Fies and Robart), found that 23% of the trout population above Camp Sherman was comprised of brown trout. A creel census study in 1975-76 (Ely 1977) showed brown trout comprised 2% of the total fish caught in 1975 and 1% of the total catch in 1976. This creel study was done when all species of trout could be kept in the daily bag limit. Snorkel surveys from February of 1993 through January, 1994 showed brown trout comprised 5% of the total trout (excluding whitefish and kokanee) observed from the headwaters downstream to below Gorge campground (Hemmingsen 1994).

Brook Trout

Brook trout are present in the mainstem Metolius and tributaries; Abbot Creek, Canyon Creek, Jack Creek, Spring Creek, and Brush Creek. Canyon Creek and Abbot Creek support the largest populations. An occasional brook trout is found in the other tributaries. There are also a few naturally reproducing brook trout in Blue Lake and it is possible for these fish to move downstream to the Metolius River via Link Creek, Suttle Lake and Lake Creek. The extent of that movement is unknown but likely affected by the presence of *Ceratomyxa shasta* in Suttle Lake and Lake Creek.

Brook trout are few in number in the Metolius River and are rarely caught. Ely (1977) reported only 10 brook trout caught during the entire 1975 angling season and none in 1976. Fies and Robart (1988) found so few brook trout above Camp Sherman that they did not include them in their species composition summary. Snorkel surveys by Hemmingsen in 1993, from the headwaters to below Gorge Campground, recorded a total of only 6 brook trout.

Fish Stocking History

The first record of stocking in the Metolius River was reported in The Oregon Sportsman (McKay January 1916) when brook trout, rainbow trout, and steelhead were stocked in a variety of Central Oregon waters. No specifics were reported of what species were stocked in which water.

During the period 1931-35, coho salmon and steelhead were liberated in Suttle Lake. These fish could have moved into the Metolius River via Lake Creek. Current stocking records show steelhead were stocked annually in the Metolius River during the

period 1952-57. The Metolius Hatchery on Spring Creek began releasing sockeye salmon juveniles in 1948. Releases continued until 1961 (Oregon Fish Commission 1967).

Artificial propagation of spring chinook began in 1947 with the construction of the Oregon Fish Commission Metolius Hatchery on Spring Creek. An average of 125,000 spring chinook were reared annually (Wallis 1960). Most of the propagated fish were liberated in Spring Creek, but in 1958, over 18,000 were released in Squaw Creek (Wallis 1960). The Oregon Fish Commission operated a salmon rack at several locations on the Metolius during the years 1947-59 (Nehlsen 1994) to collect adult spring chinook.

Hatchery rainbow trout have been released into the Metolius River to supplement sport fishing demand since about 1925. Starting initially with fingerling releases, the program expanded with the construction of Wizard Falls Hatchery in 1947.

Fry and fingerling rainbow trout were stocked in Lake Creek from 1945 to 1948. Numbers released ranged from 15,600 fry in 1945 to 42,000 fingerlings in 1948. Hatchery trout released into Lake Creek discontinued after 1948.

Around 1960, the mean size of stocked fish in the mainstem Metolius River increased to produce legal-size hatchery trout (Figure 4). Although hatchery fish derived from a Deschutes River strain were stocked occasionally, most hatchery fish were either Cape Cod or Oak Springs strains which are not native to either the Deschutes or Metolius river basins. Both those strains are likely derived from McCloud River, California ancestry (Needham and Behnke 1962; Kinunen and Moring 1978). Stocking increased to over 40,000 legal-size trout annually by 1959 and remained at that level until the late 1980's. Since 1988 releases have been reduced to 17,500 legals annually.

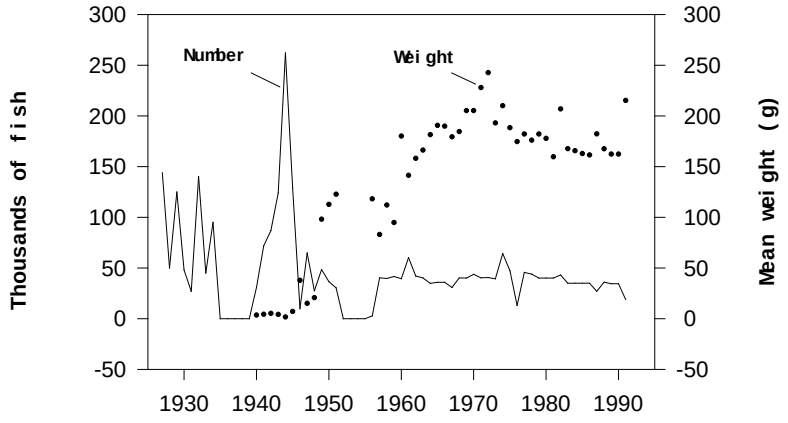


Figure 4. Hatchery rainbow trout stocked in the Metolius River.

Brook trout were most likely stocked in the Metolius basin during the 1912-14 period. The Oregon Sportsman (July 1914) reported that the Fish and Game Commission purchased 1 million brook trout eggs each year from 1912-14 and stocked fry in various streams and high mountain lakes. Specific waters stocked during that time is unknown. The Oregon Sportsman (McKay January 1916) reported brook trout, rainbow trout and steelhead were stocked in Central Oregon waters, including the Metolius River. It is unknown which trout species were released in each water. Brook trout were stocked in Link Creek and Suttle Lake in 1929 according to hatchery diaries and also had access to the Metolius River. Current stocking records show brook trout were released in the Metolius River in 1949, 1951, and 1977. None have been stocked in the stream since 1977.

There is no known record of brown trout stocking in the Metolius River. It is believed they were first released in Suttle Lake and eventually moved downstream into the Metolius River via Lake Creek, the outlet of Suttle Lake. The 1940 lake survey (Newcomb 1941) reported Loch Leven (brown trout) trout were common in Suttle Lake. Newcomb also reported brown trout were stocked in Suttle Lake in 1938 and 1939. Current stocking records (since 1945) for Suttle Lake show brown trout were planted in 1967, 1972, 1979 and 1980. None have been stocked since 1980.

Hatchery kokanee have been released into the system. Wallis (1960) noted that kokanee eggs were taken at Link Creek in 1950 and that blueback (sockeye- Washington and Bonneville stock) eggs were brought in as early as 1947. Current stocking records for Suttle Lake show kokanee were released in 1954 and last released in 1973. There has been no stocking since 1973 and their population has been maintained by natural reproduction.

Angling Regulations

The Metolius River is one of the better known fly fishing streams in Oregon. The river from Lake Creek upstream to the headwaters is closed to all angling to protect spawning adults and rearing juveniles (its importance as a spawning area was not well documented until 1990). The mainstem Metolius River above Bridge 99 to Lake Creek is restricted to fly angling only and portions of it have had such a restriction since 1939. From 1945 to 1955 Lake Creek was closed to angling.

In 1968, catch and release regulations (barbless flies) were imposed on a 1/2 mile section of the stream above Camp Sherman. The regulation reduced angling pressure, but it was not popular and was removed in 1969. Current regulations on mainstem Metolius include fly fishing only with barbless hooks above Bridge 99 and no angling above Lake Creek. The mainstem below Bridge 99 is restricted to barbless flies and lures only (no bait) except a 1/2 mile section below Bridge 99 allows bait with barbless hooks. No angling is allowed within 100 feet of the Camp Sherman Bridge. Since 1982, the release

of all wild trout except kokanee has been required. Only hatchery rainbow trout (identified by a clipped adipose fin), mountain whitefish and kokanee may be kept.

The current angling regulations for Lake Creek, in 1996, allows the harvest of 5 trout per day between the fourth Saturday in April through October 31. Minimum length of six inches with no gear restrictions. Effective in 1994 the take of bull trout by angling has been closed throughout Oregon, except for lakes Billy Chinook and Simtustus and the lower Crooked and Deschutes rivers immediately upstream of Lake Billy Chinook.

Fishery

Fishing occurs year-round. In contrast to the summer fishing activities, winter angling is usually done by the "serious" fisherman for longer periods of time. These anglers prefer the "off" season because there are fewer anglers. One commercial fishing guide was previously permitted by the USFS to use the Metolius but there are currently no fishing or rafting guides permitted to use the river.

The popularity of the Metolius River for angling is well known. In the 1920's when the Department began trout stocking the Metolius there were fewer anglers. Complaints of poor fishing, department studies verifying low trout populations, and strong local support resulted in construction of the Wizard Falls Hatchery currently operated by ODFW. Although originally constructed to produce trout specifically for the Metolius River, it is now producing trout for other waters throughout the state.

An angler survey conducted on anglers using Central Oregon waters in 1991 (Lewis) found that anglers preferred to use a variety of methods to catch fish, with 39% favoring flies. Of the 209 respondents out of 700 surveyed, 84% fished Central Oregon for trout or kokanee. The majority (65%) felt that angling pressure was not too high, while 31% felt that there was too much pressure. Respondents favored existing fly fishing regulations but opposed (63%) adding any more waters to this restriction. Eighty percent were in favor of fly fishing regulations on the Metolius while 11% opposed them. The question of more restrictive bag limits had almost equal numbers of people opposed and in favor. Two fish per day was the predominant suggestion from those in favor of restricting take. Continuation of the existing trout stocking programs were favored by the majority of respondents but there was a significant number of people who had no opinion. On the Metolius River 34% wanted to continue stocking, 22% were in favor of an increase, 5% wanted a decrease in stocking, 20% were in favor of eliminating stocking, and 9% had no opinion. In comparison, people surveyed about the fish stocking practices overall in the Deschutes basin had the following preferences: 31%, continue stocking at current levels, 14% increase stocking, 2% decrease stocking, 10% eliminate stocking, and 27% no opinion.

Angler surveys conducted by ODFW and the USFS indicate anglers on the Metolius River fish for an average of one hour at a time (Lewis, 1991; James et al., 1990).

The remainder of the day is often spent in other recreation activities. The U.S. Forest Service estimated 120,000 people visited the Head of the Metolius in 1991 while use at all fee campgrounds totaled over 49,000 visitors. The Metolius area includes nine resorts of varying sizes; some have year-round residents as well as high levels of transient use.

Fish Management

The Metolius River is currently managed under the 1981 Metolius River Fish Management Plan. In this plan, naturally-reproducing trout (redband, bull, brown, brook) are managed with emphasis on wild fish and must be released unharmed by anglers. Hatchery rainbow trout (fin-marked), kokanee, and whitefish are managed with emphasis on basic yield and may be kept by anglers. This plan will supersede the 1981 plan.

The objective of the current program is to provide an opportunity for a large number of anglers to harvest legal-size rainbow trout. However, a high percentage of anglers do not catch trout in spite of the annual stocking of about 17,500 hatchery rainbow trout. Crystal clear water, fly angling only, high angler density, and rapid angler turnover contribute to the lack of success (ODFW 1981).

A statistical creel census was conducted in 1975 and 1976 (Ely 1977). In 1975 a total of 21,079 anglers caught 40% of the planted rainbow, 38,356 anglers caught 48% in 1976. ODFW guidelines require at least 40% of hatchery fish must be harvested to justify a hatchery legal-size trout stocking program (ODFW 1987). Catch rates varied by section of the river. In 1975 the catch rate of hatchery rainbow averaged 0.27 fish per hour and in 1976 it was 0.35 fish per hour. The Department has since released hatchery trout weekly during the summer season to improve the catch percentage, increased the average fish size at release, dropped the number stocked (from 38,567 in 1976 to 17,500 since 1988), changed stocking locations, and length of the stocking season as mentioned above. The statistical creel data collected nearly 20 years ago may not be very applicable to today's fishery and new information on fishing pressure is needed.

The Lake Creek system is currently managed for natural production only. Fish have the ability to move freely downstream between Suttle Lake, Lake Creek, and the Metolius River. Some hatchery fish have been found low in the creek system that apparently entered the system following stocking in the Metolius River (information below). The only physical features limiting fish movement (upstream) are those man-made partial barriers noted earlier at Suttle Lake and Lake Creek Lodge.

The high gradient and semi-remote nature of the lower river has always made fish sampling extremely difficult. The sampling that has been conducted (1981-84 and 1991-present) has been concentrated in the upper 4 miles (of 28 total miles of river). This area is believed to be a significant spawning area, but its relationship to other likely and yet unidentified spawning areas is unknown.

Studies

Complete population abundance and distribution studies have never been conducted throughout the entire 28 miles of river. Two studies of the Metolius River rainbow have been conducted since 1980. One began in 1981 (Fies et al. 1988) and another in 1991 and is still underway.

In 1981 ODFW began a four-year study entitled Metolius River Wild Trout Investigations (Fies and Robart 1988). Objectives of the study were to study population dynamics of the wild trout population in the upper river above Camp Sherman, describe trout habitat and quality, map and describe instream cover above the Camp Sherman bridge, generate a biomass estimate in an area of typical habitat, increase trout biomass by providing additional instream cover, conduct an angler preference survey, and determine if wild rainbow are genetically similar to redband trout. No significant population or distribution studies have been done in the lower river.

The study area was located in the upper 2 miles of the Metolius above Camp Sherman bridge. Fish were collected using a pram-mounted electrofishing unit with a crew of five. Sampling was done in May and September each year. Continuous sections of stream were sampled. Fish tagging began in September 1983 using dangler and Floy tags. Four-hundred and fifty-eight wild trout of all species (> 6") and 133 hatchery trout were tagged. Hatchery trout were tagged and released at their normal release sites in August one week prior to electrofishing in the first week of September. The study's major findings are as follow:

1. From 1982-85 a total of 4,669 naturally-produced trout (all species) were sampled during spring and fall above Camp Sherman. The maximum number of trout sampled during any single effort was 753 wild rainbow, 66 brown trout, and 35 bull trout in the fall of 1983. These figures are not a population estimate and only represents a partial sample of trout present in the area. Results showed that the trout population was dominated by rainbow which comprised 73% of the total (Fies and Robart 1988). Brown trout totaled 23% and bull trout 4%. Sampling showed a 3-fold increase in abundance from spring to fall. A few brook trout and one cutthroat were also observed.

2. About 58% of the trout population above Lake Creek was composed of rainbow trout less than six inches indicating part of this area is used for spawning and rearing. Fies et al. (1988) found more fish of all species greater than 12 inches in the Metolius above the confluence with Lake Creek than below the creek. This may be indicative of difference in habitats as well as a result of the area above Lake Creek being closed to angling.

3. Eight maturing wild rainbow trout averaged 10.4 inches in length.

4. Of 458 wild trout of all species tagged only 18 (3.1%) were recovered. Eleven of these 18 recoveries came from the original tagging location, two trout moved

upstream 300-1,500 feet and five moved downstream 300 feet. Recovery rates of the 133 tagged hatchery rainbow also remained low (3.8%) during the investigation's tagging study. No information was provided on their recovery locations. Fish movement, unreported mortality and tag loss may have contributed to this low recovery. Ely (1977) found an overall average of 80% of hatchery fish not moving, 12% moving downstream of their stocking location, and 8% moving upstream. It is not completely known what happens to unharvested hatchery fish but some are lost to natural mortality, some move down to the lower Metolius, and some holdover in the upper river.

5. Above Camp Sherman, only 4.9% of the total wetted surface area was identified as trout cover.

6. Water temperatures are not optimal for maximizing trout growth.

7. The stream bank condition and fish food abundance were rated as excellent above Camp Sherman.

8. Biomass estimates above Lake Creek ranged from 48-80 pounds of trout per surface acre.

9. An angler preference survey interviewed 1,289 anglers. Eighty-nine percent were Oregon residents and 81% had fished the Metolius previously. The four most important reasons for fishing the Metolius were to enjoy the out-of-doors, to enjoy the uniqueness of the area, to flyfish, and to enjoy fishing as a sport. The two least important reasons for fishing the Metolius were to catch a lot of fish and to catch wild fish only. Approximately 39% of those interviewed were willing to accept catch-and-release of wild trout, 52% were willing to accept 1-5 fish per day, and 9% were willing to accept a 5-10 fish per day.

10. Genetic analysis (electrophoresis) of wild rainbow trout showed a strong possibility that hatchery rainbow trout released into the Metolius survived and spawned with the native trout.

Beginning in 1991 additional on-going studies have been undertaken in the Metolius Basin including Lower Lake Creek to investigate life history of wild rainbow trout and potential interactions between hatchery and wild rainbow trout. These studies have been conducted by ODFW Research staff using snorkel counts from the source to Gorge Campground (approximately 4 miles). This information is summarized below:

1. Redband trout spawning occurs from November to July with peak activity in December.

2. Eight-six percent of the spawning observed was taking place above Camp Sherman. Spawning occurred throughout the study area, as far downstream as Gorge Campground.

3. The percentage of total redds each year that occurred between the source springs and Lake Creek ranged from about from 75 to 90 (Figure 5). Most of the remainder (10 to 25%) occurred downstream from Camp Sherman Bridge.

4. The number of wild fish increases in the upper river during winter, indicating that a spawning run is occurring.

5. Hatchery rainbow trout are more abundant in reaches below Camp Sherman bridge, and often moved into the area above Camp Sherman bridge; however, the numbers during spawning appears to diminish and numbers observed that are hatchery trout during December to March are often below 10% of the total number of rainbow trout above Camp Sherman.

6. Abundance of hatchery fish below Camp Sherman combined with low numbers of wild fish suggest adverse spatial interactions.

7. There is genetic and meristic evidence of introgression between redband and hatchery rainbow trout.

8. Redband trout in the Metolius River are at least partially susceptible to *Ceratomyxa shasta* (Hemmingsen and Buchanan 1993). Differences in susceptibility between the upper river population and the population below Bridge 99 suggest that introgression between wild and susceptible hatchery stocks is taking place in the upper river fish.

9. Estimates of hatchery/wild ratios can be greatly influenced by date and location of sampling. The introgressive effects of such ratios subsequently depends on the breeding structure of both populations and the size of individuals within each population.

10. Hatchery fish have been seen spawning while wild satellite males swam nearby.

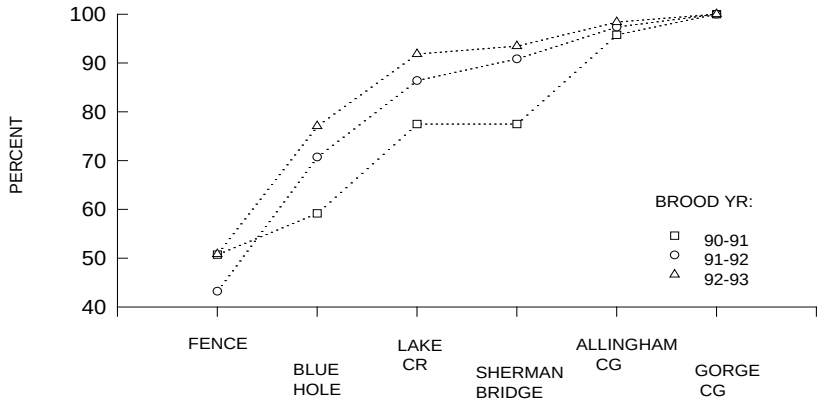


Figure 5. Cumulative percentage of redds that occurred between the source springs and the various reach boundaries shown.

Inventory in Lake Creek conducted by ODFW research personnel in 1991 found species composition to be 87% wild rainbow and 13% brown trout in the survey section that extended from FR 1419 downstream to the Metolius River confluence. Observations from November 1991 included the following information:

Species	Size	Number
Rainbow trout (wild)	2-4"	26
	4-8"	11
	>8"	11*
Brown trout	<8"	0
	>8"	7
Bull Trout	any	0

*(15 additional hatchery fish were observed)

In addition, snorkelers observed 11 rainbow trout redds. Snorkelers noted that visibility was poor in most survey sections. Surveyors found Lake Creek contained 40-45% of the total number of rainbow trout redds observed in Lake Creek and the Metolius River (source to gorge) in all months for 1991. Counts totaled 76 redds from observations made in April (2 counts), May and November. Inventory has not been collected in areas upstream of the survey section.

Estimates of trout abundance have also been made by snorkel surveys of the upper river during this study period. The number of redband trout 8 inches or larger (adults) that were observed in the upper 4 miles of the Metolius River never exceeded 500 any

month from March 1991 through December 1993 (Figure 6). Fewest numbers of fish were seen from March or April through most summer months. Numbers increased during fall months and peaked during winter.

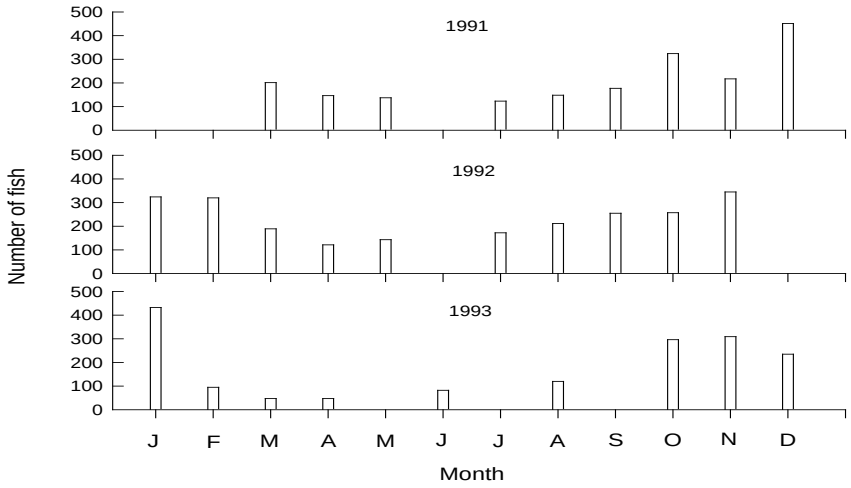


Figure 6. Redband trout 8 cm or larger counted in the upper 4 mi of the Metolius River (Hemmingsen and Buchanan 1993).

When the monthly mean numbers of new redds (Figure 7) are compared to the monthly mean numbers of large redband (Figure 8), it is apparent that spawning occurs during times of high adult abundance. That the abundance of adult redband trout during fall and winter exceeds the abundance during spring and summer, suggests a spawning migration of mature fish. Further and more extensive surveys are needed to determine the origin of the spawners found to migrate.

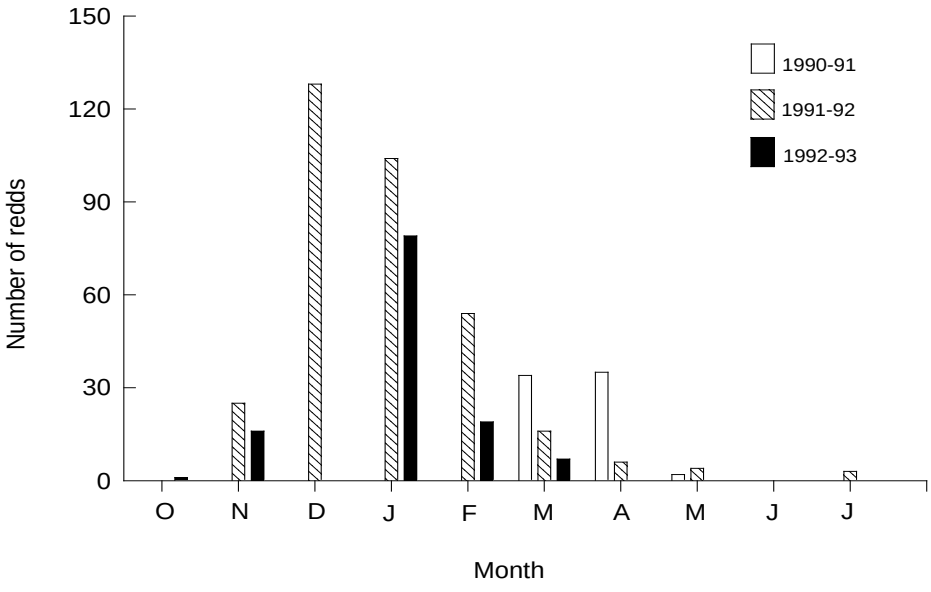


Figure 7. Redband trout 8 cm or larger counted in the upper 4 mi of the Metolius River (Hemmingsen and Buchanan 1993).

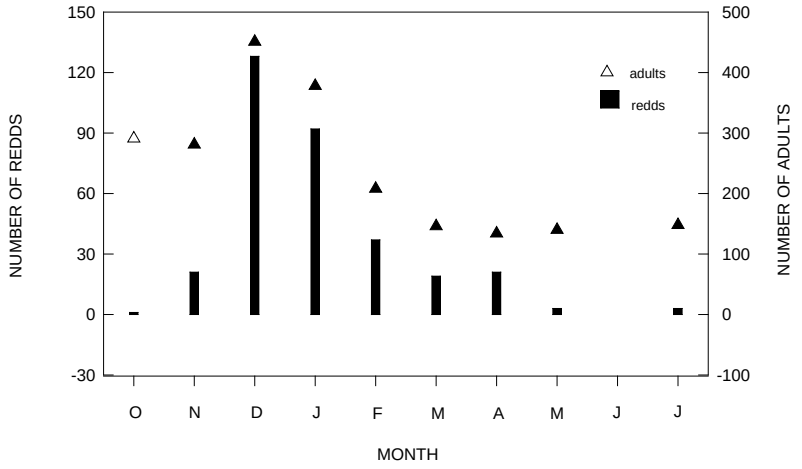


Figure 8. Monthly mean counts of adult redband trout and new trout redds in the upper Metolius River during 1991, 1992 and 1993 (Hemmingsen and Buchanan 1993).

Results of studies to date indicate that numbers of adult wild trout in the upper 4 miles may be extremely low (<500 fish). There also appears to be significant potential for spawning overlap between hatchery and wild fish. Peak spawning in the study area by redband trout occurred in December-January; the same time as Cape Cod hatchery trout used in the Metolius River spawn at the hatchery.

Fish samples were collected from wild trout populations above the Camp Sherman Bridge (the upper two miles of the basin) for genetic analysis in 1985. These samples were analyzed for allozyme (protein) frequencies and meristic characteristics. Native redband trout from the Deschutes River basin were shown to be typical of inland Columbia Basin redband trout, while both the Cape Cod (stock 72) and Oak Springs (stock 53) hatchery strains were shown to be typical of coastal rainbow trout. Naturally produced redband trout in the Metolius River were found to have some allozyme frequencies and meristic characteristics that are intermediate between the inland Columbia Basin and Coastal types. These intermediate character values may have resulted from interbreeding between hatchery and wild fish (Currens 1987).

Additional allozyme analysis by Leary (personal communication) produced similar results to Currens' in the upper basin, but showed less potential hatchery influence in the lower Metolius River. A mtDNA survey by Williams (personal communication) demonstrated substantial genetic variation in the Metolius samples but was inconclusive regarding potential interbreeding between hatchery and wild fish.

A potential consequence of interbreeding between hatchery and wild fish in the Deschutes Basin may be a decrease in resistivity to a disease called ceratomyxosis

(Hemmingsen et al. in review). Ceratomyxosis is caused by infection by the myxosporidean parasite *Ceratomyxa shasta*, and can cause high mortality in susceptible salmonids. Some salmonid populations, however, are resistant to the disease and this resistivity appears to be inherited. The parasite is present in Suttle Lake and was found during tests by ODFW in 1990 and 1991 to infect susceptible hatchery trout held in the lake and in Lake Creek. Deschutes Basin redband trout populations below the Pelton/ Round Butte Dam complex have been shown to be resistant to the parasite. The redband population in the upper Metolius River, however, has been shown to be less resistant to *C. shasta* than other Deschutes populations. This relatively lower resistivity in the Metolius population may be the result of interbreeding between susceptible hatchery and resistant wild fish (Hemmingsen et al. in review). If this is the case, interbreeding between hatchery and wild fish may be lowering the reproductive fitness of the wild population.

The occurrence of *C. shasta* population in the Metolius River appears, however, to have a variable effect on fish. For example, during the 1990 and 1991 tests in Suttle Lake, susceptible hatchery fish were also held between the mouth of Lake Creek and Bridge 99 but did not become infected by the parasite. According to Utley et al. (1975), the development of ceratomyxosis is strongly related to the temperature of water where susceptible fish reside. Low water temperatures in parts of the Metolius River may inhibit development of the disease. Therefore less resistant individuals, either from hatchery plantings or wild fish, may survive without infection in the Metolius, at least during some years. This variation in susceptibility due to water temperature may increase the probability that some susceptible hatchery fish survive to interbreed with wild fish. The variation in susceptibility due to water temperature may also produce some natural variation in the level of resistance to the parasite in the wild population.

It is unknown whether the patterns of allozyme, meristic, and disease resistivity variations in the upper Metolius is an artifact of the long-standing hatchery program, or whether the pattern is natural. It is also unknown whether the population or population segment in the upper basin is representative of the population in the other 24 miles of stream. Further surveys and research are needed to answer these questions. Currently the wild population size, population distribution and structure, and hatchery-to-wild ratios are unknown for the entire basin.

In response to the undesirable interaction between wild and hatchery rainbow, the uppermost hatchery stocking location was changed in 1993 to see if this would result in less interaction with wild fish. Fish were not stocked after July or above Allingham Campground (stocked down to Bridge 99) but the same numbers were released. Although the number of hatchery fish observed during spawning above Camp Sherman was significantly reduced following this action, it is unclear if this effect was found throughout the unsampled downstream reaches of the river. Snorkel counts by researchers will continue to document the fish interactions. Wild Fish Management Policy states that hatchery stocks which are not from the same genetic base (these fish are not) are limited to less than 5% hatchery fish spawning with the natural population.

Management Issues

1. The status of bull and redband trout within the Metolius Basin is not healthy - while bull trout appear to be rebuilding somewhat, redband trout numbers are low and pose conservation concerns.
2. There is no precise understanding of the impacts of stocking hatchery rainbow trout on native bull trout and redband trout with respect to potential competitive interactions and displacement.
3. ODFW and the Confederated Tribes of Warm Springs are interested in reestablishing spring chinook and sockeye salmon in the Metolius River system. The CTWS currently have a measure pending before the Northwest Power Planning Council requesting that the Bonneville Power Administration fund a feasibility study on upstream and downstream fish passage past Round Butte and Pelton Dams.
4. The potential to develop a local brood stock program using wild Metolius redband trout is limited and not recommended by ODFW because:
    a) The apparent history of interbreeding between the wild Metolius redband and hatchery coastal rainbow may have compromised the fitness of the current wild population. Any such impacts should decrease over time due to natural selection, if interbreeding between hatchery and wild fish is decreased. A wild-type broodstock should not be developed for several generations to allow possible fitness impacts caused by the past hatchery program to be removed from the wild gene pool.
    b) A wild-type hatchery broodstock would have to be managed to maintain wild-type phenotypes. For example, spawning time phenotypes in the hatchery would have to track those in the wild. In the Metolius wild population, spawning times extend from October through June. Such wide, spawning distributions are difficult to maintain and manage in the hatchery.
    c) The population structure in the Metolius, including potential population subdivision is unknown.
    d) It would be difficult to meet hatchery production goals while maintaining wild-type phenotypes. In order to meet management goals (such as a 40% minimum catch rate), a minimum release size of 3 fish per pound (10" average size) is necessary. Progeny from the later-spawning brood would need special manipulation to reach this size at release which would compromise the goal of maintaining wild-type characteristics.
    e) There is evidence that at least some wild spawners are migratory. This characteristic would have to be maintained in a wild-type broodstock. However, migratory hatchery fish may move away from stocking locations and thus interfere with desired management goals of providing hatchery fish for harvest in specific locations.
    f) The redband trout population size is currently unknown, but appears to be depressed compared to historical numbers. Wild Fish Management Policy requires that no more than 25% of the wild adult spawner population may be

used on any given year for hatchery broodstock development. Until wild redband trout numbers are better quantified, ODFW recommends the population should be allowed to recover before wild spawners are removed from it for a broodstock.

5. Upstream fish passage is limited by low head barriers at Suttle Lake and Lake Creek Lodge.
6. Irrigation diversions on Lake Creek are unscreened.
7. Lake Creek originates as surface outflow from Suttle Lake which causes water temperatures to rise in summer months above levels preferred by bull trout.

MANAGEMENT DIRECTION

METOLIUS RIVER SUBBASIN

POLICIES

Policy 1. Indigenous redband trout, kokanee salmon, mountain whitefish, and introduced brown and brook trout in the Metolius River shall be managed for natural production consistent with Wild Fish Management Alternative for trout (ODFW 1987).

Policy 2. Bull trout shall be managed for natural production consistent with the Featured Species Management Alternative for trout (ODFW 1987).

Policy 3. No hatchery fish shall be stocked in the Metolius River and tributaries.

Policy 4. Reintroduction of anadromous populations of spring chinook and sockeye salmon in the Metolius River will be pursued if the opportunity is physically, ecologically, and economically feasible.

Policy 5. Provide a fishery for hatchery rainbow trout in an off-channel pond.

OBJECTIVES

Objective 1. Maximize protection of genetic diversity, adaptiveness, and abundance of redband trout, bull trout, kokanee, and mountain whitefish in the Metolius River and tributaries.

Assumptions and Rationale

1. Redband trout, bull trout, kokanee salmon, and mountain whitefish are self-sustaining in the Metolius River and tributaries and have been identified on the Department's provisional list of wild fish populations.

2. Wild Metolius River rainbow trout have been identified as inland redband trout and are classified as a sensitive species under the state sensitive species act, and as a Category 2 candidate species under the federal Endangered Species Act.

3. Bull trout in the Metolius Basin are classified as a sensitive species under the state Endangered Species Act and have been listed as a Category 1 candidate species under the federal Endangered Species Act.

4. Considering recent trends of continually increasing numbers of spawners, it is believed that bull trout are currently "under-escaped" and that potential/ historic habitats are underseeded.

5. Monitoring distribution and abundance of wild rainbow trout, bull trout, kokanee, and mountain whitefish in the Metolius River will provide an indication of their stock fitness and adaptiveness.

6. Extensive numbers of non-native hatchery rainbow trout have been introduced into the Metolius River since the 1920's.

7. Interbreeding of hatchery trout with redband trout may decrease the genetic fitness of wild Metolius River trout.

8. Abundant numbers of hatchery fish released into waters occupied by resident redband trout may pose a competitive interaction which may result in decreased abundance of wild trout.

9. Electrophoresis, meristic measurements, and disease resistance studies have determined that hatchery rainbow trout have interbred with redband trout of the upper Metolius basin.

10. Genetic fitness of Metolius River redband trout may have been reduced as a result of interbreeding with past releases of *Ceratomyxa shasta* susceptible hatchery rainbow trout.

11. Special angling regulations may be needed to protect stock fitness, life history characteristics, and population health of redband trout, bull trout, kokanee salmon, and mountain whitefish.

12. The continuing genetic and ecological impacts of hatchery fish on redband trout will be removed with cessation of hatchery trout releases.

13. Abundance of redband trout should be maintained and potentially increased over time with the cessation of hatchery trout releases.

ACTIONS

Action 1.1 Discontinue stocking of hatchery rainbow trout in the Metolius River.
Action 1.2 Through development and implementation of a research project, expand the current wild trout life history studies to identify other possible spawning and rearing areas and better define population characteristics including size and age at maturity, spawning frequency, and migration patterns.

Action 1.3 Monitor population trends of fishes in the Metolius River and tributaries. Population trends will be determined through such things as statistical creel surveys, electrofishing-fishing (where feasible), trapping, snorkeling, and spawning ground surveys.

Action 1.4 Determine the need for additional or modified angling regulations to protect populations of redband trout, bull trout, kokanee salmon, and mountain whitefish by monitoring the production, harvest, catch rate, and hooking mortality in Metolius River fisheries.

Action 1.5 Continue periodic sampling of biochemical and meristic characteristics of rainbow/redbands, kokanee salmon, and bull trout. Establish baseline data on these parameters for mountain whitefish.

Action 1.6 Work with USFS, BLM, the Confederated Tribes of the Warm Springs Indian Reservation, Portland General Electric, private forest owners, conservation groups, and other interested publics, in the development and of a bull trout conservation plan for the Metolius/ Lake Billy Chinook population complex. Determine and prioritize future work on limiting factors for such items as instream habitat, harvest, migration barriers, and interactions with introduced species, i.e. brook trout. Determine the feasibility of returning bull trout to former habitats in the Metolius basin, including areas such as Lake Creek, Link Creek, and Suttle Lake.

Action 1.7 Work with USFS, BLM, the Confederated Tribes of the Warm Springs Indian Reservation, Portland General Electric, private forest owners, conservation groups, and other interested publics, in the development and of a redband trout conservation plan for the Metolius population complex. Determine and prioritize future work on limiting factors for such items as instream habitat, harvest, migration barriers, and interactions with introduced species.

Objective 2. Provide angling opportunities for a diverse fishery on naturally produced redband trout, bull trout, brook trout, brown trout, kokanee salmon, and mountain whitefish.

Assumptions and Rationale

1. Under this alternative, restrictive angling regulations will likely be continued in order to provide a fishery for a large number of anglers, which will allow wild trout to maintain themselves at sustainable levels.

2. Wild trout and mountain whitefish may increase and occupy space vacated by hatchery fish. During summer months, fishing for trout will likely provide lower than current catch rates initially, following termination of hatchery trout stocking.

3. Because of the migratory life histories of wild trout in this system, angling opportunities in some of the area of the Metolius River currently stocked may exhibit seasonal fluctuations in abundance of fish after the cessation of hatchery stocking.

4. Many anglers on the Metolius River do not know how to properly release fish unharmed. This may lead to mortality rates that affect the abundance of trout available to catch.

5. Natural production of brown trout and brook trout is adequate to sustain a non-consumptive fishery. Brook trout are predominately found in tributary streams currently closed to angling to protect spawning and rearing bull trout.

6. Tackle restrictions associated with the current fly fishing only angling regulations probably limit angler catch effectiveness.

7. There is significant demand for recreational opportunities to catch and release wild fish through fly angling only.

ACTIONS

Action 2.1 Implement actions 1.2, 1.3, and 1.4 to satisfy wild fish population monitoring requirement under this objective.

Action 2.2 Conduct periodic angler surveys to estimate catch rates, species composition, and angler effort in order to monitor success of meeting this objective.

Action 2.3 Develop an information and education program to enhance angler awareness of the status and life history requirements of sensitive species such as bull trout and redband trout.

Action 2.4 Educate Metolius River anglers on how to catch and release fish unharmed. Post signs at popular fishing sites informing anglers of how to identify and correctly release redband and bull trout.

Action 2.5 Implement a cooperative enforcement and information and education program with OSP to ensure compliance with regulations.

Action 2.6 Publicize information on the desirable attributes of whitefish as a game fish and associated angling opportunities.

Action 2.7 Evaluate current angling regulations to determine opportunities to provide more catch of abundant species such as mountain whitefish, without affecting sustainability of any wild fish species.

Objective 3. Develop a site and provide an opportunity for juveniles to angle for trout on a standing water body in the vicinity of Camp Sherman.

Assumptions and Rationale

1. Catching wild fish by fly angling in the Metolius River is a challenge for even the most experienced anglers and is not conducive to juvenile angling.

2. The Metolius River will continue to be a recreation area visited by families who either camp or stay in accommodations in the Camp Sherman vicinity.

3. There is a demand for juvenile opportunities to angle where the likelihood of catching a fish is high.

4. Hatchery-produced rainbow trout provide for greater opportunity for juvenile anglers to catch fish.

5. Families visiting the Camp Sherman areas of the Metolius River are not likely to leave the vicinity of Camp Sherman to find standing-water fishing opportunities for their children.

6. Providing and managing for a standing-water fishing experience is compatible with Wild and Scenic River management.

7. Providing a specific site for juveniles fishing would enhance opportunities to educate the public to the values of wild fish and their management.

8. A site and water is available to develop a standing water body.

ACTIONS

Action 3.1 Investigate opportunities to construct and maintain a pond with barriers to contain hatchery fish at the old Metolius Salmon Hatchery site in Camp Sherman. If this site is not feasible, investigate in priority order; 1) waste abatement pond at Wizard Falls Hatchery, and 2) Jack Lake and/or Round Lake.

Action 3.2 If the site and opportunity is feasible, manage the pond fishery under a modified Basic Yield Alternative for trout (ODFW 1987) using a marked *C. shasta* resistant hatchery rainbow stock.

Action 3.3 Work with partners identified in Objective 8 to provide opportunity for educational programs at the sites.

Action 3.4 Monitor the fishery through creel surveys to determine the catch rate and appropriate stocking rate for maintaining the fishery.

Action 3.5 Establish regulations that restrict the creel limit to sustain the opportunity and are consistent with management of the Metolius River.

Objective 4. Provide angling opportunities with a fishery for large bull trout.

Assumptions and Rationale

1. Bull trout are a self-sustaining wild fish in the Metolius basin. The Metolius River has historically produced large bull trout, and there is strong public interest in angling for these large trout.

2. Special regulations are necessary to protect stock fitness, life history characteristics and general health of the populations.

3. Both fluvial and adfluvial populations of bull trout occur in the Metolius basin; they spawn in tributaries and use the mainstem for rearing and as a migration corridor.

4. Abundance and timing of bull trout utilizing mainstem Metolius River may be influenced by the presence and abundance of hatchery rainbow trout.

5. Abundance of adult bull trout necessary to meet this objective may be influenced by the fishery in Lake Billy Chinook.

6. Availability of bull trout larger than 24 inches in the Metolius River is necessary to meet this objective. This minimum size is based on the necessity of allowing female bull trout to reach maturity and spawn prior to harvest in the Lake Billy Chinook fishery in

order to meet Objective 1 of this plan. In the Metolius River system, most female bull trout mature for the first time at age 6 at approximately 24 inches in length.

ACTIONS

Action 4.1 Implement Actions 1.2 and 1.3 to satisfy wild fish population monitoring under this objective.

Action 4.2 Determine the need for additional or modified angling regulations in the Metolius River and downstream in Lake Billy Chinook to protect populations of wild bull trout by monitoring the production, catch rate, harvest, and hooking mortality in Metolius River and Lake Billy Chinook fisheries.

Action 4.3 Develop an information and education program to enhance angler awareness of the status and life history requirements of bull trout.

Action 4.4 Conduct periodic angler surveys to estimate catch rates and angler effort in order to monitor success of meeting this objective.

Action 4.5 Implement a cooperative enforcement and information and education program with OSP to ensure compliance with regulations.

Action 4.6 Post signs at popular fishing sites informing anglers of how to identify and correctly release bull trout.

Objective 5. Develop subbasin specific knowledge that integrates fish distribution and abundance information, habitat characteristics, habitat restoration opportunities, and sensitive watershed areas into the Department's Habitat Database system.

Assumptions and Rationale

1. Better understanding of factors that affect fish distribution and abundance will lead to more effective habitat protection and restoration.

2. Computerization of the database will allow ready access by anyone in ODFW to information necessary to address habitat protection issues.

ACTIONS

5.1 Inventory stream and watershed characteristics that affect fish production.

5.2 Promote increased interagency sharing of inventory information.

5.3 In coordination with USFS, BLM, private landowners, and volunteers, survey streams to determine specific habitat problems and opportunities for habitat protection projects.

5.4 Ensure that all survey information is entered into the Habitat Database system.

Objective 6. Protect, enhance, and restore wild fish habitat in the Metolius River Basin.

Assumptions and Rationale

1. Although ODFW does not have regulatory authority over the management of most land and water resources vital to fish production, and Department does influence management of aquatic habitat by federal and state agencies, private interests, and individuals. ODFW will continue to work with habitat managers and regulatory agencies to protect wild fish habitat and to develop and implement rehabilitation and protection plans.

2. Fish habitat has been degraded over the years through removal of instream and shoreline cover, unscreened irrigation diversions, and water withdrawals from tributaries.

3. Frequency and abundance of large woody instream structure was greater historically than at present time.

4. Wild trout populations are limited by available habitat.

5. An increase in amount and quality of aquatic habitat will result in an increase in wild fish populations.

6. Instream water rights adequate to protect and enhance passage, spawning, and rearing for wild fish populations have not been secured. The current instream water right is significantly less than existing flows and likely will not provide adequate habitat for maintenance and enhancement of wild fish populations.

7. Land use practices associated with timber harvesting can reduce fish production in forested watersheds.

ACTIONS

Action 6.1 Use Sisters Ranger District surveys and ODFW Physical and Biological surveys to determine the most effective locations and type of restoration activities.

Action 6.2 Plan and implement restoration activities in cooperation with USFS, CTWS, PGE and other interested parties, when the USFS Wild and Scenic planning process is complete.

Action 6.3 Evaluate all restoration work to measure success in increasing fish populations and habitat quality/ quantity.

Action 6.4 Work with the Sisters Ranger District, Jefferson County, and other property owners to minimize future damage to riparian areas and repair past damage from the impact of campgrounds, river trails, and other development.

Action 6.5 Educate the public about the importance of fish habitat protection and restoration in the Metolius River basin.

Action 6.6 Seek protection of instream flows necessary to maintain wild fish habitat.

Objective 7. Maintain bank angler access to the Metolius River.

Assumptions and Rationale

1. Access to the Metolius River is adequate for the present use.

ACTIONS

Action 7.1 Work with the Sisters Ranger District, Confederated Tribes of Warm Springs, and private landowners to maintain access to the Metolius River.

Objective 8. Pursue feasible means of restoring anadromous populations of spring chinook and sockeye salmon to the Metolius River.

Assumptions and Rationale

1. Spring chinook and sockeye were historically distributed throughout the Metolius River.

2. Providing downstream passage for chinook and sockeye smolts through the Pelton-Round Butte Dam complex will be integral to restoration of these stocks to the Metolius River basin. Upstream passage for adult salmon was adequate at Pelton-Round Butte dams likely will need to be enhanced.

3. These restoration efforts will be compatible with Wild and Scenic River designation.

4. Lower Deschutes River stocks of spring chinook may be suitable as parent stock.

5. A stock of sockeye salmon could be found to use as parent stock if existing kokanee are not suitable to produce an anadromous population.

6. Restoring these stocks would improve the diversity of the fish community in the Upper Metolius River.

7. These fish may bring diseases to the Metolius basin which are currently not present.

8. Fish screening may be necessary to prevent entrainment of smolts at Round Butte and Pelton Dams.

9. These populations will initially need to be started with hatchery fish.

10. These reintroduction's have the opportunity to restore the ecological relationships which previously existed in the Metolius River fish community.

11. Population levels may be reached which will sustain a recreational fishery.

12. Sockeye restoration efforts would be enhanced by improved upstream passage over a number of barriers in Lake Creek. Irrigation diversions on this creek would need to be screened.

ACTIONS

8.1 Conduct a feasibility study to determine if it is physically and biologically possible to restore spring chinook and sockeye salmon to the Metolius River.

Objective 9. Develop an education project in the Metolius Basin to inform the public about the benefits of natural ecosystem restoration and enhancement, including fish and habitat management.

Assumptions and Rationale

1. The Wild and Scenic River planning now being done by federal and state agencies will provide for use compatible with this objective.

2. Managing the Metolius River to contribute to Oregon Benchmarks environmental education goals will contribute to achieving wild fish management objectives in the basin.

3. This will be a cooperative project between ODFW, USFS, conservation groups such as Oregon Trout, Trout Unlimited, Friends of the Metolius, and other interested parties.

4. The public will become better informed about wild fish and their ecosystem through these efforts.

ACTIONS

Action 9.1 Form partnerships with interest groups to develop educational material for public distribution at area stores, information outlets, lodges, and campgrounds, that describe the direction and importance of fish habitat maintenance and restoration in the Metolius basin.

Action 9.2 Update educational displays at Wizard Falls Hatchery and Camp Sherman Bridge to reflect the importance of wild fish and the policies under which the Metolius is being managed.

Action 9.3 Propose to the USFS that the educational efforts be incorporated into the pending Wild and Scenic Management plan.

Action 9.4 Implement Actions 2.3, 2.4, 2.5, 2.6, 3.3, 3.5, 3.6, 5.3, and 5.5 of this plan to satisfy public education requirements of this Objective.

SUTTLE AND BLUE LAKES SUBBASIN

Suttle and Blue lakes and Link Creek

Location and Ownership

Suttle Lake

The name "Suttle" is a misspelling of its discoverer, John Settle, who also found Blue Lake while working on the Willamette Valley and Cascade Mountain Military Wagon Road in the 1860's (Johnson, et al 1985).

Suttle Lake is located in the Deschutes National Forest approximately 40 miles northwest of Bend adjacent to US Highway 20, the major roadway accessing the area from the Willamette Valley or Central Oregon. Forest Road 2070 provides direct access to the lake from Highway 20. Suttle Lake is an extremely popular and heavily used outdoor recreation area. Recreation activities include fishing, swimming, camping, picnicking, water-skiing, windsurfing, and boating. There is a private resort at the east end of the lake, a lodge at the north end of the lake, and a number of private church camps located in the vicinity of Blue, Scout, and Suttle Lakes.

Forest Service land surrounds Suttle Lake and Forest Road 2070 follows the south lakeshore. A trail surrounds the lake providing access for bank anglers. There are four Forest Service campgrounds; they are Link Creek, South Shore, Blue Bay and Suttle Lake campgrounds. Boat launch sites are located at the northeast and southwest ends of the lake and one on the south shore. There is a 10 mph speed limit for motorboats from 8 p.m. to 9 a.m. PST on entire lake, and from 9 a.m. to 8 p.m. PST outside the area marked for water-skiing at the west end of lake. This regulation is designed to minimize conflicts between boat anglers and water skiers.

The Department considers access and facilities adequate at this time for both bank and boat fishing.

Link Creek

Link Creek is 0.6 miles in length and flows in a north-east direction into Suttle Lake from Blue Lake. Land ownership is 83% private and 17% Federal (USFS). Federal lands extend from Suttle Lake upstream 0.1 mile. Access is via Forest Road 2070. Primary land use is private with the stream corridor in a natural state.

Blue Lake

Blue Lake is situated in the Deschutes National Forest one-half mile west of Suttle Lake and is accessed via Forest Road 2070.

A private resort is located at the east end of Blue Lake near the outlet, Link Creek. About 50% of the rocky, forested shoreline at Blue Lake is in private ownership. The

remainder of adjacent lands are public, divided between Oregon State Parks and Deschutes National Forest. Adjacent lands on the south and west shores of Blue Lake include Elliott R. Corbett Memorial State Park. The park is preserved as a wilderness area, with minor recreational development inside its boundaries. Public use of this park is light, as it is accessible only by trail.

Prior to 1946, no facilities existed on Blue Lake. There is now a resort with cabins, RV hookups, campgrounds, rental boats, and an adjacent airfield. Access to the lake is FR 2070 past Suttle Lake and then through private land bordering the east shore. A public access agreement between the property owner and the Department was established in 1959. The department stocks the lake with fish in exchange for free public access. Some angling can be done from shore, but the majority of the fish are caught from boats. The resort owner allows free boat launching and limited parking. A trail exists around the lake, but most of the bank fishing takes place on the northeast shore.

Blue Lake is a small lake with adequate access for its fishery and steep shoreline topography. The trail surrounding the lake allows foot access to the entire shoreline and the single private boat launch is probably adequate for a lake this small. The Department and resort operator do need to maintain adequate signing designating public access points.

Habitat and Habitat Limitations

Suttle Lake

Suttle Lake was glacially formed during the Pleistocene Epoch and filled when the glacier retreated. It is approximately 253 acres in size and the maximum depth is 75 feet. The average depth is 44 feet and the lake has a volume of 11,200 acre feet. The shoreline is 3.6 miles in length and approximately 10 percent of the lake is classified as shoal area.

The drainage basin area for Suttle Lake is 21 square miles. A few small intermittent streams contribute flow to Suttle Lake during the snowmelt season and sub-surface seepage into the lake occurs through the permeable volcanic rock. The only permanent major surface water inflow is from Link Creek, the outlet of Blue Lake. It is an important spawning tributary for Suttle Lake brown trout, kokanee and whitefish.

Department personnel surveyed Link Creek in 1970 and found approximately 3,000 square yards of spawning gravel through the stream section. The downstream 0.1 stream miles were surveyed in 1979 by USFS personnel. In the survey section, a total of 600 square yards of spawning gravel were classified with 250 square yards rated as "good". Streambed materials were classified as 5% cobble, 55% gravel, 15% sand, and 25% silt with the balance composed of boulder and bedrock. Silts were most prevalent at the inlet of Suttle Lake. Stream gradient through the section was less than 0.05%. Pool habitat represented approximately 60% of the survey area. Riparian condition is good and composed primarily of alder.

There is a substantial barrier on Link Creek at the outlet of Blue Lake that prevents upstream fish passage into Blue Lake. The structure was constructed as part of a small hydropower development. The license for the facility has expired. Major modifications are needed to facilitate upstream fish passage at the barrier.

In February of 1996, Link Creek was impacted by high levels of silt washing into the stream from a large landslide originating on US Highway 20. Reports indicate the greatest affect is occurring to the downstream portion of the stream. Impacts will be assessed in the future to determine total extent of the damage to spawning and rearing habitat.

Suttle Lake's bottom is composed of sand, gravel, and in deeper areas, a thick layer of sediment. Most of the shallow littoral areas are composed of gravel and rock. The lake's shoreline is densely forested with conifers.

Lake Creek, the outlet, is located at the east end. Upon leaving Suttle Lake, it flows northeast 6.5 miles and enters the Metolius River at a point two miles downstream of the headwaters. In 1953, a weir and downstream trap were constructed at the outlet of Suttle Lake. The facility was used to evaluate the potential of Suttle Lake to rear of hatchery sockeye salmon. The weir is no longer in operation.

Surface water temperatures of Suttle Lake reach 70^{o}F in mid to late summer. Dissolved oxygen, pH, and other chemical characteristics are adequate at all depths throughout the lake. The lake is fairly rich in aquatic organisms including two-winged flies (Diptera), and freshwater shrimp (Amphipoda) are especially abundant.

Suttle Lake is reasonably transparent, but clarity may be decreasing due to eutrophication as a result of increased land use activities associated with the lake shore (Johnson et al 1985). Newcomb (1941) found secchi disk readings of 35 feet while several studies in the 1970's reported readings of 14 to 16 feet and measurements in 1982 were 22 feet or lower.

Water sampling in the 70's and 80's found that Suttle Lake has an unusually high concentration of phosphorus for a high mountain lake (Johnson et al 1985). The phosphorus promotes the growth of planktonic algae and the lake has a history of occasional algae blooms. The EPA (1978) found over 80% of the phosphorus was coming from a source near the outlet of Blue Lake. The original source was not determined although a fair amount was naturally occurring. The studies indicated more research should be done to find the exact source of the phosphorus and steps that can be taken to eliminate any unnatural causes.

There have periodic fish die-offs, usually confined to a few hundred kokanee and usually late in the summer following hot weather and heavy algal blooms. Examinations by Department pathologists showed the fish died from a lack of dissolved oxygen most likely caused by a sudden die-off of algae.

The lake is classified as eutrophic, but the various indicators of trophic status are contradictory. The secchi disk readings indicate mesotrophic conditions while the algal community indicates eutrophic conditions. The long mountain winters may limit biological productivity for most of the year, but during the short growing season, high phosphorus levels drive the lake to a higher than expected trophic level (Johnson et al 1985). Bioassays by the EPA (1978) indicate that nitrogen limits algal growth.

Blue Lake

Blue Lake is a natural lake located at an elevation of 3,453 feet. It is a relatively small lake covering 54 surface acres, but has a maximum depth of 314 feet. Because of its great depth and intense blue color, it is often called the "Crater Lake of the Central Oregon Cascades". Only three percent of the lake's surface area is less than 10 feet deep and the average depth is 140 feet. The shoreline is 1.3 miles in length.

Blue Lake was formed by a volcanic explosion which occurred when hot volcanic magma came into contact with ground water. Radiocarbon dating reveals the formative blast occurred about 3,500 years ago. Land adjacent to the lake consists of forested slopes that are extremely steep; much of which is actually part of the original explosion crater that holds the lake. The drainage basin for Blue Lake covers 17 square miles. Water sources include snowmelt runoff from the surrounding slopes, and one intermittent stream entering from the northwest. The source of most of Blue Lake's water is from large springs located 240 feet below the water surface near the east shore.

The water chemistry for Blue Lake is peculiar. The concentration of phosphorus is very high which by itself would classify the lake as eutrophic. However, water transparency is high, dissolved oxygen is not depleted in the hypolimnion and except for an occasional bloom, the populations of phytoplankton are low and the species are indicators of an oligotrophic lake. Blue Lake's lack of productivity and low growth potential for trout makes the use of a fingerling trout program impractical. Link Creek, the outlet stream, has cut through the crater wall on the east and flows one-half mile to Suttle Lake.

Habitat Limitations

The only habitat limitation in Suttle Lake is water quality related. The unusually high phosphorus level promotes excessive algal growth and subsequent die-offs have resulted in minor fish losses of primarily kokanee.

Habitat limitations for Link Creek include:

1. Passage barrier at Blue Lake.
2. Potential effects from flood and landslide event in February 1996.

Habitat limitations for Blue Lake are basically related to low fish growth and survival rates due to low productivity, cold water temperatures, and an absence of spawning habitat.

Fish Stocking History

Suttle Lake

The earliest stocking record found for Suttle Lake was hatchery steelhead and coho in 1923 (10,000 and 5,000 fish respectively), but not every year thereafter. Records show steelhead were released as fingerlings or legal-size in 1953, 1955, and 1956. Rainbow trout, presumably of steelhead origin were observed in angler catches in 1955 and 1956. Neither steelhead nor coho are stocked or present in Suttle Lake today.

Current stocking records show rainbow trout were first released at Suttle Lake as fry in 1945. Rainbow were stocked nearly every year during 1945-1990 with numbers released ranging from 2,999 to 171,023 and size ranging from fry to legal-size fish. In the past, legal-size rainbow trout were stocked in Suttle Lake by the Department each spring, but this program was terminated after 1990.

Legal-size rainbow were only stocked prior to opening weekend of trout season to provide a fishery during the cold water period. As the water warmed, kokanee became active and provided the bulk of the fishery. The parasite *Ceratomyxa shasta*, discovered in the lake in 1967, prevented any carryover of fingerling and legal-size non-resistant Cape Cod rainbow trout. *C. shasta* is found in the infective stage in Suttle Lake and Lake Creek. Brook trout are also susceptible to this parasite which helps to explain why they are not currently present in Suttle Lake.

Parasitic tapeworms and roundworms have caused periodic losses of rainbow trout in past years in Suttle Lake. The virus, infectious hematopoietic necrosis (IHN) has been identified in the Metolius River, but was never isolated in Suttle Lake. Stocking of rainbow trout was discontinued in 1990 after repeated years of poor catch rates and poor fish survival.

It is not known when brown trout were first introduced into Suttle Lake, but Newcomb (1941), reported their presence during a 1940 lake survey. Current stocking records show brown trout were released as fingerlings in 1967 and subsequently as fry or fingerlings in 1972, 1977, 1979, 1980, and 1981. Numbers stocked varied from 2,412 to 29,217. Brown trout stocking was terminated after 1983 because natural reproduction is sufficient to maintain the population.

Current records show brook trout were last stocked in the lake in 1949 when 560 fish were released as 2-4 inch fingerlings. Although 4,914 brook trout were stocked in Link Creek in 1952, there have been no releases of brook trout since then and they are not now present in the lake, but are occasionally observed in Link Creek.

Hatchery kokanee were first introduced in 1954 when 22,291 fingerlings were released. Kokanee were also released in 1961-63, 1965, 1966, 1968, and 1970-73. Numbers ranged from 10,125 to 93,272 fish. They were released as fry or fingerlings. Today, natural reproduction is maintaining the kokanee population.

Surplus Atlantic salmon brood fish (878, 18-30 inches) from Wizard Falls hatchery were stocked only once, in 1967.

Blue Lake

Fish stocking at Blue Lake began in 1945 when 15,570 fingerling brook trout were released. Rainbow trout were first introduced in 1947 as fingerlings (6,030 fish). Steelhead were released only one year, 1953 (9,450 legal-size fish). Kokanee were planted in 1954, 14,972 fingerlings were released. A combination of rainbow and brook trout have been planted in subsequent years with the present program dominated by the stocking of legal-size rainbow trout. Occasionally, excess brook trout brood are also released from Wizard Falls Hatchery into Blue Lake. Numbers range from 627 to 12,904. These fish are large (1 pound or more) and contribute well to the fishery.

The first plant of legal-size rainbow trout was in 1948. Rainbow have been stocked in the lake each year at a rate of 8,000 to 16,750 fish. In 1995, 15,521 rainbow were stocked. They are stocked in small amounts throughout the fishing season to maximize their utilization by as many anglers as possible. Fry and fingerlings have been tried in the past with little success. The lake is relatively non-productive for growing trout, but is ideal for a put-and-take fishery.

Angling Regulations

Suttle Lake

Suttle Lake has had a variety of regulations through the years. The most significant regulation changes are listed below:

1932 Closed to angling from September 16 - April 14 from 1932-1942; bag limit 15 lbs plus one fish, not to exceed 25 fish per day.

1935 Special open season of April 5 -September 20.

1942 Suttle Lake around mouth of Link Creek closed.

1945 Suttle Lake closed to angling within 100 yard radius of Link Creek.

1946 Suttle Lake around mouth of Link Creek and Link Creek closed to angling.

1984 Bag limit in Suttle Lake for kokanee is 15 per day any size, regular trout bag limit applies to other trout.

Currently, Suttle Lake is open for fishing from late April to October 31 with a limit of 10 trout per day, six-inch minimum length. No more than 5 fish can be over 12 inches and of these no more than 2 can be over 20 inches. The season for whitefish is the same, but there is no bag limit. There is a bonus bag limit for kokanee of 25 fish, in addition to the trout catch limit. There are no gear restrictions and angling from a boat while the motor is running is permitted.

Link Creek
Link Creek has generally been closed to angling.

1932 Link Creek closed to angling until April 14, 1942

1945-1996 Closed to angling

Blue Lake
Angling regulations changes for Blue Lake have been few over the years due to the simplicity of the management:

1932 Blue Lake open from April 15 to September 15 during the years 1932-1942; bag limit in Jefferson County 15 lbs plus one fish, not to exceed 25 fish per day.

1951 Bag limits for trout, jack salmon, steelhead and salmon less than 20" in length 10 fish per day, not more than 5 over 12". Closed to angling in Blue Lake within 50 feet of head of Link Creek.

1953 Blue Lake reopened to fishing around the head of Link Creek.

1965 General bag limit of 10 fish per day, not more than 5 over 12", with 2 over 20".

1980 General bag limits for streams and lakes/ponds/reservoirs adopted: 10 trout per day, not more than 5 over 12", not more than 2 over 20" for lakes; 5 trout per day for streams.

1992 Blue Lake bag limit reduced to 5 trout per day.

Currently, Blue Lake is open for fishing from late April to October 31 with a limit of 5 trout per day, six-inch minimum length. No more than 1 fish can be over 20 inches. There are no gear restrictions. There are no restrictions on the use of boats or motors.

Fish Management

Suttle Lake

Fish species historically indigenous to Suttle Lake and Link Creek included bull trout, sockeye salmon, redband trout, mountain whitefish, sculpin and longnosed dace. Suttle Lake currently contains kokanee, mountain whitefish, longnose dace, and brown trout. Hatchery kokanee, brown and rainbow trout have been introduced in past years. Redband trout are no longer present. It is unknown why they disappeared, but may be related to the presence of *C. shasta* and migrational barriers on Lake Creek downstream. At the time of the Department's first extensive survey on Suttle Lake in 1940, the lake also contained brook trout.

Fish species composition has not been taken in Link Creek since the 1970's. At that time, sampling found 30% brown trout and 70% kokanee. The surveys found brown trout to 9 inches in length. Recent snorkeling observations by Forest Service personnel found hatchery rainbow trout, brown trout, brook trout, and whitefish.

Sockeye salmon in Suttle Lake were an indigenous species (Fies and Robart, 1988.; Fulton 1970; NOAA No. 618). Sockeye used Link Creek for spawning and Suttle Lake for rearing. The native run of sockeye in Suttle Lake and Link Creek were reported extinct by 1940, probably due to impassable dams on Lake Creek (Frey 1942), especially at the outlet of Suttle Lake (Nehlsen 1995). Hatchery sockeye were planted in the late 1940's and 1950's in the hope of rebuilding the runs (Wallis 1960). The former Metolius Hatchery (opened in 1947) released sockeye into the Metolius River and Suttle Lake from 1948 to 1961. In the 1950's, a small artificial run of sockeye and kokanee utilized Suttle Lake and its tributaries. Marked sockeye salmon were released by the Department into Suttle Lake beginning with the 1953 brood. In 1958, 10,000 blueback salmon (sockeye) eggs were placed in baskets in Link Creek to evaluate survival. Survival ranged from 62 to 91%.

Counts of adult sockeye at the Pelton trap (Deschutes River) from 1955 to 1962 varied from 30 to 332 adults. The hatchery program for sockeye salmon was not continued and the return of native fish ranged from 7 to 35 from 1957-59 (Nehlsen 1995). No effort to continue the sockeye run was attempted after Round Butte Dam was constructed in 1964.

Since sockeye salmon were indigenous to Suttle Lake and Link Creek, it is reasonable to believe a residual sockeye(kokanee) population existed as well. The 1940 lake survey (Newcomb 1941) reported that land-locked Blueback salmon were abundant. It is unknown if the indigenous form of kokanee are still present in Suttle Lake. Samples have been collected for electrophoretic analysis, but results are pending. Kokanee stocks from Colorado, Montana, and British Columbia were released in Suttle Lake and the present stock may be a blend of those three plus any influence from indigenous stocks.

Bull trout were present in Suttle Lake as reported by (Newcomb 1941). The last record of bull trout by the Department was an angler caught fish in 1961. It is believed they were vulnerable to overharvest by anglers and spawning migrations to and from the Metolius and Deschutes rivers were hampered by dams in Lake Creek.

Nearly all of the current natural reproduction of whitefish, kokanee, and brown trout in Suttle Lake takes place in Link Creek. There may also be some limited beach spawning along the lake shore by kokanee, however, that has not been well documented.

Fish populations in Suttle Lake are monitored periodically by using multiple-size mesh gillnets set in the spring and by taking lengths of mature spawning kokanee in the fall. In addition, creel census on opening day of trout season also provides information on status of fish populations.

Fish inventory using gillnets was last conducted in spring of 1992. Four gillnets captured 40 brown trout and 125 whitefish. Brown trout ranged from 7 inches to over 20 inches and whitefish ranged from 7-12 inches. Brown trout females at that time were maturing at an average fork length of 12.8 inches. All brown trout were in rather poor body condition with an average condition factor of 1.09. The brown trout population in Suttle Lake is very abundant and it is common to see fish in poor body condition. Additional harvest of brown trout could easily be sustained at Suttle Lake.

The Department constructed a weir on Link Creek in the 1960's for the purpose of evaluating hatchery release of different stocks of kokanee, and later for capturing brown trout and kokanee for egg collections. Fish were collected for eggs periodically through the 1970's, but disease concerns, small-size kokanee, difficult access to the weir in early winter and extensive maintenance problems caused termination of the program. However, the weir was used again in the 1980's to block off spawning runs of kokanee to reduce the number of kokanee in Suttle Lake and thereby increasing the average fish size. Anglers were complaining about the small size of kokanee. Those efforts resulted in increasing the average size (fork length in inches) of mature kokanee from 9.8 inches in 1984 to 14.3 inches in 1990 (Table 4).

Table 4. Average fork length (in inches) of mature kokanee spawning in Link Creek, tributary to Suttle Lake, 1984-1994.

Year	Average fork length (in)
1984	9.8
1985	no sampling
1986	10.8
1987	11.5
1988	12.3
1989	13.0
1990*	14.3
1991	no sampling
1992	no sampling

Table 4. Continued.

1993	13.4
1994	10.8

***** In 1990, the weir was not installed and kokanee were allowed to spawn throughout Link Creek.

In the late 1980's, discussions with from kokanee anglers indicated they preferred a more abundant population of fish in the lake. The weir was removed in 1990 and by 1994, the average size of spawning kokanee had decreased to 10.8 inches. Current angling regulations include a 25 fish bonus bag limit for kokanee in Suttle Lake and recent opening day creel census indicates more kokanee are being harvested (Table 5). For the period of 1990-95, opening day creel checks showed kokanee constituted 96% of the harvest with the remainder comprised of brown trout, whitefish, and legal-size rainbow trout which had moved downstream from Blue Lake.

By monitoring the annual spawning run and periodically using the weir in Link Creek to block off spawning kokanee, the size and number of kokanee available to the angler can be regulated.

Table 5. Opening day creel census at Suttle Lake showing fish per angler and fish per hour, 1990-1995.

Year	Fish per angler	Fish per hour
1995	5.20	1.73
1994	8.30	3.16
1993	1.24	0.31
1992	1.07	0.29
1991	1.76	0.52
1990	1.87	0.61

Brown trout and whitefish are very abundant in Suttle Lake, but constitute a small percentage of the harvest. They are generally caught incidentally by kokanee anglers. Both species could support additional harvest.

The most popular angling methods are still fishing for kokanee and trolling for trout. Late May and June are the most productive months for angling, but fish are taken throughout the season with bait being a favored method.

Blue Lake

A 1940 Department lake survey (Newcomb 1941) of Blue Lake reported rainbow trout, land-locked blueback salmon (kokanee), brown trout, brook trout, and whitefish were present. Rainbow consisted of 85% of the population, sockeye 14%, brook trout 1%, and brown trout less than 1%. The hydroelectric dam built on Link Creek at the outlet of Blue Lake in later years blocked the free movement of fish from Suttle Lake thus reducing species composition and numbers of fish present, especially since there was no way for them to reproduce. Presently Blue Lake contains only hatchery rainbow trout and

the occasional stunted brook trout, kokanee and whitefish. It is unknown how these species are sustaining themselves in Blue Lake.

A good boat and bank fishery exists at Blue Lake on legal-size hatchery rainbow trout. Most trout harvested are within a few days after each release. Some of the stocked rainbow trout go over the dam and are caught in Suttle Lake. Although there are no current estimates of total return to the angler from the 13,000 annual stocking, it is believed there is a very high return based on random creel checks and the fact that holdover rainbow trout are rarely seen. The Department coordinates with the resort operator on fish release dates through the season in order to optimize the number of trout available to as many anglers as possible. It has not been practical to sustain a fishery from fingerling rainbow trout stocking because the lake has very limited food production.

Random creel checks on opening day for the period 1990-1995 showed anglers generally average about 2 fish each with a catch rate of about 1 fish per hour (Table 6). In 1990 and 1995, extremely cold weather hampered fishing resulting in poor catch rates.

Table 6. Random creel census at Blue Lake on opening day of trout season showing fish per angler and fish per hour for the years 1990-1995.

Year	Fish per angler	Fish per hour
1995	0.50	0.17
1994	2.33	0.87
1993	2.34	1.24
1992	2.56	1.17
1991	3.58	1.11
1990	0.75	0.31

Management Issues

1. Sockeye salmon were indigenous to Suttle Lake and Link Creek. The habitat appears capable of supporting a reintroduction of sockeye salmon. The dam at the outlet of Suttle Lake would require improvements for upstream fish passage. The impacts on the existing fishery for kokanee would have to be determined.
2. It is not known if the indigenous form of kokanee still exist in Suttle Lake. Samples have been collected for electrophoresis analysis, but results are not yet available.
3. High phosphorus levels promote algal blooms and fish kills, of mostly kokanee, can occur when sudden algal die-offs occur.
4. The occurrence of *C. shasta* in Suttle Lake prevent the use of non-resistant trout species such as Cape Cod rainbow trout and brook trout.
5. Brown trout and whitefish are abundant and can provide for a fishery. There is an opportunity to generate additional angling opportunities for these species.
6. Size and abundance of kokanee needs to be controlled to meet the desires of anglers. Use of the weir in Link Creek in conjunction with the bonus bag limit can achieve the desired results.

7. Effects of the February 1996 landslide into Link Creek on natural production capability of trout are unknown.
8. Passage barrier at the outlet of Blue Lake on Link Creek.
9. The low productivity of Blue Lake limits its ability to grow fish for a consumptive fishery.

MANAGEMENT DIRECTION

SUTTLE AND BLUE LAKES SUBBASIN

POLICIES

Policy 1. Kokanee, mountain whitefish and introduced brown trout and brook trout in Suttle Lake and Link Creek shall be managed for natural production consistent with the Basic Yield Management Alternative for trout (ODFW 1987).

Policy 2. No hatchery fish shall be stocked in Suttle Lake and Link Creek.

Policy 3. Rainbow trout in Blue Lake shall be managed for hatchery production consistent with the Basic Yield Management Alternative for trout (ODFW 1987). No other hatchery fish will be stocked.

Policy 4. Reintroduction of an anadromous population of sockeye salmon in Suttle Lake and Link Creek will be pursued if the opportunity is physically, ecologically, and economically feasible.

Policy 5. Reintroduction of bull trout into the Suttle Lake-Link Creek-Blue Lake complex will be determined in the Deschutes basin conservation plan for bull trout.

OBJECTIVES

Objective 1. Maintain genetic diversity, adaptiveness, and abundance of kokanee, brown trout, brook trout, and mountain whitefish in Suttle Lake and Link Creek.

Assumptions and Rationale

1. Self-sustaining populations of kokanee, brown trout, and mountain whitefish exist in Suttle Lake.

2. Mountain whitefish indigenous to the upper Metolius River and tributaries including Link Creek have been identified as a provisional wild fish population.

3. Kokanee stocks from British Columbia, Colorado, and Montana have been used for kokanee programs in Oregon, including Suttle Lake. Electrophoresis will be used to determine if the hatchery fish interbred with the existing population of kokanee.

4. Spawning kokanee, brown trout, and whitefish are vulnerable to illegal harvest in their only spawning stream, Link Creek.

5. Monitoring of fish populations in Suttle Lake and Link Creek will provide an indication of their stock fitness and population levels.

ACTIONS

Action 1.1 Monitor population trends of brown trout, whitefish, and kokanee in Suttle Lake and Link Creek. Population trends will be determined through creel surveys, gillnets, trapnets, and spawning ground surveys.

Action 1.2 Determine the extent and relative contribution of shoreline spawning kokanee in Suttle Lake.

Action 1.3 Determine the need for additional or modified angling regulations by monitoring the production, harvest, and catch rates of kokanee, brown trout, and whitefish.

Action 1.4 Through enforcement of angling regulations, protect spawning fish from harvest in Link Creek.

Action 1.5 Pursue results of electrophoretic analyses on Suttle Lake kokanee to determine their origin in relationship to Metolius River kokanee.

Objective 2. Provide consumptive angling opportunities for naturally-reproducing kokanee, brown trout, and mountain whitefish in Suttle Lake.

Assumptions and Rationale

1. Kokanee in Suttle Lake are abundant enough to provide a sustainable consumptive fishery.

2. Although abundant, whitefish and brown trout constitute a small percentage of the fish caught in Suttle Lake.

ACTIONS

Action 2.1 Monitor catch contribution, abundance, size, and growth of brown trout, kokanee, and whitefish by conducting periodic creel surveys, inventory using gillnets, trapnets, and spawning ground surveys.

Action 2.2 Publicize information on the abundance of whitefish and brown trout in Suttle Lake and opportunities to angle for them.

Action 2.3 Review angling regulations and implement restrictions, if necessary, to sustain the fishery.

Objective 3. Provide consumptive angling opportunities for hatchery rainbow trout in Blue Lake.

Assumptions and Rationale

1. Currently, hatchery rainbow trout provide the only fishery in Blue Lake since passage from Suttle Lake has been blocked and there is no natural producing populations of rainbow trout. A rare stunted whitefish or brook trout or kokanee appears in angler catches. The origin of these fish is unknown.

2. Establishment of fishable populations of whitefish, brown trout and kokanee in Blue Lake would be contingent on removal of the dam at the outlet and voluntary upstream movement of fish from Suttle Lake.

ACTIONS

Action 3.1 Monitor harvest rates of hatchery rainbow trout by conducting periodic random creel surveys.

Action 3.2 Adjust the stocking frequency and density of hatchery rainbow trout at Blue Lake to optimize angler catch rates.

Action 3.3 Explore desirability of re-establishing fish passage over the hydroelectric dam in order to increase the diversity of fish species available for a consumptive fishery at Blue Lake.

Objective 4. Protect fish rearing and spawning habitat in Suttle Lake, Link Creek and Blue Lake.

Assumptions and Rationale

1. Whitefish, kokanee, and brown trout spawn in Link Creek and rear in Suttle Lake and Link Creek.

2. Link Creek provides adequate spawning habitat to sustain natural production of kokanee, whitefish and brown trout for Suttle Lake.

3. The effects of the 1996 landslide into Link Creek are unknown.

4. Nutrient loading and warm water temperatures in Suttle Lake often produce algal blooms that are suspected to be linked to periodic fish kills in the lake.

5. Water quality in Blue Lake affects the productivity of Suttle Lake.

6. There is currently good physical habitat in Blue Lake.

ACTIONS

Action 4.1 Work with the Sisters Ranger District, Jefferson County and private landowners to maintain quality shoreline fish habitat.

Action 4.2 Work with DEQ, and USFS to identify the source of phosphorus loads in Suttle and Blue lakes and devise methods to ameliorate the effects of excessive phosphorus.

Action 4.3 Conduct general habitat survey using recent ODFW inventory protocol.

Action 4.4 Determine suitability and capability of Link Creek to sustain natural production of bull trout and sockeye salmon.

Objective 5. Determine the feasibility to reestablish anadromous sockeye salmon in Suttle Lake and Link Creek.

Assumptions and Rationale

1. A suitable stock of sockeye salmon could be found to use as parent stock.

2. These fish may bring new diseases to Suttle Lake.

3. Sockeye were historically found in Suttle Lake.

4. Providing downstream passage for juvenile fish through the Round Butte-Pelton Dam complex will be integral to restoration.

5. This reintroduction may need to be initiated using hatchery reared fish.

6. Restoring these stocks would improve the diversity of fish species in Suttle Lake, however, these fish may change the ecological relationships in the existing fish community, thereby potentially affecting the sport angling opportunities currently available.

7. Spawning and rearing habitat appear adequate enough in Suttle Lake and Link Creek to sustain a population of naturally-reproducing sockeye salmon.

ACTIONS

5.1 Conduct a feasibility study to determine if it is physically, biologically, and socially desirable to restore sockeye salmon to Suttle Lake.

METOLIUS RIVER SUBBASIN HIGH LAKES

Overview, Location and Ownership

Within the Metolius Basin, fisheries in 21 of the Cascade mountain lakes are managed for recreational angling utilizing stocked hatchery fish. These lakes are located east of the Cascade summit from Mt. Jefferson south to Mount Washington. All 21 lakes are located on Deschutes National Forest land and are managed under its Land and Resource Management Plan (LRMP 1990). Historically, most of these lakes were barren of fish likely because they are geologically young and have not been connected with other water bodies. In cooperation with the US Forest Service, ODFW has stocked a variety of trout species since the 1910's (The Oregon Sportsman, August 1914).

Because there were no indigenous fish in these lakes originally, application of the Wild Fish Management Policy (ODFW 1992) for these lakes is much more limited. A "wild only" alternative is not required in this case; however, movement of hatchery fish out of the lakes and into wild populations downstream is a concern and will be addressed in this plan. The only known populations of non-game fish are longnose dace in Round Lake. It is not known if they are indigenous but they are found in the nearby Metolius River.

Access

Most Metolius basin lakes are located within wilderness or roadless areas that can only be reached by non-motorized or non-wheeled travel such as by foot or horse. Early season access is generally limited by persistence of winter snows on access trails. Lakes open to road access are Round, Link, Island, Dollarnine, Meadow, Torso, and Cache lakes. Since increasing access by improving road quality would not be compatible with maintaining the primitive to semi-primitive nature of the fishery, the Department has recommended to the USFS that current access roads be maintained as unimproved.

Habitat and Habitat Limitations

The Metolius basin lakes program relies on the natural productivity of each lake to grow stocked fingerling trout to legal-size fish in one to two years. Consequently, the success of the program is contingent on maintaining the productivity of these waters. Management of lands and resources surrounding the Metolius basin lakes addressed here is described in the Deschutes NF LRMP.

National forest management of lakes located on federally designated land as Wilderness, Research Natural Areas, or Old Growth, where 16 of the 21 lakes are located, is generally compatible with ODFW management guidelines for primitive or semi-

primitive fisheries. These lands do not have programmed timber harvest but do allow other activities associated with mineral development, range, forest health, and fire management that may affect the natural productivity of these lakes (Meehan 1991).

Although management activities allowed on land designated as General Forest, Dispersed Recreation, Winter Recreation, Scenic Views, Metolius Special Forest, or Front Country (5 lakes- Round, Island, Link, Meadow, and Four O'Clock lakes) can potentially affect the natural productivity of Cascade Mountain lakes, Standards and Guidelines identified in the LRMP should protect the productivity of these waters.

Natural factors may limit the productivity of fish populations. Habitat deficiencies may include a lack of abundant food resources, lack of cover, (a common limiting factor) and prolonged periods of ice cover resulting in periodic winter kill.

Fish Management

The Metolius basin lakes were first stocked utilizing packhorses by USFS and ODFW personnel. From the early 1950's through early 1980's, each lake was stocked by fixed-wing aircraft. Since then each lake has been stocked annually or biennially using a helicopter.

At the inception of the stocking program, limnological information was gathered at each lake to determine if it would support fish life. One or more trout species were stocked if the lake appeared to be suitable. Fish stocked in the past include several races of rainbow trout, brook trout, and cutthroat trout. Presently, fish stocking decisions are guided by periodic lake surveys, creel surveys, historical records, and anecdotal information from fishermen. The Department has determined that 21 of over 112 Cascade Mountain lakes covered in the Upper Deschutes Basin and this plan are capable of sustaining trout throughout the year.

The Department currently stocks brook trout (original brood unknown, possibly from New Jersey), coastal rainbow trout (referred to as Cape Cod stock, original stock from McCloud River, California), and westslope cutthroat trout (Twin Lakes brood from Washington's Lake Chelan) in the 21 Metolius basin lakes. Brook trout and rainbow trout stocked are fall spawners while cutthroat are spring spawners. Inventories generally show little natural reproduction, although fish have successfully spawned in some lakes.

ODFW currently manages Metolius basin lakes under the Basic Yield Management Alternative in the Trout Plan (1987). Fisheries under this alternative are of a general consumptive nature and production is based on fingerling stocking and the water's natural rearing capability. One objective of this program is to provide a diversity of fisheries to anglers. This diversity may be measured in difficulty of access, or uniqueness of species or combination species available at each lake. The Department has found brook, rainbow, and cutthroat trout best suited to provide a legal-size fish within

one to two years. Lakes have been stocked on an annual basis in past years but due to current budget limitations stocking is now conducted biennially.

The stocking rate in each lake depends on size, productivity, catch rate, survey information, and past experience. The target size at stocking is 150 to 200 fish per pound. Survival and catch rates vary annually and for each lake and the number subsequently stocked is adjusted accordingly. Stocking is also dependent on availability of eggs. In 1993 the Washington Department of Wildlife did not have surplus eggs to supply to ODFW so Twin Lakes cutthroats were not stocked. Lakes (noted in Table 7) scheduled for cutthroat were planted with rainbow or brook trout.

There is no conclusive data to confirm movements of hatchery fish out of the lakes, but the potential risk to downstream wild populations affects the management alternatives. Information on each lake's outlet and inlet has been compiled from periodic Cascade Mountain lake surveys began in 1932, from Oregon Water Resources Board maps and USGS maps, and from field observations of ODFW district personnel; this information is shown in Table 7. Some lake outlets are ephemeral and may be open only during years of above average precipitation, others are open continuously, while others have outlets that disappear into the substrate or may be open only during periods of snowmelt. Status of lake outlets listed in Table 7 is subject to change as future high lake surveys provide more updated information.

The outlet status is important because Wild Fish Management Policy (1992) directs the Department to not authorize introduction of non-indigenous fish in locations where impacts to wild populations might occur from hybridization, competition, disease introduction, or predation. Brook trout interbreeding with bull trout exemplifies such a concern. Dambacher et al. (1992) found negative interactions between introduced brook trout and wild bull trout in the Crater Lake watershed where interbreeding resulted in sterile off-spring and, eventually, diminished numbers of bull trout. Stocking of Table Lake (Metolius subbasin) with brook trout was discontinued in 1993 because of potential risks to Metolius River bull trout. Other lakes with outlet status which needs to be confirmed are: Booth, Cabot, Cache, Carl, George, Island, Link, Long, Round, Shirley, Square, Table, and Wasco lakes.

In recent years there has been a growing concern about the impacts of fish stocking on native lake ecosystems. Herpetologists are concerned that stocking fish into lakes may disrupt amphibian populations. Blaustein et al. (Biological Conservation 1994) found mortality in western toad *Bufo boreas* eggs from the fungus *Saprolegnia ferax* in Lost Lake, Todd Lake, and Three Creeks Lake. While *Saprolegnia* spp. occurs naturally in these lakes, it is also a common pathogen of hatchery fish. Although *Sparolegnia* appears to be an acute cause of mortality in *B. boreas*, research suggest that their susceptibility may be exacerbated by increased levels of ultraviolet-B radiation measured at these lakes (Blaustein, A. presentation to American Fisheries Society. Sunriver, OR. February 1994). It is unknown at this time if stocking of hatchery fish, changes in the ozone layer, or both are causing these losses.

Liss et al. (1991) found in studies in the Washington Cascades that introduced fish populations can have substantial effects on plankton, aquatic insect, and salamander populations. The Cascade frog *Rana cascadae* is known to occur at high elevations east of the crest of the Cascades. It is listed as a Federal Category 2 species and the Department lists it as State Sensitive- Critical. The spotted frog *Rana pretiosa* also occurs in this region and is listed as State Sensitive- Critical. It is difficult to assess impacts of fish stocking since historic and current distribution and abundance of these amphibians in the region of the Cascade Mountains covered in this plan is unknown. Hopefully, further research and additional inventories of native amphibians will help answer these questions.

These issues indicate a need to examine the ODFW stocking program of the Metolius basin lakes with regard to its potential ecological impacts to natural ecosystems. ODFW is committed to the conservation of native ecosystems, and will work jointly with the USFS to identify the lakes appropriate for fish management activities. In 1986 through its representative the International Association of Fish and Game Agencies, ODFW signed a Memorandum of Understanding with the USFS that resolution of recreation management in wilderness areas of Oregon, including fish stocking, would be addressed through cooperative development of Wilderness Management Plans. To date, the format and protocol for addressing these issues in Wilderness Management Plans has yet to be developed. This plan will provide interim direction until amended following concurrence with the USFS of new fish stocking policies for these lakes as part of jointly developed wilderness management plans.

Personnel from Deschutes NF have indicated some lakes have recreational use approaching or beyond limits of acceptable change. Recreational fishing is one activity that may be contributing to heavy use. Other factors such as distances to the trailhead, ease of terrain, distance to neighboring lakes, or outstanding scenic beauty also effect levels of use. It may be possible to redistribute anglers through reduction or discontinuation of fish stocking, removal of trail access, or other management actions. Again, these issues will be settled in the future in Wilderness Management Plans.

ODFW has committed to not stock any new lakes in the Cascade Mountains covered under this plan since 1978. Over 400 additional lakes and ponds in the Upper Deschutes region of the Cascade Mountains are not stocked. These lakes range in size from less than one acre to several acres in surface area.

Currently, Metolius basin lakes are open for fishing from late April to the end of October (general Oregon trout season) with a 10- trout bag limit, minimum length 6 inches. Non-motorized boats are allowed. There is no bag limit for whitefish; open season is the same as for trout.

Management Issues

1. Harsh climate limits the productivity of these lakes.
2. Movement of non-native fish downstream.
3. Interaction of fish with herptiles.
4. Little or no natural reproduction.

MANAGEMENT DIRECTION

METOLIUS RIVER SUBBASIN HIGH LAKES

POLICIES

Policy 1. Cascade Mountain lakes in the Metolius River subbasin will be managed for natural and hatchery production consistent with the Basic Yield management alternative for trout (ODFW 1987).

Policy 2. Hatchery rainbow, brook, and cutthroat trout will be stocked into the lakes listed in Table 7.

OBJECTIVES

Objective 1. Provide diverse angling opportunities for selected trout species in Cascade Mountain lakes of the Metolius River subbasin.

Assumptions and Rationale

1. There is a high level of public interest in retaining this fishery.

2. These high lakes have been stocked periodically since the 1910's.

3. Suitable spawning habitat does not exist in most of these lakes and periodic stocking is required to maintain a fishery.

4. These angling opportunities depend on Deschutes NF adhering to Standards and Guidelines in the LRMP to maintain the natural productive capacity of each lake.

5. There may be opportunities to stock additional trout species in the high lakes.

6. Diversity may be measured in difficulty of access or the trout species or combination of species available at each lake.

7. George Lake has never been surveyed.

ACTIONS

Action 1.1 Periodically stock the lakes listed in Table 7 with hatchery rainbow trout, brook trout, and/or cutthroat trout.

Action 1.2 Periodically inventory trout populations in stocked lakes for size, growth, condition factor, and species composition.

Action 1.3 Periodically monitor angler effort and catch.

Action 1.4 Continue to adjust the high lakes stocking program to meet the productivity and angler use of each lake.

Action 1.5 Investigate the possibility of introducing new trout species to increase the diversity of the fishery.

Action 1.6 Continue to work with Deschutes NF to document adherence to Standards and Guidelines.

Action 1.7 Survey George Lake.

Objective 2. Minimize the impacts of hatchery trout on the production and genetic integrity of wild trout in the Metolius River subbasin.

Assumptions and Rationale

1. Some high lakes have outlets that may allow hatchery fish access to waters containing wild fish and wildlife populations.

2. Effects of emigrating hatchery fish on wild fish and wildlife populations is unknown but poses certain risks.

3. Where high lakes have connections to waters containing wild trout and wildlife, maximizing harvest or eliminating stocking will minimize impacts to wild fish and wildlife.

4. Information on the outlet status of some high lakes needs to be confirmed.

ACTIONS

Action 2.1 Survey high lake outlets that drain into the Metolius River subbasin to determine if wild trout or naturalized populations of introduced trout are present. If hatchery trout stocked in the lakes have access to downstream wild trout populations, electrophoresis or morphometric measurements may be necessary to determine the degree of interaction between wild and hatchery trout.

Action 2.2 Continue to use hatchery stocks that demonstrate a minimum of migratory behavior.

Action 2.4 Determine if elimination of stocking is needed to minimize impacts of hatchery fish on wild fish and wildlife and act as necessary.

Action 2.5 Determine outlet condition of those lakes listed in Table 7 with unknown status.

Objective 3. Manage Cascade Mountain lakes fisheries consistent with wilderness management plans to be jointly developed with Deschutes National Forest personnel.

Assumptions and Rationale

1. Recent research has shown introduced hatchery fish populations negatively impact native amphibian and macroinvertebrate populations and plankton ecosystems in high lakes. It is unknown at this time if these actions are causing a serious depletion of wildlife in these ecosystems in Cascade Mountain lakes.

2. Some effects of introduced hatchery fish may be irreversible.

3. There may be a relationship between riparian habitat damage by recreationists and the fisheries in the high lakes.

4. Without a Wilderness Management Plan in place, the Metolius basin plan will provide direction in the interim.

ACTIONS

Action 3.1 Work with the Deschutes NF to investigate if the stocking of hatchery fish in high lakes has negatively affected native species ecosystems.

Action 3.2 Work with the Deschutes NF to determine the cause of damage to land surrounding high lakes stocked with hatchery fish. Manage the fishery to minimize the problem if the attraction of people to the fishery is the source of the damage.

Action 3.3 Identify jointly with USFS lakes that have intrinsic values that preclude fish stocking and discontinue stocking.

Action 3.4 Develop a monitoring plan with Deschutes NF to assess the impact to Cascade Mountain lakes as a result of fish stocking.

Table 7. Metolius River Subbasin High Mountain Lakes

Water Body	Map Location	Size (acres)	Depth (feet)	Elevation (feet)	Species Allocated *	Outlet	Number Stocked (1993) #	Land Management @
1. Booth	T13S R8E S7	8	34	5,050	BT	y-to unnamed lake, then to First Creek	795	wilderness
2. Cabot	T 11S R8E S34	6	22	4,550	CT	y-int. to Cabot Creek	753-RB	wilderness
3. Cache	T13S R8E S33	8	8	4,350	BT	y-thru impassable beaver dam to Blue Lake	190	research natural area
					CT		215-RB	
4. Carl	T11S R8E S28	20	51	5,450	CT	y-cont. to Cabot Creek	753-RB	wilderness
5. Dollarnine	T13S R8E S32	3	10	4,500	CT	y-unknown direction	0	scenic views
6. Four O'Clock	T14S R8E S8	3	35	4,550	CT	no outlet	161-RB	old growth
7. George	T14S R8E S31	5	20	7,400	RB	never surveyed	430	wilderness
8. Island	T13S R8E S32	8	18	4,350	BT	y-cont. outlet to Blue Lake blocked by beaver dam	663	scenic views
					CT		0	
9. Koko	T12S R8E S19	3	10	5,500	CT	no outlet	323-RB	wilderness
10. Link	T13S R8E S32	13	20	4,350	BT	y-cont. outlet to Link Creek then to Blue Lake	680	scenic views
11. Long	T13S R8E S20	18	20	4,650	BT	y-cont. through two lakes then to First Creek	1,723	wilderness
12. Martin	T13S R7.5E S12	4	20	5,150	RB	no tributaries	215	wilderness
13. Meadow	T14S R8E S5	16	29	4,550	BT	y-to Hortense L. which has no outlet	1,723	winter recreation/ scenic views
					CT		0	
14. Patsy	T11S R8E S21	2	19	6,200	CT	no outlet	215-RB	wilderness
15. Peewee	T14S R8E S5	2	18	4,500	CT	no outlet	215-RB	research natural area
16. Round	T13S R8E S16	22	41	4,250	BT	y-unknown duration to First Creek	3,400	metolius special forest

17. Shirley	T11S R8E S28	4	11	5,500	CT	y-int. to Cabot Creek	323	wilderness
18. Square	T13S R8E S19	55	43	4,750	BT	y-unk. duration to Round Lake	2,120	wilderness
19. Table	T11S R8E S16	5	13	5,600	BT	y-cont. outlet to lava flow	0- bull trout	wilderness
20. Torso	T14S R8E S5	9	12	4,480	BT	no outlet	238	research natural area
21. Wasco	T12S R8E S20	20	25	5,150	CT	y-int. to Canyon Creek	860-RB	wilderness

*- BT= brook trout, RB= rainbow trout, CT= cutthroat trout. @- Deschutes National Forest Land and Resource Management Plan (1990). n= no, y= yes, int. = intermittent; cont. = continuous; unk. = unknown; bull trout refers to no longer stocked due to concerns about bull trout downstream; #- numbers listed for reference, for example- 900-BT refers to numbers and change in species due to shortage in allocated species

APPENDIX A

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APPENDIX B

GLOSSARY

Abatement pond- Large pond used to purify effluent from a hatchery.

Adaptiveness- Tending toward, fit for, or having a capacity for adaptation.

Adfluvial- A fish life history where juveniles are born in streams, move to lakes to rear, and then migrate back up to streams to spawn. Migrating between lakes and streams.

Adipose- Small fleshy fin between the caudal fin and dorsal fin on salmonid fishes.

Allozyme- An allele of an enzyme. An allele is a particular form of a gene at a particular locus.

Anadromous- A fish life history where juveniles are born in streams, move to the ocean to rear, and then migrate back up to streams to spawn. Moving from the sea to fresh water for reproduction.

Aquatic invertebrate- Animals which have at least part of their life cycle in water.

Benthic- Relating to, or occurring at the bottom of a body of water. The substrate of a water body (freshwater, estuarine, or marine).

Benthic invertebrate- Aquatic animals which spend their in-water life on the bottom of a body of water.

Biomass- The total mass of living matter within a given volume of environment.

Category 1 candidate- Taxa for which the USFWS has sufficient information to support a proposal to list as Threatened or Endangered under the ESA.

Category 2 candidate- USFWS candidates which need additional information in order to propose as Threatened or Endangered under the ESA.

Ceratomyxa shasta- Mxyosporidean parasite. Spread through ingestion of spores in the water from infected fish. Becomes infective when water temperatures reach 50-53 ^{0}F. There is no treatment available, always results in death of affected fish.

Ceratomyxosis- Disease caused by *Ceratomyxa shasta*

Cfs- Cubic feet per second, a measure of water flow.

Chironomid(ae)- A diverse and ecologically important family of aquatic insects. An important food item for fish commonly known as midges.

Creel survey- A survey interviewing anglers for catch information.

Competitive interaction- Interaction where two species compete for resources.

Condition Factor- A measure of how fat a fish is based on the ratio between the length and weight of a given species of fish. The higher the condition factor, the fatter the fish.

Conductivity- The ability or power to conduct or transmit.

Cover- Habitat which hides or conceals from view. With fish this may be logs, boulders, substrate, depth or surface turbulence.

Dangler tag- Small, plastic laminated tag attached with fine thread on small fish.

Degradation- Erosional removal of materials from one place to another. Degradation lowers the elevation of the streambed and floodplain.

Detritus- Undissolved organic or inorganic matter resulting from the decomposition of parent material

Dewater- Lowering of the water table in a stream caused by a channel shift or flow reduction.

Diatoms- A class of minute planktonic unicellular or colonial algae with silicified skeletons.

Displacement- Interaction between fishes where one moves the other out of position or the area.

Electrofishing- Non-lethal method of catching fish by the use of electricity conducted through water.

Electrophoresis- The separation of molecules in an electric field.

Ephemeral- Streams that flow briefly and in direct response to local precipitation, and whose channel is always above the water table.

Extirpated- Removed from or no longer existing in a particular area.

Fish Commission- ODFW was formerly made up of the Fish Commission and State Wildlife Commission, they merged in 1975.

Fitness- Suited, adapted, or acceptable for a given circumstance or purpose.

Floy tag- A fish tag consisting of a t-shaped anchor and a hollow, spaghetti-shaped marked tube.

Fluvial- Pertaining to streams or rivers, or produced by stream actions. Also, a fish life history where juveniles are born in streams, move to a main river to rear, and then migrate back up streams to spawn.

Freshet- A sudden overflow of a stream resulting from a heavy rain or a thaw.

Habitat potential- The ability of a given habitat to produce fish.

Head of the Metolius- A day-use area at the springs forming the start of the Metolius River.

Hooking mortality- Death cause by catching and releasing fish.

Hydrograph- A graph showing water flow over time in a stream or river.

Impoundment - Any structure that impedes the flow of a stream or river, usually used to indicate a reservoir.

Indigenous- Descended from a population that is believed to have been present in the same geographic area prior to the year 1800 or that resulted from a natural colonization from another indigenous population.

Introgression- To combine with another as in hatchery fish naturally spawning with wild fish and their genes combining together.

Large woody debris- Trees and roots that enter water bodies and form fish habitat.

Large woody material- Same as large woody debris.

Legal size- Fish that are legal size, 6 inches or larger. Hatchery fish stocked as legal-size are generally 9-10 inches in length to provide a more desirable product for the angler. These are sometimes referred to as catchable-size fish.

Life history- The life pattern of a fish species. Includes time of spawning, time of emergence, freshwater residence time, and time of migration.

Low head barriers- Barriers to fish that are small in height.

Lotic- Of or in running water such as a river or stream.

Macroinvertebrate- Aquatic insects large enough to be seen with the naked eye.

Maladaptive genes- Genes that do not increase the fitness of an organism.

Meristic- Modified by the changes in the number or placement of entire body parts, as contrasted with modification by gradual change of the entire organism.

Metapopulation- Groups of populations evolving with significant connections between them.

Microohms- One millionth of an ohm.

Morphology- The science of form and structure.

Myxosporidean- Class of Protozoa that are parasitic and spore forming. They are incapable of locomotion and resemble amoeba. Three groups that occur in salmon in the Pacific Northwest are Myxosporidia, Microsporidia, Haplosporidia.

Naturally produced- Produced in nature as opposed to hatchery-produced. May be indigenous or introduced fish.

Oligotrophic- Lacking in plant nutrients and having an abundance of dissolved oxygen throughout.

Omnivorous- Eating both plants and animals.

Phenotype- The environmentally and genetically determined observable appearance of an organism.

Phenotypic- Characters arising from reactions to environmental stimulus.

Piscivorous- Fish eating.

Pool-to-riffle ratio- A measure of habitat quality. The number of pools versus the number of riffles expressed as a number.

Reach- A section of a river or stream.

Redband- The group of rainbow trout that evolved East of the Cascade Mountains. Coastal rainbow trout developed West of the Cascades.

Redd- A nest made by a fish containing its eggs.

Resident fish- Fish that do not migrate to the ocean for part of their life history.

Resolution- The action or process of separating or reducing something into its constituent parts.

Riffle- Shallow section of stream or river with rapid current and a surface broken by gravel, rubble or boulders.

Riparian- Area with distinctive soils and vegetation between a stream and the adjacent upland.

RM- River mile.

Rotenone- Commonly used fish toxicant which is derived from the derris root.

Salvage logging- Logging small groups or single trees for reasons such as blowdown, disease, or danger to life or property.

Satellite males- Male fish swimming around the main breeding pair of fish while in the act of spawning. May attempt to breed with the female.

Snorkel surveys- Surveys done using a mask and snorkel while swimming in a water body. May be qualitative or quantitative.

Standing crop- The weight of organic material that can be sampled or harvested by normal methods at any one time from a given area.

Spatial interaction- Interaction between individuals trying to occupy the same space.

Thermocline- The region in a thermally stratified body of water, as a lake, in which the temperature decrease with depth is greater than that of the water above and below it. The epilimnion is below and the hypolimnion is above.

Total wetted surface area- The total amount of surface area of a water body that is underwater.

Tributary- A stream flowing into a lake or larger stream.

Turbidity- Clouded with stirred up sediment; a darkening or clouding up of what should be clear.

Ultraoligotrophic- Referring to the trophic status of a lake defined by the nutrient concentrations. Ultraoligotrophic lakes are very nutrient poor.

Under-escaped- Not enough escapement. An inadequate amount of fish escaping to reproduce.

Weir- A notch or depression in a dam or other water barrier through which the flow of water is measured or regulated. Also a barrier constructed across a stream to divert fish into a trap or to raise the water level or divert water flow.

Width/depth- The ratio of width to depth. An indicator of environmental health.

Wild- Occurring, growing, or living in a natural state; not domesticated, cultivated, or tamed.

Windfalls- Trees blown down by the wind.

Yearling- A fish that has not completed its second year.

Zooplankton- Small (often microscopic) animals suspended or weakly swimming in water. Zooplankton feed on phytoplankton and are a critical food item for small fish In lakes and reservoirs.

APPENDIX C

Partial List of Oregon Administrative Rules Relating to the Upper Deschutes River Subbasin Fisheries Management Plan

General Fish Management Goals
635-07-510 to 515

Natural Production Policy
635-07-521 to 524

Wild Fish Management Policy
635-07-525 to 535

Wild Fish Gene Resource Conservation Policy
635-07-536 to 538

Hatchery Fish Gene Resource Management Policy
635-07-540 to 541

Transgenic Fish
635-07-595

Fish Species- Salmon
635-07-800 to 805

Statewide Angling Regulations
635-11-050 to 175

Instream Water Rights
635-400-000 to 040

State Agency Coordination Program
635-405-000 to 045

Steelhead, Trout and Warmwater Fish Management
635-500-010 to 120