FINAL

LOWER DESCHUTES RIVER SUBBASIN

MANAGEMENT PLAN

July 1997

Mid-Columbia Fish District

Oregon Department of Fish and Wildlife

LOWER DESCHUTES RIVER SUBBASIN MANAGEMENT PLAN

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FOREWORD

The Oregon Department of Fish and Wildlife (ODFW) requires that management plans be prepared for each basin or management unit in the state. Resources of the state shall be managed according to these plans which set forth goals, objectives, and operating principles for management of species, waters, or areas. Such plans are a primary means of implementing ODFW policies regarding fish management. The Lower Deschutes River Subbasin Fish Management Plan was developed to direct management of the fish resources of the lower Deschutes River, its tributaries, and the standing waters within the lower Deschutes River subbasin.

ODFW is committed to the planning process as an integral part of all current and future management by the agency. The Lower Deschutes River Subbasin Fish Management Plan is one element in the ODFW's planning process. 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 ODFW's funds and personnel can be used accordingly. They inform the public and other agencies about ODFW's management programs and provide them with the opportunity to help formulate those programs.

Plan Scope

Fish management in the waters of the lower Deschutes River subbasin, including the reach of the Deschutes River from river mile 100 to the Deschutes River - Columbia River confluence, is addressed by this plan. A fishery management plan for the waters of the Upper Deschutes River subbasin above Pelton Reregulating Dam is in progress, and will be presented to the Oregon Fish and Wildlife Commission in July, 1996.

Plan Development Process and Participants

This plan was developed by ODFW with extensive input from the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS). ODFW actively sought input from resource management professionals and others who have special interest in the lower Deschutes River subbasin. These comments and suggestions were incorporated into the final draft plan, which was adopted by the Oregon Fish and Wildlife Commission on July 26, 1996.

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Purpose of the Plan

This plan is intended to guide fish management direction for the next 5 to 10 years within the subbasin. 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) developing angling regulations, stocking fish, protecting habitat, acquiring habitat, and interacting with co-managers of the resource. A wide variety of actions are described; however, due to funding uncertainties, not all may be implemented.

Organization of the Plan

This plan is divided into eight major sections: habitat, trout in standing waters, trout and other fish species in flowing waters, summer steelhead, spring chinook, fall chinook, warmwater gamefish, and access. A section dealing with sockeye salmon in the lower Deschutes River was not developed for this plan. Run size, life history and population characteristics, population status, and constraints to production are unknown at this time since passage is currently not possible over the Pelton/Round Butte hydroelectric complex. However, if passage is achieved, a management plan for this species will need to be developed.

Each of these sections is, in turn, divided into sub-sections that generally contain:

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

All of the management options, including specific actions, are governed by Oregon Administrative Rules (OARs) currently in place which relate to fish management.

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 Water (1982), and Habitat Protection Policies and Standards (1991).

GENERAL CONSTRAINTS

Legal Considerations

Besides the statewide species plans, the Lower Deschutes Subbasin Fish Management Plan must also conform to other established constraints, such as federal acts (i.e. Wilderness, Endangered Species, Wild and Scenic Rivers), state statutes, administrative rules, memoranda of understanding, other policies, and Federal Energy Regulatory Commission (FERC) mitigation requirements at hydroelectric projects.

ODFW interacts with other agencies primarily in dealing with fish habitat issues. Although the U.S. Department of the Interior's Bureau of Land Management (BLM) and U.S. Forest Service (USFS) are major public land manager in the planning area, several federal and state entities also have jurisdiction over activities that affect fish habitat. These include U.S. Fish and Wildlife Service (USFWS), Army Corps of Engineers (COE), Oregon Water Resources Department (OWRD), Oregon Division of State Lands (DSL), Oregon Department of Environmental Quality (ODEQ), Oregon State Police (OSP), Oregon Department of Geology and Mineral Industries (DOGAMI), Oregon Department of Forestry (ODOF) and U.S. Natural Resources Conservation Service (NRCS, formerly the Soil Conservation Service).

State Regulatory Actions That Affect Habitat

The OWRD regulates water use throughout the state. The 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 harvest operations on state and private lands are regulated by the act, which is administered by ODOF. Forest management activities on USFS and BLM lands are designated to comply with Forest Practices Act rules and state water quality standards.

The Oregon Removal-Fill Law (ORS 196.800 to 196.990) and statutes relative to removal and filling in Oregon Scenic Waterways (ORS 390.805 to 390.925) are administered by DSL. A permit is required from DSL for removal or filling of 50 cubic yards or more of material from beds or banks of waters of the State. A permit is required for any alteration of the beds or banks of an Oregon Scenic Waterway.

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 OARs. 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 landowner and ODFW. 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

The lower 100 miles of the Deschutes River from the Pelton Reregulating Dam to its confluence with the Columbia River were designated in 1970 by voter initiative as a component of the Oregon State Scenic Waterways System. The boundary of this State Scenic Waterway is, by law, a uniform one quarter mile from the bank on each side of the river. The program protects the free flowing character of designated rivers for fish, wildlife, and recreation. The program is also designed to protect and enhance the scenic, aesthetic, natural, recreation, and fish and wildlife values along scenic waterways. Construction of new dams, reservoirs, and impoundments, and placer mining are not allowed on scenic waterways. New development or changes in existing uses proposed within a scenic waterway are reviewed before they may take place. This State Scenic Waterway excludes the Deschutes River and tributaries within the boundaries of the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) and off-reservation trust land. The CTWS, through a resolution enacted by Tribal Council, subsequently adopted a one quarter mile boundary for river management purposes.

This same 100 mile segment of the Deschutes River and White River were designated by the U.S. Congress as part of the National Wild and Scenic River in October, 1988. The lower Deschutes River was classified as a recreational river, while White River was divided into six segments classified as either scenic or recreational. The National Wild and Scenic River boundary is variable but averages approximately one quarter mile on either side of a river and does not exceed more than an average of 320 acres per river mile. Federal Wild and Scenic designation strengthens protection given under the state Scenic Waterways System. Timber harvest, road building, mining, and grazing can be regulated to reduce adverse impacts on the designated rivers. Designation of these rivers with the Federal Wild and Scenic system theoretically provides access to increased federal funding for management of the rivers.

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

The CTWS is the modern-day 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 on June 25, 1855, 12 Stats. 963. Streams running through and bordering the reservation include the Deschutes, Metolius, Warm Springs rivers, and others. 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, Hood River, and others.

The CTWS role as a management entity for purposes of subbasin planning in the Deschutes River is based on their fishing rights in the Deschutes, Warm Springs, and other waters on or bordering the CTWS reservation and in the John Day and Hood rivers, Fifteenmile Creek, and others waters in the ceded area. Additionally, the Columbia River Fish Management Plan, a component of the U.S. vs. Oregon legal action, establishes CTWS as co-managers in fish management matters.

FERC and Oregon State License Regulations for Pelton/Round Butte Hydroelectric Complex.

The Pelton/Round Butte hydroelectric complex on the Deschutes River at RM 100 is at the upper end of the subbasin that will be managed under this management plan. FERC and the State of Oregon issued state and federal licenses to Portland General Electric (PGE) for the operation of the Pelton/Round Butte hydroelectric complex (FERC No. 2030 and Oregon State No. 217 and 222) which stipulate conditions under which the Pelton/ Round Butte hydroelectric complex must be operated.

Presently, the State of Oregon's process for the state relicensing of the Pelton/Round Butte hydroelectric complex and others in Oregon is being deliberated by a state-sponsored committee. The FERC federal license for the Pelton/Round Butte hydroelectric complex, however, is due for renewal with the present federal license expiring December 31, 2001. The FERC process for relicensing a large hydroelectric facility is an intensive five year effort that helps shape important resource decisions for many years. Thus, it is important that the alternatives listed in this lower Deschutes River Subbasin fish management plan take into account how the FERC relicensing process may interrelate.

The formal FERC relicensing process will involve state and federal agencies, tribes, citizens, and interest groups. The broad consultation process is designed to give consideration to the many resource values provided by the Deschutes River. At the culmination of this process, a completely new set of conditions for the operation of the Pelton/Round Butte hydroelectric complex including new fisheries mitigation and enhancement requirements may result.

Formal relicensing of the Pelton/Round Butte hydroelectric complex will begin the last half 1996 with the filing of an Initial Consultation Document (ICD) and a Notice of Intent (NOI) to relicense the complex. A three-year period of consultation follows the filing of the ICD, during which studies are requested by agencies and interested parties that will result in a better understanding of resources and their management and use. Late in 1998 or early in 1999, a draft license application will be issued. Following a period of comment and further consultation, the draft will be modified into a final application for relicensing the Pelton/Round Butte hydroelectric complex which will be filed with FERC by December 31, 1999.

During the formal consultation process for relicensing, many questions regarding fish resources and habitats effected by Pelton/Round Butte hydroelectric complex will be proposed, discussed, and studied. Recommendations within the final relicense application, based upon consultation and the studies conducted, will be proposed to protect, enhance, or mitigate impacts of the Pelton/Round Butte hydroelectric complex on resources, including fisheries resources. After completing the National Environmental Protection Act (NEPA) process, FERC will issue a new license for the Pelton/Round Butte hydroelectric complex. A coordinated effort should help insure that conflicts between this plan and the new Pelton/Round Butte hydroelectric complex license will be minimized or avoided.

LOWER DESCHUTES RIVER FISH MANAGEMENT PLAN
OREGON DEPARTMENT OF FISH AND WILDLIFE

EXECUTIVE SUMMARY

Introduction

Fish management plans are comprehensive documents which the Oregon Department of Fish and Wildlife (ODFW) regards both as a means to implement policy and as an explanation of the intent and rationale of management direction. Plans contain factual background material, statements of the rationale for selection of objectives, actions to be completed to attain objectives, and statements of general priorities for various actions.

This plan covers management of fish and their habitats in the lower Deschutes River subbasin. The lower Deschutes River subbasin as defined in this plan as the Deschutes River from the Pelton Reregulating Dam downstream to the Columbia River and all waters within that drainage area. This plan was developed in cooperation with the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS). The CTWS and the ODFW are co-managers of the fishery resources in the lower Deschutes River. Policy and objective statements contained in this plan are not applicable to waters on the CTWS reservation. Natural resource management strategies for the waters contained on the CTWS reservation are developed by the staff and committees of the CTWS. Some policy and objective statements contained in this plan are in opposition to CTWS resource management strategies.

The lower 100 miles of the Deschutes River flows through a picturesque desert canyon and supports a variety of fish and wildlife. The lower Deschutes River is classified as both state of Oregon and federal Wild and Scenic rivers. White River, a major tributary to the lower Deschutes, begins at White River Glacier on the southeast side of Mount Hood and flows 44 miles to its confluence with the Deschutes River. White River is classified as a federal Wild and Scenic river and has been nominated to be included in the state of Oregon wild and scenic river program.

The lower Deschutes River is known nationally and internationally for its sport fishing. Resident trout, summer steelhead, spring chinook, and fall chinook are the most sought after species. The lower Deschutes River also supports important tribal fisheries for indigenous fishes. Both summer steelhead and spring chinook are supplemented with hatchery produced fish. Rainbow trout and fall chinook are not stocked in the mainstem lower Deschutes River.

In the late 1980's the Northwest Power Planning Council administered a planning process to create a management plan for the Columbia River basin. As a part of that process, a subbasin plan concerning management of steelhead and salmon was written for the lower Deschutes River. This document, the Lower Deschutes Subbasin Fish Management Plan, significantly expands on the Northwest Power Planning Council document by adding resident fish species and new information on anadromous species and will ultimately produce the final plan used to guide fish resource management in the subbasin for the next 5 to 10 years.

The plan includes ODFW management policies, objectives, assumptions and rationale concerning those objectives, and recommended actions to address:

- Habitat
- Management of fish species
- Angler access

To be consistent with other ODFW basin plans, salmon, steelhead, and trout sections of this plan comply with the Natural Production and Wild Fish Management Policy (OAR 635-07-521 to 635-07-541) and associated guidelines.

SECTION 2. TROUT IN STANDING WATERS

This section covers management of standing waters (lakes, reservoirs, and ponds) of the lower Deschutes River subbasin. Non-indigenous stocks of rainbow, cutthroat, and brook trout have been stocked in standing waters in the lower Deschutes River subbasin. Brown trout have been stocked in Lake Simtustus, formed by Pelton Dam.

Standing waters, for purposes of this plan, include all lakes, reservoirs and ponds in the lower Deschutes River subbasin that are periodically stocked with hatchery trout. These waters were largely created by man and did not historically or presently contain indigenous trout.

For the purposes of this plan, it is assumed that current stocking policies for standing waters do not significantly impact wild fish, except where wild fish are present in the inflow or outflow streams of these standing waters. These exceptions will be noted and management concerns listed.

Hatchery trout stocked into lakes, reservoirs, and ponds of the subbasin may escape upstream or downstream and hybridize with wild rainbow trout present in the flowing waters of the subbasin. Wherever a reservoir, lake, or pond is fed by or drains into a stream with wild rainbow trout, compliance with the Oregon's Wild Fish Management Policy is needed.

Standing water bodies in the lower Deschutes River subbasin have been grouped into three categories:

1. Cascade Mountain Lakes
2. High Use Lakes and Reservoirs
3. Small Ponds

Cascade mountain lakes, due to an overall similarity in fish management goals from lake to lake, are discussed as a group.

Small ponds are discussed as a group.

High use lakes and reservoirs, due to differences in management goals and the diversity of angling experiences they provide, are discussed separately. Specific management direction is offered for each water body in this group.

Cascade Mountain Lakes

Management Direction

Policies

Policy 1. *Cascade Mountain lakes addressed in the lower Deschutes River subbasin will be managed for natural and hatchery production consistent with the Basic Yield (OAR 635-500-115(4)) or Featured Species (OAR 635-500-115(2)) management alternative for trout.*

Policy 2. *Hatchery rainbow, cutthroat and/or brook trout will be periodically stocked into the lakes listed.*

Objective 1. Provide diverse angling opportunities for trout in the Cascade Mountain lakes in the lower Deschutes River subbasin.

Objective 2. **Minimize the impacts of hatchery trout on the production and genetic integrity of adjacent populations of wild trout.**

Objective 3. **Manage Cascade Mountain lake fisheries consistent with management plans developed jointly with the USFS and the CTWS.**

Small Ponds

Management Direction

Policies

Policy 1. *Small ponds with public access containing warmwater gamefish will be managed for warmwater fish consistent with the basic yield management alternative for warmwater fish (OAR 635-500-055(1(d))).*

Policy 2. *Small ponds with public access containing trout will be managed for hatchery production of trout consistent with the basic yield alternative for trout (OAR 635-500-115(4)).*

Policy 3. *To protect native species and desired introduced species, other fish, including but not limited to, non-indigenous salmonids, smallmouth bass, spotted bass, yellow perch, channel catfish and all other members of the catfish family, muskellunge, walleye, northern pike, striped bass, hybrid bass, and koi will not be approved for use in public or private waters covered by this plan.*

Policy 4. *Only rainbow trout, largemouth bass, bluegill and black crappie from sources approved by the ODFW may be considered for introductions into private ponds in the lower Deschutes River subbasin.*

Objective 1. **Provide angler opportunity for a consumptive fishery by stocking legal-sized or fingerling rainbow trout or warmwater gamefish in the ponds listed for the lower Deschutes River subbasin.**

High Use Lakes And Reservoirs

Badger Lake

Management Direction

Policies

Policy 1. *Brook trout shall be managed for natural production consistent with the Basic Yield Management Alternative for trout (OAR 635-500-115(4)). No hatchery brook trout shall be stocked.*

Policy 2. *Rainbow trout shall be managed for hatchery production consistent with the Basic Yield Management Alternative for trout (OAR 635-500-115(4)).*

Objective 1. Provide a diverse, consumptive angling opportunity for hatchery rainbow trout and naturally produced brook trout.

Objective 2. Minimize impacts of hatchery trout stocked in Badger Lake on the production and genetic integrity of downstream populations of wild redband trout in Badger Creek and the White River system.

Objective 3. Minimize annual lake level fluctuations associated with irrigation drawdown at Badger Lake.

Clear Lake

Management Direction

Policies

Policy 1. *Legal-sized rainbow trout shall be managed for hatchery production consistent with the intensive use management alternative for trout (OAR 635-500-115(5)).*

Policy 2. *Hatchery brood rainbow trout will be managed for hatchery production consistent with the trophy fish management alternative for trout (OAR 635-500-115(3)).*

Policy 3. *Brook trout shall be managed for natural production consistent with the Basic Yield Management Alternative for trout (OAR 635-500-115(4)). No hatchery brook trout shall be stocked.*

Objective 1. Provide a diverse, consumptive angling opportunity for hatchery rainbow trout and naturally produced brook trout.

Objective 2. Minimize impacts of hatchery trout stocked in Clear Lake on the production and genetic integrity of downstream populations of wild redband trout in Clear Creek and the White River system.

Objective 3. Enhance fish habitat for adult cover and juvenile rearing.

Objective 4. Minimize annual lake level fluctuations associated with irrigation drawdown at Clear Lake.

Objective 5. Provide additional or improved boat access at Clear Lake during low water conditions.

Frog Lake

Management Direction

Policies

Policy 1. *Legal-sized rainbow trout shall be managed for hatchery production consistent with the intensive use management alternative (OAR 635-500-115(5)).*

Policy 2. *Hatchery brood rainbow trout will be managed for hatchery production consistent with the trophy fish management alternative (OAR 635-500-115(3)).*

Objective 1. **Provide a diverse, consumptive angling opportunity for hatchery produced rainbow trout.**

Objective 2. **Minimize impacts of hatchery trout stocked in Frog Lake on the production and genetic integrity of downstream populations of wild redband trout in Frog Creek and the White River system.**

Olallie Lake

Management Direction

Policies

Policy 1. *Legal-size rainbow trout shall be managed for hatchery production consistent with the intensive use management alternative (OAR 635-500-115(5)).*

Policy 2. *Brood rainbow trout will be managed for hatchery production consistent with the trophy fish management alternative (OAR 635-500-115(3)).*

Objective 1. **Provide a diverse, consumptive angling opportunity for hatchery produced rainbow trout.**

Objective 2. **Minimize impacts of hatchery trout stocked in Olallie Lake on the production and genetic integrity of downstream populations of wild redband trout in the Warm Springs and lower Deschutes rivers.**

Pine Hollow Reservoir

Management Direction

Policies

Policy 1. *Fingerling and legal-sized rainbow trout shall be managed for hatchery production consistent with the Basic Yield Management Alternative (OAR 635-500-115(4))*

Policy 2. *Largemouth bass, brown bullhead, and green sunfish populations resulting from introductions not authorized by ODFW shall be managed for natural production consistent with the Basic Yield Management Alternative for warmwater fish (OAR 635-500-055(1(d))).*

Policy 3. *Pine Hollow Reservoir shall be managed primarily for trout production.*

Objective 1. **Provide diverse, consumptive angling opportunity for hatchery rainbow trout and warmwater game fish.**

Objective 2. **Minimize impacts of hatchery trout stocked in Pine Hollow Reservoir on the production and genetic integrity of downstream populations of wild redband trout in the White River system and lower Deschutes River.**

Rock Creek Reservoir

Management Direction

Policies

Policy 1. *Fingerling, legal-sized, and surplus brood rainbow trout shall be managed for hatchery production consistent with the Basic Yield Management Alternative (OAR 635-500-115(4)).*

Policy 2. *Largemouth bass, brown bullhead, and bluegill populations resulting from introductions not authorized by ODFW shall be managed for natural production consistent with the Basic Yield Management Alternative for warmwater fish (OAR 635-500-055(1(d))).*

Policy 3. *Rock Creek Reservoir shall be managed primarily for trout production.*

Objective 1. Provide a diverse, consumptive angling opportunity for hatchery rainbow trout and warmwater game fish.

Objective 2. Minimize impacts of hatchery trout stocked in Rock Creek Reservoir on the production and genetic integrity of wild redband trout populations above and below the reservoir.

Objective 3. Enhance fish habitat for adult production and juvenile rearing.

Objective 4. Minimize annual lake level fluctuations associated with irrigation drawdown at Rock Creek Reservoir.

Objective 5. Provide additional or improved boat access at Rock Creek Reservoir during low water conditions.

SECTION 3. TROUT, WHITEFISH, AND MISCELLANEOUS SPECIES IN FLOWING WATERS

Rainbow Trout

Rainbow trout, *Oncorhynchus mykiss* (formerly *Salmo gairdneri*), are indigenous to the lower Deschutes River subbasin and they are found throughout the lower 100 miles of the Deschutes River. Rainbow trout are also found throughout tributaries of the lower Deschutes River, but are most abundant in the White River system. Anadromous fish passage is blocked approximately two miles from the mouth of White River by impassable waterfalls. Indigenous rainbow trout populations above White River Falls are significantly different from those in the rest of the subbasin. The White River group of rainbow trout exhibit genetic and morphological characteristics that were previously found in populations of rainbow trout inhabiting isolated drainages of the northern Great Basin. White River rainbow trout may have been isolated from populations in the Deschutes River during the Pleistocene epoch.

Abundance of rainbow trout larger than 8 inches has been estimated in specific areas of the lower Deschutes River during the 1970's, 1980's and 1990's. Density of rainbow trout in the lower Deschutes River above Sherars Falls ranged from 640 to 2,560 fish/mile. Densities in the 1980's, the time period with the most data, averaged 1,630 fish/mile in the North Junction area (river mile 69.8 to 72.8) and 1,830 fish/mile in the Nena Creek area (river mile 56.5 to 59.5). Rainbow trout in the lower Deschutes River are believed to generally be most abundant between Pelton Regulating Dam and Maupin.

Estimates of production of wild rainbow trout within the White River system indicate that the mainstem White River produces a higher percentage of legal-sized trout (about 30% were over 6 inches long) than other parts of the White River system. Legal-sized trout production (percentage of the total population over 6 inches long) of other streams within the basin is lower, from 3% in Little Badger Creek to 18% in Clear Creek.

The lower Deschutes River supports a popular rainbow trout fishery. The character of this fishery has changed over the years as angling regulations have become more restrictive and the stocking of hatchery rainbow trout has been discontinued. Angling regulations and management strategies have changed to protect juvenile steelhead and to potentially increase certain size groups of wild rainbow trout.

The density of trout in the lower Deschutes River appears to currently be stable but fluctuating around a mean value and appears to be driven by density dependent and independent mortality factors other than harvest.

Natural mortality of trout in the lower Deschutes River, particularly associated with spawning, is high (45% to 69%) for fish greater than 31 centimeters (about 12.2 inches). This high natural mortality and not harvest is likely the limiting factor controlling recruitment of trout into size ranges over 41 centimeters (about 16.1 inches). This suggests that unless lower Deschutes River trout change their life history characteristics for high natural mortality and slow growth after maturity, no angling regulation will be successful in stockpiling a large percentage of large fish in the population.

Bull Trout

Bull trout, *Salvelinus confluentus,* are indigenous to the lower Deschutes River and are currently listed on the Oregon Sensitive Species List (OAR 635-100-040) as Critical. Additionally, bull trout are a candidate for protection under the federal Endangered Species Act.

The limited quantitative measures of bull trout numbers in the basin suggest a small population size. Small populations risk extinction through excessive rates of inbreeding and chronic or catastrophic natural processes. It is unknown if lower Deschutes River subbasin bull trout populations are large enough to escape these risks.

It is difficult to speculate on potential habitat degradation issues that may have contributed to reductions in bull trout populations in the subbasin. Water withdrawals from the mainstem lower Deschutes, Shitike Creek and the Warm Springs River have been minimal. The Deschutes River is thought to have historically had a very stable flow regime. The potential effects of logging, road construction, and intensive livestock grazing in the lower Deschutes River subbasin could have and may continue to impact bull trout habitats.

The Pelton/Round Butte hydroelectric complex eliminated upstream passage of bull trout in the Deschutes River subbasin. Downstream passage of all species is limited to passage through the turbines and the effectiveness of this route is unknown. The hydroelectric complex is the major factor severing migration between bull trout subpopulations in the metapopulation in the Deschutes basin. The importance of migration and genetic interchange between populations in the basin is unknown but there likely was movement of bull trout between subpopulations within the metapopulation prior to construction of the hydroelectric complex. A cooperative conservation strategy to recover bull trout in the Deschutes River basin is being developed by many parties and actions to reconnect populations fragmented by passage barriers are being addressed.

Hybridization with brook trout is a concern for the Warm Springs River and Shitike Creek bull trout population(s). Hybridization has not been documented in the lower Deschutes River subbasin but brook trout are present in high lakes in both stream systems and the potential does exist. Competition between juvenile brook trout and bull trout for available resources may exist where both are present even if hybridization is not occurring. Additionally, competition with brown trout that escape downstream from Lake Simtustus is a concern in the upper reach of the lower Deschutes River and possibly Shitike Creek.

Mountain Whitefish

Mountain whitefish, *Prosopium williamsoni,* are found in the lower Deschutes River, Warm Springs River, White River and Shitike Creek. Mountain whitefish are indigenous to the subbasin.

Whitefish are believed to be the most abundant sport fish in the mainstem lower Deschutes River and are under-utilized as a sport species. This population could support a substantial fishery and provide additional angling diversity. Mountain whitefish may be an important prey species for bull trout in the lower Deschutes River.

The population of whitefish in the White River above the falls is limited to the mainstem White River in the area of Tygh Valley. It is possible that the population of mountain whitefish upstream from White River Falls is genetically unique. Maintaining the population of mountain whitefish in White River is a management concern.

Brook Trout

Brook trout, *Salvelinus fontinalis,* are not indigenous to Oregon. The earliest recorded introduction into the lower Deschutes River subbasin was in 1934, when they were released into Clear Lake and Badger Creek. Brook trout were subsequently stocked into many of the high lakes in the subbasin, including high lakes in the Olallie Lake basin.

Brook trout have invaded the upper White River system by moving out of lakes where they were originally stocked. The abundance of rainbow trout is thought to be reduced in Clear Creek by competition with brook trout for available food and space. Rainbow trout appear to have been displaced from Frog Creek by brook trout above river mile 0.4.

There are naturally reproducing populations of brook trout in both Clear and Badger lakes. Natural reproduction also occurs in upper White River, Clear, Frog, Boulder, Barlow, Bonney, Mineral, Buck creeks and in Mill and Shitike creeks on the CTWS reservation. It would be difficult to remove these naturally reproducing populations of brook trout. Future brook trout stocking into lakes that have outflow streams and have never been stocked with brook trout will be evaluated for competition and genetic impacts to other fishes, as well as for potential impacts to sensitive non-game wildlife resources.

Brown Trout

Brown trout, *Salmo trutta*, are not indigenous to Oregon waters. There are, however, established populations of brown trout present in a variety of waters of the state.

Anecdotal information suggests that brown trout were present in the lower Deschutes River in the vicinity of the Pelton/Round Butte hydroelectric complex prior to its construction but their abundance decreased following project construction. It is possible that environmental changes related to construction and operation of the hydroelectric complex were responsible for a change in brown trout abundance and distribution.

Brown trout stocked in Lake Simtustus from 1987 through 1996 are known to have moved out of Lake Simtustus through the turbines and into the Regulation Reservoir upstream from Pelton Reregulating Dam. They are also known to move out of the Regulation Reservoir and into the lower Deschutes River either through the turbines or in spill over the Pelton Reregulating Dam.

Brown trout that pass from Lake Simtustus into the lower Deschutes River may jeopardize the management of indigenous fish species in the lower Deschutes River. A decision to stop the release of brown trout in Lake Simtustus was made in 1995. Brown trout did not appear to be accomplishing the desired nongame fish control objectives in Lake Simtustus and were known to leave the reservoir environment and take up residence in the lower Deschutes River.

Management Direction

Policies

Policy 1. *Wild rainbow and bull trout, whitefish and introduced brook trout shall be managed for natural production consistent with the Wild Fish alternative of Oregon's Trout Plan. No hatchery trout or whitefish shall be stocked in the lower Deschutes River and tributaries.*

Objective 1. Maintain the genetic diversity, adaptiveness, and abundance of the wild indigenous rainbow trout, bull trout, and mountain whitefish in the lower Deschutes River and in the tributaries of the lower Deschutes River.

Objective 2. Provide the opportunity for consumptive harvest of wild trout in the lower Deschutes River subbasin.

Objective 3. Maintain a population of rainbow trout of 1,500 to 2,500 fish per mile larger than 8 inches in length in the lower Deschutes River from Pelton Reregulating Dam to Sherars Falls. Maintain a population of rainbow trout of 750 to 1,000 fish per mile larger than 8 inches in length in the lower Deschutes River below Sherars Falls.

Objective 4. Maintain a population size distribution in the lower Deschutes River such that 30% of the population (fish >8 inches in length) is larger than 12 inches in length, as measured at the Jones study section, the Nena Creek study section and in a study section upstream from White Horse Rapids.

Other Fishes

Pacific Lamprey

Pacific lamprey, *Lampetra tridentatus*, are found in the subbasin in the lower Deschutes River, Shitike Creek, Beaver Creek, and the Warm Springs River. Pacific lamprey are indigenous to the subbasin.

Suckers

Two species of suckers, bridgelip sucker, *Catostomus columbianus*, and largescale sucker, *Catostomus macrocheilus*, are found in the lower Deschutes River and many of its tributaries. Suckers are not found in the White River system above White River Falls.

Chiselmouth

Chiselmouth, *Acrocheilus alutaceus*, are found in the lower Deschutes River and some of its tributaries including Warm Springs River, and Bakeoven, Buck Hollow, Shitike, and Trout creeks. Chiselmouths are not found in the White River system above White River Falls.

Dace and Sculpin

Several species of dace, *Rhinichthys* sp., and sculpin, *Cottus* sp., are indigenous to the lower Deschutes River and many of its tributaries, including White River above White River Falls, the Warm Springs River and Shitike Creek.

Northern Squawfish

Northern squawfish, *Ptychocheilus oregonensis,* also referred to as the bigmouth minnow, are indigenous to the subbasin and are found in the mainstem lower Deschutes and Warm Springs rivers, Trout and Shitike creeks, and may make spawning migrations into other tributaries.

Redside Shiners

Redside shiner, *Richardsonius balteatus,* are indigenous to the lower Deschutes River subbasin. They are found in the mainstem, Bakeoven, Buck Hollow, Shitike, and Trout creeks and the Warm Springs River.

Miscellaneous Species Angling and Harvest

Little information is available on the harvest of mountain whitefish, suckers, squawfish, and chiselmouth in the subbasin. Recreational and tribal harvest of these species is believed to be low. Squawfish are captured incidentally while angling for rainbow trout and summer steelhead throughout the lower Deschutes River. They will readily take artificial flies, particularly during the salmon fly hatch. Lamprey and mountain whitefish are of more importance to members of the CTWS than are suckers and chiselmouth. Protection and enhancement of the lamprey is very important to the CTWS. Whitefish can be easily caught on hook and line while fishing for rainbow trout but are targeted by recreational anglers at a low rate.

Management Direction

Policies

Policy 1. *Manage all indigenous species of fish in the lower Deschutes River and its tributaries to sustain the tribal cultural and subsistence needs, while providing the structural, functional and biological requirements to insure ecosystem viability.*

Objective 1. Protect populations of all indigenous species of fish in the lower Deschutes River subbasin.

SECTION 4. SUMMER STEELHEAD

Wild Summer Steelhead

Summer steelhead, *Oncorhynchus mykiss*, (formerly *Salmo gairdneri*) occur throughout the mainstem lower Deschutes River below Pelton Reregulating Dam (river mile 100) and in most tributaries below the dam. Before construction of the Pelton/Round Butte hydroelectric project in 1958, summer steelhead were also found in the Deschutes River upstream to Big Falls (river mile 128), in Squaw Creek, and in the Crooked River.

Lower Deschutes River summer steelhead are currently classified as a wild population on Oregon's Wild Fish Management Policy Provisional Wild Fish Population List [OAR 635-07-529(3)]. A population meets ODFW's definition of a wild population if it is a native species, naturally reproducing within its native range, and descended from a population that is believed to have been present in the same geographical area prior to the year 1800.

The Columbia Basin System Planning Deschutes River Subbasin Production Plan adopted by the Northwest Power Planning Council in 1990 and reviewed by the Oregon Fish and Wildlife Commission in late 1989 proposed creating access into White River for anadromous species (spring chinook and summer steelhead). The objective of that proposal was to increase natural production of both species. The Lower Deschutes Subbasin Fish Management Plan, this document, does not carry that proposal forward or propose objectives for increased production of anadromous fishes into areas beyond their historic ranges.

The estimated number of wild summer steelhead migrating over Sherars Falls has ranged from a low of 480 in the 1994 run year to a high of 9,600 in the 1985 run year, averaging 4,900 for the period of record.

Recreational landings of wild summer steelhead in years when total catch below Sherars Falls was estimated ranges from a low of 1,465 in 1994 to a high of 14,330 in 1987 and has averaged 5,869 for the period of record. Recreational anglers have been prohibited from retaining wild summer steelhead in the lower Deschutes River since 1978. Tribal harvest of wild summer steelhead during years of unrestricted tribal dipnet effort has ranged from a low of 299 in 1990 to a high of 1,649 in 1984 and has averaged 731 for the period of record.

The maximum wild summer steelhead production capacity of the lower Deschutes River has been estimated to be 9,098 adults returning to the mouth of the Deschutes River. To achieve this production capacity would require, on the average, 6,575 spawners; therefore, a harvest of 2,523 (9,098 - 6,575 = 2,523) fish would theoretically be possible at maximum production.

Oregon's Wild Fish Policy recognizes the minimum viable population size to be 300 breeding fish. Managers should be conservative with the valuable genetic and cultural resource that lower Deschutes River wild summer steelhead represent. A minimum spawning escapement size of 1,000 passing Sherars Falls for three consecutive years has been identified as the minimum acceptable spawning population used to trigger more restrictive and protective angling regulations.

Specific information on habitat carrying capacity for wild summer steelhead is not available for the lower Deschutes River subbasin.

The large influx of out of subbasin stray summer steelhead may be contributing significant amounts of maladapted genetic material to the wild summer steelhead population in the lower Deschutes River subbasin. The cumulative effect of this genetic introgression may contribute to lowered productive capacity of the wild population as evidenced by decreased run strength of wild summer steelhead through time.

The question of compliance with Oregon's Wild Fish Management Policy (WFMP) for lower Deschutes River wild summer steelhead is a very complicated, serious, and difficult question to address. The effort required to analyze the biological, social, and economic data necessary for resolution will be significant and undertaken at the Commission's request, not as a specific component of this plan.

Hatchery Summer Steelhead

Round Butte Hatchery (RBH), completed in 1972 to mitigate the effects of the Pelton/Round Butte hydroelectric project, is the only hatchery releasing summer steelhead in the lower Deschutes River subbasin. Portland General Electric (PGE) funded construction of the hatchery and continues to finance operation and maintenance. The ODFW operates the hatchery. Warm Springs National Fish Hatchery (WSNFH) reared summer steelhead and released them in the subbasin in 1978 and 1980 but steelhead production at WSNFH was discontinued in 1981. Future steelhead production is not planned at that facility.

The summer steelhead mitigation requirement mandated by PGE's Federal Energy Regulatory Commission license is an average of 1,800 RBH origin summer steelhead returning annually to Pelton trap, the hatchery's brood stock collection facility. This mitigation is intended to replace fish lost due to construction and operation of the Pelton/Round Butte hydroelectric complex. The mitigation requirement was met fairly consistently prior to the 1989 return year. To meet this requirement, the hatchery releases approximately 162,000 summer steelhead smolts annually.

Brood stock for the summer steelhead program at RBH are currently collected from hatchery origin and wild fish returning to Pelton trap and from wild fish captured at the Sherars Falls adult trap.

Estimates of the number of RBH origin summer steelhead escaping above Sherars Falls have been made for all run years from 1977 to present. The estimated number of RBH origin summer steelhead migrating over Sherars Falls ranged from a low of 1,200 in 1993 to a high of 9,200 in 1987 and averaged 4,800 for the period of record. RBH origin summer steelhead averaged 54% of the estimated number of hatchery origin summer steelhead passing Sherars Falls, ranging from a low of 22% to a high of 92% for the period of record.

Stray hatchery origin summer steelhead averaged 45% of the total estimated number of summer steelhead passing Sherars Falls from 1977 to 1994, ranging from a low of 8% in 1980 to a high of 88% in 1993.

Catch of RBH origin summer steelhead by recreational anglers in years when total catch below Sherars Falls was estimated ranged from a low of 184 in 1994 to a high of 3,287 in 1974. During years of unconstrained harvest, tribal fishers harvested a low of 221 RBH origin summer steelhead in 1976 and a high of 1,925 in 1974. The percentage of RBH origin adults in the fisheries has decreased over time, due largely to the increasing percentage of stray origin hatchery summer steelhead in the catch.

Off-station juvenile acclimation and adult capture facilities may be a hatchery technique available to increase hatchery fish availability and utilization by subbasin fishers. Wild summer steelhead in the subbasin may also benefit from potentially reduced competition and interbreeding as a result of hatchery juvenile acclimation. Juvenile hatchery summer steelhead could be acclimated to a specific water source, increasing the potential for them to return to that water source as adults.

Adults returning to a juvenile acclimation/adult capture facility located significantly downstream from Pelton trap would be available for trap capture earlier in the year making them less likely to remain in the river over winter to potentially spawn with wild summer steelhead. The potential would exist to recycle captured fish downstream to increase angler utilization of these fish and minimize genetic interaction with wild summer steelhead. Juvenile acclimation has been shown in other systems to enhance smolt to adult survival.

Management Direction

Policies

Policy 1. *Hatchery reared summer steelhead will continue to be released in the lower Deschutes River subbasin.*

Policy 2. *Angler induced hooking mortality of wild lower Deschutes River summer steelhead shall be reduced or eliminated when estimated escapement levels of 1,000 wild summer steelhead or less over Sherars Falls occur for three consecutive years.*

Objective 1. Maintain an estimated escapement of 6,575 wild adults over Sherars Falls annually.

Objective 2. Provide a recreational fishery based on wild summer steelhead, out of subbasin stray hatchery summer steelhead and lower Deschutes River origin hatchery summer steelhead returns.

SECTION 5. SPRING CHINOOK

Wild Spring Chinook

Spring chinook, *Oncorhynchus tshawytscha,* are indigenous to the lower Deschutes River subbasin, with the exception of White River above White River Falls. Historically they occurred in the mainstem Deschutes River up to Big Falls (river mile 133) and in the Metolius River. Adult passage was feasible at the Pelton-Round Butte hydroelectric complex but spring chinook juveniles could not successfully migrate downstream past the dams to the ocean.

Wild spring chinook salmon are currently produced only in the Warm Springs River and Shitike Creek. The Warm Springs River above Warm Spring National Fish Hatchery (WSNFH) and Shitike Creek are currently managed for wild fish only. Hatchery spring chinook salmon are not released in either system or allowed to spawn in the Warm Springs River above WSNFH.

The optimum escapement goal for the Warm Springs River above WSNFH is 1,300 adult spring chinook salmon with a minimum adult run size goal of 1,000. This optimum goal has been met in 12 of the last 17 years. The average run of wild adult spring chinook salmon to the mouth of the Deschutes River was 1,817 fish from 1977 through 1995.

Hatchery Origin Spring Chinook

Spring chinook salmon are produced at two hatcheries in the subbasin. Round Butte Hatchery, funded by Portland General Electric (PGE), has released 220,000 to 270,000 smolts annually to meet PGE's mitigation requirement of an average of 1,200 adult spring chinook salmon, of which 600 must be females, returning annually to Pelton trap. This mitigation requirement is intended to replace spring chinook lost due to construction and operation of the Pelton/Round Butte hydroelectric complex. WSNFH releases approximately 700,000 smolts annually and has released over 1,000,000. The run size of hatchery spring chinook salmon in the subbasin averaged 3,427 fish from 1982 through 1994.

Angling and Harvest

A large recreational fishery and a tribal fishery for spring chinook salmon takes place in the 3-mile section from Sherars Falls downstream to the first railroad trestle from April to June most years. Harvest rates in these fisheries have historically been great enough to cause concern for the wild component of the spring chinook salmon run. Harvest of hatchery and wild spring chinook has averaged 1,002 fish and 737 fish, respectively, from 1977 through 1993. The recreational spring chinook season was closed in 1981, 1984, 1994, and 1995 based on the low predicted return of wild spring chinook. Tribal spring chinook seasons were either closed or restricted during those years.

Off-station juvenile acclimation and adult capture facilities may be a technique available to increase the availability of hatchery spring chinook to fishers in the Deschutes subbasin. Juvenile hatchery spring chinook could be acclimated to a specific water source, increasing the potential for them to return to that water source as adults. The returning adults would likely hold in the river in this vicinity and be available to subbasin fishers for a longer period of time than adults returning to a release site at in the Warm Spring river or at river mile 100. If the acclimation and adult capture facility was located in the vicinity of Sherars Falls, it is likely that adults returning to that facility would hold in the Sherars Falls area and be available to subbasin fishers for a longer period of time.

Management Direction

Policies

Policy 1. *The lower Deschutes River subbasin shall be managed for wild and hatchery spring chinook salmon.*

Objective 1. **Achieve a spawning escapement level between an optimum of 1,300 and a minimum of 1,000 adult wild spring chinook salmon above the barrier dam at Warm Springs National Fish Hatchery.**

Objective 2. **Provide the opportunity to harvest wild spring chinook salmon when returns are greater than the optimum wild adult spawning escapement of 1,300 adults. Provide the opportunity to harvest Round Butte Hatchery and Warm Springs National Hatchery origin spring chinook salmon that are excess to brood stock needs.**

Objective 3. **Increase harvest opportunity of hatchery spring chinook salmon within existing hatchery production levels.**

SECTION 6. FALL CHINOOK SALMON

Fall chinook salmon, *Oncorhynchus tshawytscha,* are indigenous to the subbasin and are found throughout the mainstem Deschutes River downstream from Pelton Reregulating Dam. All production of fall chinook salmon in the subbasin is from wild stock. Summer and fall flows in the lower Deschutes River may have historically limited distribution of fall chinook salmon to 44 miles of river below Sherars Falls before a fish ladder was built at the falls in the 1930's.

The fall spawning chinook stock enters the subbasin from late June to October. It may be composed of both summer and fall runs or a single run with a protracted time of entry into the subbasin. The existence of both summer and fall runs is supported by two peaks in run timing at Sherars Falls, an early peak occurring in July and a later peak in September. Evidence supporting one run is that there does not currently appear to be detectable reproductive isolation between the early and late segments of the run and interbreeding between the two components has taken place for many years. Both segments appear to spawn in the same areas and considerable overlap in time of spawning exists between the two groups. The available information suggests that if a summer race of chinook was present, it appears to be functionally extinct today. Information has been compiled and presented in this plan under the assumption that this is one race of chinook salmon but an escapement goal for adult fall chinook migrating upstream from Sherars Falls is recognized to manage for the biological diversity these fish are thought to represent.

The run size of fall chinook salmon (adult and jack) into the lower Deschutes River subbasin from 1977 through 1995 averaged 9,465 fish annually, ranging from 4,061 fish to 19,808 fish. Annual spawning escapement of jacks and adults averaged 3,482 fish and 4,107 fish, respectively, during the same period.

Redd counts during years 1988 to 1995 suggest a change in historic spawning distribution may be occurring and a higher percentage of all spawning is taking place downstream from Sherars Falls.

A popular recreational fishery and one of the last tribal subsistence fisheries for fall chinook salmon in the region typically occurs from early July, when the first fish arrive at Sherars Falls, to late October. Harvest of fall chinook salmon in the lower Deschutes River occurs primarily in a 3-mile section from Sherars Falls downstream to the first railroad trestle.

Recreational harvest averaged 320 adult fall chinook and tribal harvest averaged 1,297 adult fall chinook from 1977 to 1990, years when season length and harvest restrictions were not in place. During the same time period, recreational harvest averaged 693 jack fall chinook and tribal harvest averaged 372 jack fall chinook. Of the fall chinook salmon that entered the lower Deschutes River from 1977 through 1990, 31% of the adults and 29% of the jacks were harvested in recreational and tribal fisheries.

Harvest of lower Deschutes River fall chinook in the ocean and Columbia River may constrain managers abilities to meet subbasin production goals.

Management Direction

Policies

Policy 1. *No hatchery fall chinook salmon shall be released into the lower Deschutes River and its tributaries.*

Objective 1. **Achieve a minimum annual spawning escapement of 4,000 adult fall chinook in the lower Deschutes River with a minimum annual spawning escapement of 2,000 adult fall chinook upstream of Sherars Falls.**

Objective 2. **Provide the opportunity to harvest wild fall chinook when returns are greater than the spawning escapement objectives of 4,000 adults to the river and 2,000 adults escaping upstream from Sherars Falls.**

SECTION 7. WARMWATER GAMEFISH IN STANDING WATERS

Most warmwater gamefish populations in the lower Deschutes River subbasin are the result of unauthorized introductions by the public. Warmwater species known to exist in the basin are brown bullhead, *Ictaluras nebulosus*, bluegill, *Lepomis machrochirus*, green sunfish, *Lepomis cyanellus*, largemouth bass, *Micropterus salmoides*, and smallmouth bass, *Micropterus dolomieui*.

Unauthorized introduction of warmwater gamefish, salmonids, and nongame fish species by the public is a serious management concern within the lower Deschutes River subbasin.

ODFW does not have an active stocking program for warmwater fish in the lower Deschutes River subbasin.

ODFW recognizes the value of well managed warmwater fisheries in areas where indigenous fish populations are not impacted. The goal of this plan is to provide the greatest diversity of angling opportunities with fish species currently in the subbasin by providing direction on how warmwater species will be managed for present and future generations of Oregon anglers while maintaining indigenous fish populations.

Management Direction

Policies

Policy 1. *Warmwater fish in the lower Deschutes River subbasin shall be managed for natural production consistent with the Basin Yield Management Alternative for warmwater fish (OAR 635-500-055 (1(d)).*

Policy 2. *Largemouth bass, bluegill and black crappie are the only species of warmwater fish that will be considered for introductions in small ponds within the subbasin.*

Policy 3. *To protect native species and desired introductions, such as largemouth bass, bluegill and black crappie, other species of exotic fish, including but not limited to smallmouth bass, spotted bass, yellow perch, channel catfish and all other members of the catfish family, walleye, northern pike, striped bass, muskellunge, hybrid bass, koi and grass carp shall not be approved for new introductions in public or private ponds in the lower Deschutes River subbasin.*

Objective 1. **Promote warmwater fisheries as a recreational alternative in isolated waters in the lower Deschutes River subbasin in locations that do not harm indigenous species.**

Objective 2. **Minimize unauthorized introductions of undesirable warmwater species by the public into the lower Deschutes River subbasin.**

Objective 3. **Regularly inventory public water bodies that support warmwater fish.**

Objective 4. **Maintain or develop access at water bodies managed for warmwater fisheries.**

SECTION 8. ACCESS

Public access to waters in the lower Deschutes subbasin varies depending on individual waters. Access to the lower Deschutes River is limited by four factors including the roughed topography of the canyon, privately owned lands, lands within the Confederated Tribes of the Warm Springs Reservation of Oregon, and limitations of the existing road and trail systems. Public access to the river is often restricted or prohibited on privately owned lands.

Management Direction

Policies

Policy 1. *The Oregon Department of Fish and Wildlife (ODFW) will recognize other resource and recreation plans in affect in the lower Deschutes subbasin. ODFW will work cooperatively with other agencies to maintain or increase boat access and shoreline angler access that will satisfy public need for a variety of angling opportunities and a dispersion of angling effort throughout the subbasin.*

Policy 2. *Acquisition and development of angler access sites will be consistent with the guidelines and objectives for management of fish and their habitat.*

Policy 3. *ODFW will attempt to maintain public access at all existing public access sites in the White River system.*

Policy 4. *ODFW will pursue possible easements or land purchases to create new public access at key sites throughout the planning area, on a willing seller-willing buyer basis.*

Objective 1. **Improve the distribution of people angling on the lower Deschutes River by supporting other agencies in the development of new parking areas and the improvement of designated launch sites and foot trails.**

Objective 2. **ODFW will continue to work with other agencies and landowners to both maintain existing public access sites and to develop new ones.**

Objective 3. **ODFW will not pursue increased public angling access to Buck Hollow, Bakeoven, or Trout creeks.**

Objective 4. **ODFW will work with other agencies and private landowners to develop new reservoirs or ponds, or access to existing reservoirs and ponds for additional public angling opportunity.**

MAJOR ISSUES

The Pelton/Round Butte hydroelectric complex has changed the lower Deschutes River. Anadromous and resident fish production in the lower Deschutes River may be limited by these changes. These changes and their effect on indigenous fishes and their habitats are poorly understood.

This plan does not recommend providing anadromous fish passage into the White River system upstream from White River Falls. The Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) continue to support introduction of anadromous species there as a production technique.

The large number of stray hatchery summer steelhead entering and potentially spawning in the lower Deschutes River is an enormous concern to managers. This issue will be difficult or impossible to solve.

It is unknown if fall chinook in the lower Deschutes River are made up of one stock that spawns throughout the lower 100 miles of the Deschutes River or two stocks, one that spawns upstream from Sherars Falls and one that spawns downstream from Sherars Falls. It is also unknown if a summer chinook population exists in the lower Deschutes River.

LOWER DESCHUTES RIVER SUBBASIN FISH MANAGEMENT PLAN
SECTION 1. HABITAT

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HABITAT

PHYSICAL DESCRIPTION

Geographic Location

The Deschutes River flows northerly through central Oregon and enters the Columbia River 205 miles from the Pacific Ocean. The subbasin covers 10,400 square miles and is 170 airline miles long by 125 airline miles wide, greatest dimensions (Oregon State Water Resources Board 1961; as cited in Aney et al. 1967), as shown in Figure 1.1. The Deschutes River watershed is second in size only to the Willamette River watershed in Oregon.

This plan encompasses the lower Deschutes River and its tributaries below the Pelton/Round Butte hydroelectric complex located at RM 100 (Figure 1.1). The lower subbasin covers approximately 2,700 square miles and has 760 miles of perennial streams and 1,440 miles of intermittent streams. Major tributaries include White and Warm Springs rivers and Shitike Creek on the west side and Buck Hollow, Bakeoven, and Trout creeks on the east side.

The Cascade Range forms the western boundary of the basin. The southern boundary of the lower Deschutes River subbasin follows the Tenino Bench on the Warm Springs Reservation and continues east to the Ochoco Mountains. The plateau between the Deschutes and John Day basins forms the eastern boundary, while Tygh Ridge and the Columbia River form the northern boundary.

Topography and Geology

The lower Deschutes River flows through a narrow canyon 700 to 2,200 feet deep. Million of years of geological events can be traced in the deep gorge of the lower Deschutes River between its confluence with the Columbia River and South Junction (river mile 84.0).

The Deschutes basin lies in the southern portion of the Columbia basin physiographic province (Franklin and Dyrness 1973). Major geologic formations in the basin include The Dalles, John Day, and Clarno formations and the Columbia River Basalts group. Loess, volcanic ash, and pumice have been laid down during recent geologic times. Much of the original deposits of loess and ash have been removed from the uplands and redeposited along streams. The soils are primarily silt loam, but also include clay loams, stony loams, cobbly loams, and clay. Erosion potentials due to water or wind range from slight (less than 2.5 tons/acre/year) to severe (5 to 15 tons/acre/year) (BLM 1986).

The elevation of the lower Deschutes River drops from 1,393 feet at Pelton Reregulating Dam to 160 feet at the mouth, or an average drop of 12.3 feet per mile. Two major drops in the lower Deschutes River are Sherars Falls at RM 44 with a vertical drop of 15 feet and Whitehorse Rapids at RM 75 with a drop of 35 feet in one mile (Figure 1.2).

The three largest tributaries to the lower Deschutes River, the Warm Springs River, White River, and Shitike Creek, all originate on the east slope of the Cascades. The elevation of the Warm Springs River drops from 3,775 at its source to approximately 1,230 feet at its confluence with the Deschutes, or an average drop of 48 feet per mile along its 53 mile course. White River originates high on the southeast slope of Mt. Hood at the White River Glacier. The elevation of the White River drops from 6400 feet at its source to 820 feet at its confluence with the Deschutes, or an average drop of 118 feet per mile over its 47 mile course. Shitike Creek originates in Harvey Lake near the Cascade Mountains summit approximately four miles north of Mount Jefferson. The elevation of Shitike Creek drops from approximately 5,280 feet at its source to 1,476 feet at its confluence with the Deschutes River, or an average drop of 126.8 feet per mile along its 30 mile channel.

Climate

The climate in the basin is primarily semiarid. The average annual precipitation ranges from as high as 100 inches in the Cascade Mountains, to 20 inches in the Ochoco Mountains, and to between 9 inches and 14 inches in the Deschutes Valley and the eastern plateaus. Approximately 25 percent of the annual precipitation falls between May 1 and September 30.

Vegetation

Major vegetation groups are steppe, shrub-steppe, and juniper savanna in the canyon and plateau areas and coniferous forest in the Cascade and Ochoco mountains. Indigenous vegetation includes bunch grass, sagebrush, bitterbrush, juniper, and ponderosa pine in the lower elevation canyon and plateau areas. At increasing elevations in the western and southeastern portions of the watershed the coniferous forests transition from pine into Douglas fir, and finally grand fir. Hemlock and lodgepole pine are common at upper elevations on the east slope of the Cascade mountains, while western red cedar and Engelmann spruce are common along the stream margins at mid to upper elevations. Introduction of non-indigenous species such as cheat grass, Kentucky bluegrass, and medusahead wild rye has altered the indigenous plant communities, as have cultivation, livestock grazing, and other human activities (BOR 1981). Various species of noxious weeds have invaded range areas disturbed by heavy livestock grazing and various human activities. Species such as Russian and diffuse knapweed effectively out compete desirable native grasses, which contributes to the degradation of the upland watershed.

At elevations below 2,000 feet, riparian vegetation along the perennial streams includes perennial grasses, sedges, rushes, emergent aquatic plants, shrubs and deciduous trees, primarily willow and alder. At higher elevations, the riparian corridor is usually dominated by a mix of conifer species, but it is not uncommon to have a deciduous canopy component that could include vine maple, white alder, and cottonwood trees. Condition of the riparian vegetation is generally better along the mainstem Deschutes River and the higher elevation west side tributary reaches than it is along the lower elevation and east side Deschutes River tributaries. The better condition riparian vegetation along the lower Deschutes River is directly associated with recent projects designed to control livestock grazing and the railroad right-of-way fencing that has excluded livestock from approximately 75 miles of river shoreline for decades.

Water Resources

The Deschutes River has a more uniform flow than any other river in the United States of comparable size or larger, especially in the upper reaches (USGS 1914; as cited in Nehlsen, 1995).

Deschutes River discharge measurement records for flow at Moody are available from U.S. Geological Survey (USGS) gauging station 1410300 for the period 1897 to present. The maximum recorded discharge for the period of record, 79,800 cubic feet per second (cfs), occurred on February 8, 1996. Since 1965 Deschutes River flow at the Pelton gauge has exceeded 3,200 cfs 99 percent of the time, while exceeding 9,040 cfs only 1 percent of the time (Huntington 1985) (Figure 1.3). The average annual runoff for the Deschutes River subbasin is 4.2 million acre feet, of which 1.2 million acre feet enter the Deschutes River within this planning area. Only five rivers within Oregon have greater average annual runoff (Aney et al. 1967).

Regulation of waters in the upper Deschutes River and tributaries alters the flow patterns of the river from what which would have occurred naturally. Upper watershed impoundments that alternately store and release water on a seasonal basis include Ochoco and Prineville reservoirs (Crooked River subbasin) and Crescent Lake, Crane Prairie and Wickiup reservoirs (upper Deschutes River subbasin). Lower Deschutes River flows are controlled by discharge from Portland General Electric's (PGE) Pelton/Round Butte hydroelectric complex, located at the upstream end of this planning area (river mile 100). Under terms of this project's Federal Energy Regulatory Commission (FERC) and the State of Oregon Water Resource Board hydroelectric licenses, the allowable river discharge immediately below the project must be at least 3,500 during the months of March, April, May and June, and 3,000 cfs during the remainder of the year unless reservoir inflow is less than that. The Pelton/Round Butte hydroelectric complex has the ability to significantly alter the flow pattern in the lower Deschutes River but flow alteration resulting from the project has historically been minimal.

Warm Springs River flows have been monitored since 1972 by USGS gauging station 14097100 near Kah- Nee-Ta. The drainage area above this gauging station is 526 square miles. The average flow in the Warm Springs River over a twenty year period was 425 cfs. The high flow of record is 24,800 cfs on February 7, 1996. The low flow of record is 149 cfs on December 20, 1990.

White River flows were monitored from 1917 to 1990 by USGS gauging station 14101500 below Tygh Valley. The mean annual flow for the period of 1918 to 1982 was 427 cfs. This flow originates from a drainage area of 368 square miles. The maximum recorded discharge for White River for the period of record is 13,300 cfs, which occurred on January 6, 1923. The record low flow is 7.5 cfs, which occurred on August 31, 1961; however the mean flow for this date is 126 cfs. This wide variation of flow is not characteristic of unregulated streams like White River and is probably attributable to diversion for irrigation at some upstream site(s) (Ott Water Engineers 1984).

Shitike Creek flows have been monitored since 1974 by USGS gauging station #14092885 located near the town of Warm Springs. The mean annual flow for the period of record is 93.3 cfs. This flow originates from a drainage of 75.8 square miles. The maximum recorded discharge for Shitike Creek is an estimated 4,500 cfs on February 7, 1996. The minimum flow of record is 17 cfs during October and November, 1978.

There is little flow information available for the east side tributaries to the lower Deschutes River. Trout Creek is the only stream that has had any discharge gauging station. Average monthly flows at the mouths of Buck Hollow, Bakeoven, and Trout creeks are presented in Figure 1.4 (BOR 1981).

Many of the lower Deschutes River tributaries are characterized by intermittent or low flows. This problem of insufficient flows is often directly related to consumptive water withdrawals and degraded stream corridors. The lack of adequate flow can occur on some streams by early spring. This early onset of low stream flow can block adult steelhead spawning migrations, isolate spawners in unsuitable habitat, prevent downstream migration of spawned out adults, and prevent smolt out-migration. Reduced stream flow reduces the potential production of aquatic organisms, which are an important food source for rearing anadromous and resident fish. Low flows reduce total quantity of rearing habitat for fish and make them more susceptible to predation and mortality associated with degraded water quality.

MAN'S INFLUENCE ON THE WATERSHED

Native Americans

Native Americans have lived in the Deschutes country for at least 10,000 years. For these early residents the Deschutes River and tributaries were an important source of food. For example, a prehistoric steelhead and salmon fishery probably existed at Sherars Falls using fishing platforms and dipnets in a manner similar to that of today (Aney et al 1967). These early Deschutes residents lived in harmony with the watershed and the water and fishery resources for thousands of years.

Subbasin Settlement and Development

The first white men to visit the Deschutes River subbasin were the members of the Lewis and Clark expedition, which reached the river's mouth on October 22, 1805. Other early explorers, including Peter Skene Ogden and John Fremont, arrived shortly after Lewis and Clark. They in turn were followed by fur trappers and traders. The white trappers and traders exhausted the resource and moved elsewhere, a use pattern deeply ingrained (Clark and Clark 1981). Peter Skene Ogden wrote in his diary on December 8, 1825 regarding his encounter with trapper Mr. McDonald "Success in Beaver [h]as not been great only 460..." (Clark and Clark 1981). The first immigrant wagons passed through the Deschutes country in 1845, 1853 and 1854 in an attempt to find a shorter route to the Willamette Valley.

Land Use

Ownership

Ownership of land in the lower Deschutes River basin is shown in Table 1.1.

Livestock Grazing

The first stockmen had driven cattle over the Cascades into the Deschutes country as early as 1857. In 1862 Felix Scott Jr. drove 900 head of cattle over the McKenzie Pass; and they wintered in a cave on Hay Creek north of Madras. George Barnes described the area in 1887 - "This was, certainly, as fine a country as a stock man could wish to see. The bottoms were covered with wild rye, clover, pea vines, wild flax and meadow grass that was waist high on horseback. The hills were clothed with a mat of bunch grass that seemed inexhaustible. It appeared a veritable paradise for stock" (Clark and Clark 1981).

Sheepmen were the contemporaries of the early cattlemen in the Deschutes country. William C. McKay's journal includes a passage that records his encounter with a band of sheep in the Trout Creek bottom in 1867. Sheep flocks multiplied rapidly (Clark and Clark 1981). By the turn of the century Shaniko was noted as one of the world's leading railheads for the shipment of wool. This wool was predominately produced in the lower Deschutes River subbasin.

The impacts of intensive sheep and cattle grazing transformed the watersheds of the Deschutes River and tributaries. The bunch grass hillsides were over-grazed and less desirable grasses successfully invaded the area.

The degradation of the native vegetation and the control of fire encouraged the rapid invasion of juniper into many areas between 1890 and 1900. Junipers have been part of the central Oregon landscape for hundreds of years, but their distribution was restricted by periodic wild fire. Since juniper is a large, long-lived evergreen, the expansion of its range has altered ecosystems in many ways. Microclimates, water cycles, nutrient cycles, and the plant and animal species diversity have changed greatly in areas dominated by new juniper woodlands (Bedell et al. 1991). Specific areas of new juniper establishment in the lower Deschutes River subbasin include the Buck Hollow, Bakeoven, Wapinita, Nena and Trout creek watersheds and the lower elevation tributaries to the Warm Springs River.

Under some circumstances, increases in juniper cover may have adverse impacts to normal watershed hydrologic function since this tree effectively intercepts water and causes a decline in grass, forbs, and shrub ground cover. The reduction in ground cover increases the potential for overland water flow during large storms because the water cannot be held on the surface long enough to infiltrate into bare soil. Sediment production is 20 times less from a sagebrush/grass community than from bare ground. Sites that are dominated by juniper can release significant amounts of sediment from the overland flow caused by large storms or snow melt (Bedell et al. 1991). Some of this sediment enters streams and degrades the aquatic habitat.

Livestock have traditionally grazed year around in the lower Deschutes River canyon and tributaries, or from spring until the fall harvests were complete on the cropland. This livestock use historically included horses and mules used to propel farm equipment, as well as sheep and cattle. Remnant sheep shearing and lambing sheds can still be seen at several sites adjacent to streams in this planning area, even though the large sheep operations have been absent for many decades.

The pattern of year-long or spring, summer, fall livestock grazing in the steep stream valleys has concentrated animals near the streams where there is shade, water, green feed, and cooler air temperatures. Grasses, forbes, shrubs, and trees have been heavily impacted by this livestock use. Tree recruitment needed for replacement of larger trees lost to natural attrition has also been eliminated by the intense grazing. The ultimate, long term effect of this livestock use has been a general denuding of stream corridors.

The loss of important riparian stream side vegetation often resulted in instability of the stream channel. This condition was further aggravated by the physical damage to streambanks associated with livestock grazing. This channel instability, combined with rapid upland storm runoff from degraded upland rangeland, led to frequent and devastating flood and erosion events. These flood events unraveled stream banks, removed remnant trees and top soil from the flood plain, and in some areas destroyed cropland, buildings and other structures. This flooding, or the post-flood remedial channel repair projects, caused significant widening of the stream channels, loss of instream structure, and reduction in average stream depth.

Platts (1981) found that stream channels were four times as wide in an area heavily grazed by sheep as compared to an adjacent area that was lightly grazed. The typical broad, degraded, channel configuration, with little or no overhead cover and reduced natural flood plain water storage capacity, can result in extreme water flow and temperature fluctuations during the year. Armour et al. (1988) reported that erosion can lower water tables and reduce stream flows during critical base flow periods. Elmore and Beschta (1987) reported that vegetation influences hydrologic conditions within a watershed. Any activity, including overgrazing, that decreases vegetation can result in adverse hydrological conditions including lowering of summer flows in streams. Narrow, well vegetated stream channels result in deeper cooler water during the summer and warmer water in the winter. Deep snow at high elevation may bridge the stream and insulate against extreme winter temperatures (Chaney et al. 1993).

Historically, well vegetated uplands and stream bottoms acted to moderate runoff from storm events. Beaver were plentiful throughout the area. Beaver dams scattered along the lengths of the tributary streams slowed the higher spring stream flows, while at the same time recharging the adjacent flood plain with water that was subsequently released slowly throughout the remainder of the year. This natural storage of water coupled with narrow, well vegetated stream corridors, produced optimum flows of high quality water throughout the year. In addition, there was ample overhead and instream cover and a high quality and well distributed gravel substrate. These factors combined to provide good anadromous and resident fish habitat.

Many streams in the subbasin are currently broad and shallow with wide extremes in flow, temperature, and turbidity. Streams or stream reaches may be seasonally intermittent. Spring flows may be insufficient to provide water depth needed for adult fish during spawning migrations. Rapidly declining flows isolate adult fish and prevent downstream migration following spawning. Rearing juvenile fish are often isolated in small pools during the summer low flow period. Significant loss of these juveniles during their two to three years of fresh water rearing typically occurs. This loss is attributed to lethal water temperatures, temperature associated disease or parasites, and predation. Predators are extremely efficient in pools where fish are concentrated and little or no escape cover exists.

Salmonid and resident fish production in lower Deschutes River tributaries is believed to be at historical low levels because of stream habitat degradation, the effects of a prolonged drought, and lower ocean productivity brought on by recent El Niño events. These conditions have seriously magnified other habitat deficiencies.

Agriculture

Dry land and irrigated farming are the two predominate types of agriculture in the lower Deschutes River subbasin. Dry land farming is generally confined to the northern portion of the watershed. This practice is predominately associated with grain production, principally wheat and barley.

Dry land farming generally involves raising a crop every other year. During the non-production year the land is usually in a cultivated fallow condition and a conscious attempt is made to prevent any vegetation from growing in these fallow fields in order to conserve water for the upcoming production cycle. Fallow fields are particularly susceptible to erosion during periods of heavy precipitation.

Erosion from these fallow fields can be particularly severe when there is a rain on snow event and the ground is frozen. Erosion can be further exaggerated on some of the steeper fields where the slope may approach 35%. Natural Resource Conservation Service (formerly the Soil Conservation Service) technicians have measured soil loss on steeper fields up to 300 tons per acre per year (Eddy 1996). Sediment originating from dry land farming affects the following streams within the planning area: Antelope, Trout, Bakeoven, Buck Hollow, Macks Canyon, Sixteen Canyon, Gordon Canyon, Fall Canyon, Oak Brook, Jordan, Tygh, Wapinita, Nena, Dry, Ferry, and Bull Run creeks, as well as White River and the lower Deschutes River.

In recent years farming and conservation practices on the dry land grain fields has improved and erosion has been reduced. The Conservation Reserve Program (CRP) has been one of the most effective conservation programs in recent years. The program reimbursed landowners who put highly erodible cropland into permanent grass cover. Permanent grass cover effectively minimized erosion and sediment transport from the CRP fields. However, some of the conservation practices have been counter productive. Level terraces and diversions have been installed to intercept downslope runoff and reduce rilling of the bare cropland. The diversions are designed to move accumulated storm water horizontally off the fields. However, in some instances the discharge from these diversion was routed over the edge of the lower Deschutes River canyon. This caused severe cutting and scouring of steep canyon walls, with resulting sediment and debris deposition in the lower Deschutes River and tributaries.

Irrigated agriculture is generally confined to the valley bottoms along Trout, Buck Hollow, Tygh, Shitike, and Badger creeks, as well as lower Warm Springs and White rivers. There are also several small irrigated areas adjacent to the Deschutes River between North Junction and the Pelton Reregulating Dam. Water for irrigation is generally pumped or diverted from an adjacent stream although some wells are used.

Diversion structures used to transfer water from the stream to a ditch system may be as simple as a gravel berm that is pushed up each year, or as complex as a concrete structure with removal stoplogs. These structures frequently divert most of the stream flow during a portion of the irrigation season. Both upstream and downstream fish passage is usually blocked at these sites during periods of low stream flow. There are 25 unscreened gravity diversion structures in the lower Deschutes River subbasin (off reservation). Four of these diversions, all maintained by one landowner, are on Trout Creek and the remainder are in the White River system upstream from White River Falls.

Oregon Department of Fish and Wildlife (ODFW), with Mitchell Act or Bonneville Power Administration (BPA) funding, has provided individual irrigators with self-cleaning rotary pump intake screens for most irrigation pumps located on lower Deschutes River tributaries supporting anadromous fish (Figure 1.5). ODFW personnel regularly service these screens during the irrigation season. During the non-irrigation season these screens are removed and prepared for the next season.

Irrigation districts in the Agency Plains and Juniper Flat/Wamic areas provide irrigation water to large tracts of cropland from developed storage reservoirs and elaborate water distribution systems. These large water diversion storage projects were generally constructed after the early 1900's. The irrigation water used in the Agency Plains area originates from the upper Deschutes and Crooked rivers. Irrigation water for the Juniper Flat/Wamic area originates in Clear, Frog, Lost, Boulder, Gate, Rock, Threemile, and Badger creeks.

The irrigation water delivery system that directs water to storage impoundments and individual landowners in the Juniper Flat/Wamic area is comprised of many miles of open, earthen ditches and canals. These ditches and canals are believed to be relatively inefficient due to the potential for significant water loss through leakage and evaporation between the source and the eventual destination. It is also more difficult to accurately regulate water use based on irrigator needs in a ditch/canal system. It is not uncommon to have ditch flow that exceeds demand wasted at the end of the delivery system. This water wasting can cause serious erosion to the steep slopes and result in subsequent deposition of silt and sediment into adjacent streams if the excess water is routed over the canyon rim.

Irrigation return, or waste water, enters the Deschutes River at several locations in the Madras area, including: Pelton Reregulation Reservoir, Rattlesnake, Frog Springs, Mud Springs, and Trout creeks. This water may contain agricultural chemicals as well as elevated levels of turbidity. No data exists on the level of chemical contamination of this return flow to the lower Deschutes River and tributaries, making it is difficult to evaluate the potential impacts on the aquatic ecosystem.

Sediment originating from upland agricultural and range areas commonly contributes to increased stream turbidity and sediment loading. Some of this sediment settles into the spaces between the aggregate in the substrate of the lower Deschutes River and tributaries. This filling of the substrate can seriously impact fish production by interrupting the free movement of water, which is critical to the development and survival of eggs and alevins found in streambed gravel spawning areas. The interruption of free water movement through the gravel means fish eggs or alevins do not receive adequate dissolved oxygen and metabolic wastes can not be readily carried away. Armour et al (1988) indicated that the mortality rate for rainbow trout can exceed 75% when sediments reach 200 parts per million, which is a common occurrence in streams damaged by improperly managed grazing. For steelhead trout, when sediment approximates 30% of the substrate, less than 25% of the eggs develop to the emergent fry stage compared to an excess of 75% emergence when sediments are less than 20% (Bjornn 1973) (Figure 1.6).

High sediment levels in streams encourages growth of rooted aquatic vegetation, which then acts to collect additional sediment and continues the downward spiral of gravel quality. Concentration of sediments in the stream substrate can lead to serious compaction or cementing of the substrate. This armoring of the stream bed can effectively interfere with or prevent fish spawning, as well as aquatic invertebrate production.

Water Developments

Irrigation

Irrigation developments began around the turn of the century with the development of ditches and finally reservoirs in the upper Deschutes River system. These impoundments, including: Ochoco, Wickiup, Crane Prairie, Hay Stack, and Prineville reservoirs, provided additional water for irrigation that eventually extended as far north as Madras and Agency Plains. Irrigation development in the Juniper Flat/Wamic area began around the turn of the century with gravity diversions from local streams. Several impoundments were later constructed to provide additional water supplies. These irrigation storage impoundments include: Clear and Badger lakes; as well as Rock Creek and Pine Hollow reservoirs. A summary of existing water rights for the lower Deschutes River subbasin is presented in Table 1.2.

The Oregon Water Resources Department (WRD) is accepting water right applications for limited consumptive uses in the lower Deschutes River subbasin. Water rights are still being issued in the mainstem lower Deschutes up to river mile 100 for domestic, livestock, irrigation of lawn or noncommercial garden not to exceed one-half acre in area, fish enhancement, recreation, and fish and wildlife uses (OAR 690-505-006). Water rights are still being issued in the Deschutes River basin upstream from river mile 100 for the previously mention uses and municipal, irrigation, power development, industry, and mining. However, WRD adopted rules in 1994 that prohibit issuance of new irrigation surface water rights for applications submitted after July 17, 1992 in order to protect threatened and endangered salmon stocks in the Columbia River Basin above Bonneville Dam (OAR 690-33-000 to 690-33-230).

There are water rights within the subbasin that have not been active for many years. By law, these water rights can be revoked because of non-use. However, water rights are generally maintained unless a party seeks revocation.

There are existing consumptive water rights on a number of streams in the subbasin that exceed the total flow available in the individual streams. These streams with an over appropriation of water include: Trout, Badger, Tygh, Boulder, Lost, Gate, Threemile, and Rock creeks.

Hydroelectric Development

The Deschutes River was dammed for hydroelectric power generation by PGE beginning in 1957 when Pelton Dam, forming Lake Simtustus, and the Reregulating Dam, forming the Reregulation Reservoir, were completed. Round Butte Dam, forming Lake Billy Chinook, located immediately upstream of Lake Simtustus, was completed in 1964. This three dam complex is collectively referred to as the Pelton/Round Butte hydroelectric complex. The completion of Round Butte Dam effectively eliminated the production of anadromous fish in the upper Deschutes River subbasin. Attempts to pass adult salmonids around this complex was partially successful. Adult passage was accomplished with a three mile long fishway that extended above Pelton Dam, and a tramway that lifted fish over Round Butte Dam. Downstream passage of juvenile fishes through the project was found to be inadequate and attempts to continue anadromous fish production above the complex were abandoned in 1968 (Nehlsen 1995). With the upcoming relicensing of the Pelton/Round Butte hydroelectric complex, the feasibility of downstream and upstream fish passage through the hydroelectric complex will be reexamined (Ratliff et al. 1996).

PGE completed construction of Round Butte Hatchery in 1972. This hatchery was built to mitigate for steelhead and spring chinook production lost above the Pelton/Round Butte complex.

The Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) began retro-fitting the Pelton Reregulating Dam for hydroelectric generation in 1980. This completed the full utilization of the complex for hydroelectric generation.

Electronic operational problems at the Reregulating Dam hydroelectric plant have taken place. These problems initially resulted in occasional periods when river flow below the project was interrupted for short periods. This flow interruption occurred when the powerhouse wicket gates closed because the generator unexpectedly shutdown. When this happened, the Reregulating Dam spillway gates were slow to open. This problem was even further aggravated when the spillway gates would over compensate and send a short burst of high flow downstream. These power plant anomalies had the potential to affect downstream fish populations and posed safety concerns for river users. Recent modification to the electronic control system at the Reregulating Dam, combined with improvements in the power distribution system, have apparently resolved this problem.

The Pelton/Round Butte hydroelectric complex has changed the lower Deschutes River. Natural movement of gravel and other bedload was effectively blocked by the three dams although gravel can move into the lower Deschutes River from tributaries downstream from the hydroelectric complex. These bedload traps have precluded the natural recruitment of gravel below the projects since the mid-1950's. This loss of gravel recruitment may have lessened spawning gravel availability in the three miles immediately downstream from the hydroelectric complex. The overall effects of this reduction in gravel recruitment is poorly understood although a fluvial geomorphology study funded by PGE may yield valuable answers.

All impoundments in the Deschutes River basin have effectively blocked the recruitment of large woody material into the river from upstream. This wood historically contributed to a rich diversity of aquatic habitat structure. Large woody material acts to grade and concentrate gravel, form islands, disrupt homogenous river flow, and provides important escape and hiding cover for juvenile fish. Reduction in natural recruitment of large wood to the lower Deschutes River downstream from the Pelton/Round Butte hydroelectric complex potentially impacts aquatic habitat through loss or degradation of high quality fish spawning areas, loss of aquatic habitat complexity, increased predation on juvenile fish, and reduction in the production of aquatic insects.

It does not appear that the water temperature regime of the lower Deschutes River has been modified appreciably by the Pelton/Round Butte hydroelectric complex. A recent comparison of before and after hydroelectric project summer water temperatures at the mouth of the river (Figure 1.7) and at the base of the Pelton Reregulating Dam (Figures 1.8) indicate that the existing temperatures are comparable to the pre-project temperatures (Beaty 1995).

Alteration of the historic flow pattern of the lower Deschutes River downstream from the Pelton/Round Butte hydroelectric complex has been minor. Huntington (1985) showed that outflow from the hydroelectric complex closely resemble inflow on most years. A total of 19,800 acre feet of seasonal or flood control storage is utilized in the Pelton/Round Butte hydroelectric complex reservoirs. This is 7% of the total storage of seasonal runoff present in the other reservoirs in the Deschutes basin and is 1% of the average annual flow past the hydroelectric complex.

Municipal and Industrial

Municipal water use in the planning area is generally dependent upon ground water or spring water sources. The communities of Tygh Valley, Wamic, Antelope, Pine Hollow, Sidwalter, Simnasho and Pine Grove all rely on wells for their domestic water supplies. The CTWS pump water from the lower Deschutes River near the mouth of Dry Creek for domestic water. Maupin receives its domestic water from a large spring located within the city limits.

Industrial water use from the lower Deschutes River is presently confined to the large pump diversion supplying water to the Warm Springs Forest Products mill at Warm Springs. A saw mill located at Tygh Valley has been closed and the water right from that operation has been converted to agricultural use.

Transportation

Developments of different forms of transportation have had profound impacts on the lower Deschutes River subbasin. In the 1850's efforts were underway to find a suitable route for a railroad into Central Oregon. Vast stands of old growth ponderosa pine provided potential investors with significant economic incentives if the lumber could be shipped out of the area. The Oregon Trunk Line was organized on paper on February 24, 1906 after several other potential railroad construction projects died in the planning stage. The planned route to Central Oregon was from The Dalles east to the mouth of the Deschutes River and then up the Deschutes River canyon to Willow Creek and on to Madras.

Eventually two railroad developers, James Hill from the Northern Pacific and Great Northern railroads, and Edward Harriman from the Union Pacific and Southern Pacific lines, began laying tracks up each bank of the Deschutes River - Harriman up the east bank and Hill up the west bank. The last great railroad construction war in the West proceeded upstream until an agreement was signed on May 17, 1910 that required the two railroads to jointly use an eleven mile section of track between North and South Junctions. Railroad construction on the west river bank never extended upstream beyond North Junction. The railroad track reached Bend on 5 October, 1911, and now extends into California (Cogswell 1981).

Railroad construction along both river banks impacted riparian and aquatic habitat. Blasting basalt outcroppings, slope excavation, and sidecasting excavated material eliminated areas of riparian vegetation and filled sections of river. In addition, culverts installed at tributary stream crossings eventually formed barriers that now preclude upstream fish migration.

Routine maintenance of the railroad and right-of-way has resulted in disposal of additional sidecast material in the riparian corridor as well as in the river. Railroad right-of-way maintenance has also included removal of trees from the river's margin, as well as the application of soil sterilizing chemicals and herbicides to reduce fire danger. These activities have direct or indirect adverse impacts on the river and the riparian corridor.

The Burlington Northern and Union Pacific railroads have had a number of train derailments along the river over the years. To date, no known fish kills have resulted from these accidents, but the potential for a catastrophic spill of a highly toxic substance exists. Such an event could eliminate all aquatic life from the lower Deschutes River downstream from the spill site.

Railroad operation in the lower Deschutes River canyon has had other adverse affects on the riparian and upland vegetation. Range fires sparked by railroad activities have periodically consumed significant acreage in the watershed. These fires leave the steeper canyon slopes highly susceptible to erosion, have contributed to the elimination of the beneficial native perennial grasses, and have damaged sensitive riparian plant communities.

The road transportation network in the subbasin ranges from Interstate 84 to primitive forest roads and crude wheel tracks in the open rangeland. This system of roads has had some negative impacts on the watershed and water quality. Road construction commonly occurred in stream bottoms and frequently resulted in the loss of riparian vegetation, changes in the channel configuration, filling of the stream channel, and constriction of flow at bridge sites. Road corridors frequently are a source of erosion that culminates in turbidity and sedimentation in adjacent streams. This can be a significant problem when the road is located in close proximity to the stream.

Road surfaces have reduced natural infiltration of water into the soil, which is important for ground water and spring recharge. Roads have acted to divert and concentrate surface water flow, which can exacerbate erosion and stream sedimentation problems.

Existing state and federal regulations now in affect are designed to reduce water quality problems associated with road systems on state, private, and federal forest lands. ODFW has actively sought to have unnecessary roads on public lands closed and rehabilitated to restore natural vegetation and water infiltration characteristics.

Timber Management

Timber harvest in the western portion of the lower Deschutes River subbasin has been a major land use activity. Harvest has occurred within the Mount Hood National Forest, the CTWS reservation, and on state and privately owned forest lands. Timber harvest in the eastern portion of the subbasin has been almost entirely confined to the upper Trout Creek watershed where ownership is dominated by private individuals and timber companies, although the Ochoco National Forest does take in part of the Trout Creek watershed. The only timber harvest known to have occurred outside these primary areas were small operations on private land near the headwaters of Cove and Deep creeks.

Timber harvest activities in the Trout Creek headwaters resulted in considerable negative impacts to streams and fishery resources. Logging and skid roads were historically concentrated in the stream bottoms with little regard for stream or riparian protection. Stream crossings commonly included fords or under-sized culverts with no provisions for preventing trash buildup during high stream flow. Major storm events plugged numerous culverts, rerouted stream channels, and washed out sections of road, resulting in large sediment loads being deposited in streams.

Merchantable timber has been repeatedly removed from the streams bottoms. This intensive timber management, combined with intensive livestock grazing, effectively eliminated most riparian vegetation from stream margins. This loss of natural cover accelerated erosion, lower water tables, degraded stream channels, exaggerated flow and water temperature extremes, and resulted in significant stream sedimentation.

ODFW personnel have been working with private landowners and the Ochoco National Forest to restore the streamside and instream habitat in the Trout Creek system for the past eight years. These activities have included riparian exclosure fencing, instream structure placement, limited spawning gravel placement, and some stream bank armoring.

Timber harvest in the western portion of the subbasin (off reservation) has been significantly reduced as a result of past harvest rates that exceeded the maximum sustained harvest level. These timber lands are exclusively within the White River drainage. The largest private timber owner in this area liquidated their timber resources, closed their mills, and sold their timber lands in the early 1990's.

The watershed impacts from past intensive timber management have altered the flow characteristics of White River. Huntington (1985) found that the peak river flows from 1925 through 1963 occurred during April and May. The peak discharge has now been shifted to January and February (Figure 1.9). The alteration of flow patterns is likely attributed to an increased acreage of cut-over timber land where snow melts more rapidly than it did historically under a closed tree canopy. The reduction in spring stream flows in the White River drainage has likely reduced the quantity of potential spawning area available for the resident trout populations.

INSTITUTIONAL CONSIDERATIONS

Federal

Bureau of Land Management

The Prineville District of the Bureau of Land Management (BLM) manages approximately 108 square miles of land throughout the subbasin, much of it in the lower Deschutes River canyon. The Two Rivers Resource Management Plan (RMP), adopted by the BLM in 1986, is a comprehensive land use and resource management plan for all BLM lands within the lower Deschutes River subbasin. This plan established land use goals and objectives for minerals, soils and watershed, rangeland, forest and woodlands, fish and wildlife habitat, cultural and archeological resources.

Management of BLM lands in the subbasin is also guided by the Lower Deschutes River Management Plan (LDRMP 1993). The BLM, working cooperatively with local, state, and other federal agencies, and the CTWS, completed the LDRMP in January 1993. The LDRMP is a comprehensive plan that guides the management of the lower Deschutes River and the adjacent canyon uplands. This plan was required by the Oregon Legislature through passage of House Bill 3019 and the U.S. Congress since the lower Deschutes River was designated a National Wild and Scenic River in 1988. This plan addresses protection of natural and cultural resources, as well as management of recreational activities. Recreational use management will include limiting access, controlling user numbers, assessing user fees, controlling recreational facility development, regulating commercial activities, coordinating law enforcement and emergency services, and restricting types and numbers of river craft. An important part of this plan, as well as the Two Rivers RMP, is the specific objective to manage riparian areas along the lower Deschutes River and its major tributaries to full vegetative potential, with a minimum of 60 percent of the vegetative potential to be achieved within 15 years. The objectives also include managing all streams with fisheries or fisheries potential to achieve a good to excellent aquatic habitat condition (BLM 1986).

Full implementation of the Two Rivers RMP has occurred over the past ten years. The process has been protracted because of limitations associated with funding, manpower, and fragmented or isolated BLM land holdings. The riparian habitat restoration objectives may not be met on all BLM lands within the specified time frame, particularly on lower Deschutes River tributary streams. The desired recovery of diverse riparian vegetative communities may require many years. Current BLM grazing management strategies for these degraded stream corridors range from complete exclosure to annual late winter/early spring (November 1 to May 1) grazing.

Changes are now occurring in federal land management policies that may increase the level of protection afforded stream habitats. The BLM currently receives interim guidance on managing fish producing watersheds from a document formerly known as PACFISH [USDS (USFS) AND USDI (BLM), 1995]. Other recent federal land management strategies also recommend an increased emphasis on the protection of fishery resources. It appears likely that stream and fishery resource protection and restoration projects on BLM lands will increase in the near future.

Bureau of Indian Affairs

The Bureau of Indian Affairs (BIA) is the federal agency that assists treaty tribes in managing their affairs. One of the BIA's primary responsibilities is administering and managing land held in trust by the United States for treaty tribes. Protecting tribal water and land rights is included in this responsibility.

U.S. Forest Service

The Mount Hood National Forest manages approximately 235 square miles of land in the White River drainage. The White River watershed lies within the Mount Hood National Forest and two ranger districts, Bear Springs and Barlow. The Ochoco National Forest manages approximately 27 square miles of land in the headwaters of the Trout Creek drainage. The U.S. Forest Service (USFS) also manages approximately 23 square miles of the Crooked River National Grasslands in the Trout Creek drainage.

The Badger Creek Wilderness (24,300 acres) is located within the Mount Hood National Forest on the upper Badger Creek watershed in the White River drainage. The area became wilderness under the Oregon Wilderness Act of 1984. This is the only designated wilderness area in the lower Deschutes River subbasin.

Management of USFS lands in the subbasin is based on Forest Service policies, federal legislation, and the Mount Hood and Ochoco Forest land and resource management plans. These plans guide all natural resource management activities and establish management standards and guidelines for the forests. They describe resource management practices, levels of resource production and management, and the availability and suitability of lands for resource management.

Federal legislation that guides management of USFS lands in the subbasin includes the National Environmental Policy Act, National Forest Management Act, Wilderness Act, Multiple Use and Sustained Yield Act, and the Northwest Power Planning Act. USFS also follows guidelines set by the National Wild and Scenic Rivers Act for management along the White River. White River from the mouth to the headwaters is designated as part of the federal Wild and Scenic River System, with individual reaches designated for management as wild, scenic, and recreational.

Changes are now occurring in federal land management policies that may increase the level of protection afforded stream habitats. In particular, recent management strategies, formerly called PACFISH, are recommending an increased emphasis on the protection of fishery resources [USDS (USFS) AND USDI (BLM), 1995]. It appears likely that stream and fishery resource protection and restoration projects on USFS lands will increase in the near future.

The Mount Hood National Forest completed the White River National Wild and Scenic River Environmental Assessment and Management Plan in December, 1994. This plan describes the conditions which need to be achieved or maintained to protect or enhance the river's values. It prescribes standards and guidelines to govern activities within the wild and scenic river boundaries. It establishes a schedule for implementation and a program of monitoring activities within the area boundaries to measure achievement of desired conditions. However, actual accomplishment and monitoring of activities will depend on budget allocations.

USFS policy for land management in Oregon is to meet or exceed the standards of the Oregon Forest Practices Act and Oregon water quality standards.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) administers the federal Endangered Species Act. The USFWS reviews and comments on various land use activities that affect fishery resources such as fill/removal permit applications and hydroelectric projects on anadromous fish streams.

The USFWS operates the Warm Springs National Fish Hatchery located on the Warm Springs River. The hatchery produces spring chinook salmon smolts for release at the hatchery site.

Federal Energy Regulatory Commission

FERC issues permits for hydroelectric development, establishes permit operating criteria, monitors hydroelectric project operation, and requires periodic relicensing of projects. The FERC hydroelectric licensing process includes provisions for protection of fishery resources or requires mitigation for hydroelectric project caused losses to the fishery resource.

National Marine Fisheries Service

The National Marine Fisheries Service (NMFS) administers the federal Endangered Species Act as it pertains to anadromous fish in the Columbia River. NMFS reviews and comments on fill/removal permit applications on streams with anadromous salmonids and on any FERC hydroelectric project proceedings where anadromous fish are involved.

Natural Resource Conservation Service

The Natural Resource Conservation Service (NRCS), formerly the Soil Conservation Service, is responsible for providing technical support to the Agricultural Stabilization and Conservation Service (ASCS) with distribution of federal cost-share monies associated with reducing soil erosion and increasing agricultural production. NRCS also works closely with local soil and water conservation districts to provide engineering and other technical support for various land and water resource development, protection, and restoration projects.

Tribal

Confederated Tribes of the Warm Springs Reservation of Oregon

The CTWS reservation is approximately 1,000 square miles in size, most of which is included in the lower Deschutes River subbasin. Almost all land within the boundaries of the reservation is held in trust by the BIA for the benefit of the CTWS or individual tribal members. Also within the reservation is a small amount of allotted land, most of which is owned by individual tribal members.

The entire lower Deschutes River subbasin outside the reservation was ceded to the U.S. Government by the Tribes and Bands of Middle Oregon through the ratified treaty of 1855. This treaty reserves to the Indians exclusive rights of taking fish in streams running through and bordering the reservation.

The CTWS own significant lands within the planning area that are off their reservation lands. The CTWS purchased 888 acres along both banks of the Deschutes River downstream from Maupin in 1980. These lands include the Sherars Falls area and other tracts upstream to Oak Springs (river mile 47.5). The CTWS have also acquired additional lands along the river from Oak Springs upstream to the Harpham Flat (river mile 55.5) and along the east bank of the river between the Highway 26 Bridge at Warm Springs and Mecca (river mile 95).

The CTWS are co-managers of the fishery resource along with ODFW. CTWS Natural Resource Department staff routinely work with ODFW personnel to inventory the resource, monitor in-river harvest, conduct habitat restoration and enhancement planning and implementation, and review and comment on land use activities within the lower Deschutes River subbasin.

State

Oregon Department of Fish and Wildlife

ODFW has significant habitat protection responsibilities (authorized by ORS Chapter 498 and 509) relative to protective fish screening and maintenance of fish passage at in-channel obstructions. ODFW has several policies that involve protection of fish habitat. ODFW has adopted a fish and wildlife habitat mitigation policy (635-415-010) that states in part "...the Department will require or recommend, depending upon the habitat protection and mitigation opportunities provided by specific statutes, mitigation for losses of fish and wildlife habitat resulting from land and water development actions." Paragraph 6 of the Fish Management Policy (OAR 635-07-515) states "Available aquatic and riparian habitat shall be protected and enhanced to optimize fish production of desired species."

ODFW also owns and manages land in the lower Deschutes River subbasin.

The Lower Deschutes Fish and Wildlife Area encompasses approximately 12.5 square miles along the lower 18 miles of the lower Deschutes River. The area is managed primarily for fish and wildlife habitat, recreation, and livestock grazing. Management practices include riparian enhancement, upland wildlife habitat enhancement, spring development, and livestock grazing.

The White River Wildlife Area encompasses approximately 44 square miles in the White River drainage. This area is managed primarily as winter range for deer and elk. Management practices include irrigated and dry land agriculture, livestock grazing, controlled burning, winter feeding, rangeland seeding, and timber management.

Oregon State Parks and Recreation Department

The Oregon State Parks and Recreation Department (OSPRD) is responsible for acquisition, improvement, maintenance, and operation of Oregon's State Park system. OSPRD administers a number of programs, including the State Scenic Waterway program. The lower Deschutes River from Pelton Reregulating Dam to the Columbia River was designated a state scenic waterway in 1970 under the Oregon Scenic Waterways Program. The scenic waterway includes the river and its shoreline and all land and tributaries within one quarter of a mile of the lower Deschutes River, except for that portion of the river and its tributaries within the boundaries of the CTWS Reservation, off-reservation Indian trust land, and the City of Maupin.

The Scenic Waterways Program is designed to protect and enhance river values such as fish, wildlife and recreation. A major function of the Scenic Waterways Program is to protect the natural and scenic diversity of scenic waterways by ensuring that new development blend in with existing conditions. There is no attempt to restore scenic waterways to a pristine condition. The program does not restrict existing land uses. Improvements that existed before a river was designated may remain and are protected. New development proposals are reviewed to determine consistency with Scenic Waterways Program direction.

A state scenic waterway is a specially protected area. Within it, unlike any other area in the state, very strict standards apply for working in the river or on the river bank. Approval must be granted by the State Land Board for any alteration to beds or banks of state scenic waterways.

The OSPRD also administers the Deschutes River Boater Pass program, which assesses a user fee for all river boaters. The money generated by this program is spent on lower Deschutes River enhancement projects by OSPRD and other agencies. Boater Pass monies have funded habitat restoration/protection, facility development, land acquisition, law enforcement, recreation and land use planning, and information and education.

OSPRD was also the state's lead agency in the cooperative federal/state/CTWS planning process which developed the LDRMP.

Oregon State Marine Board

The Oregon State Marine Board (OSMB) cooperates with federal, state, and local agencies to promote uniformity of laws and regulations relating to boating and assists county sheriffs and other peace officers in the enforcement of these laws. The OSMB also assists local governments with the development or improvement of boating facilities.

Oregon Department of Environmental Quality

The Oregon Department of Environmental Quality (DEQ) is responsible for monitoring and maintaining air and water quality. This responsibility includes working with other state and federal agencies to meet implementation requirements of the Clean Water Act (P.L. 92-500).

Oregon Water Resources Department

Except for the reserved water rights of the CTWS, the Oregon Water Resources Department (WRD) regulates and administers water uses in the subbasin. Water rights have been granted in the lower Deschutes River subbasin for irrigation, livestock, domestic, recreation, and instream uses.

Oregon Department of Forestry

The Oregon Department of Forestry (DOF) regulates commercial timber production and harvest on private and state lands within the lower Deschutes River subbasin. The Oregon Forest Practices Act establishes statutory authority for the protection of fish habitat and water quality during forest management activities on private and state forest land. The protection of specific resources, such as riparian habitats, are regulated through the Oregon Forest Practices Act.

Oregon Division of State Lands

The Oregon Division of State Lands (DSL) and U.S. Army Corps of Engineers (COE) regulate removal or filling of material from the beds or banks of waters of the state. Permits are required for projects on tributaries of the lower Deschutes River that involve 50 cubic yards or more of material. The Oregon Scenic Waterway System requires State Land Board review and approval of any fill/removal activity within the scenic waterway corridor along the lower Deschutes River. ODFW, NMFS, USFWS, and the appropriate county Soil and Water Conservation District review applications for permits and may request specific protective conditions or denial of the permit based on impacts of the project on fish resources. DSL and COE make the final decision on permits not on state scenic waterways.

Oregon Department of Transportation

The Oregon Department of Transportation (ODOT) maintains public highways that border and cross the Deschutes River. This transportation system includes five major bridges across the river and approximately three and one-half miles of highway that closely parallels the river.

County Governments

Five counties - Crook, Hood, Jefferson, Sherman, and Wasco - are located entirely or in part within the lower Deschutes River subbasin. These counties have numerous responsibilities including road construction and maintenance, land use planning, law enforcement, and public health. Representatives from Jefferson, Sherman, and Wasco counties were active participants in the development of the LDRMP.

Municipalities

There are several communities within this planning area. The City of Maupin, located on the Deschutes River at river mile 51 is directly impacted by management actions on the river. The river within the city limits is not included within the State Scenic Waterway system. The city has worked with state and federal agencies to develop a riverside park with camping, picnicking, and boat launching facilities.

Soil and Water Conservation Districts

Each county Soil and Water Conservation District (SWCD) is composed of a locally elected board of directors that work with private, state and federal land managers to encourage wise management of soil and water resources. The SWCDs from Wasco, Jefferson, and Sherman counties have all been active participants in recent projects designed to restore in-stream, riparian, and upland habitat in the lower Deschutes River subbasin.

FACTORS LIMITING FISH PRODUCTION IN SUBBASIN STREAMS

Factors limiting resident and anadromous fish production in individual streams within the lower Deschutes River subbasin are summarized in Tables 1.3 and 1.4, respectively.

Water Quantity

The lower Deschutes River is characterized by its uniform flow. Mean annual discharge at the mouth of the river was about 6,000 cubic feet per second (cfs) from 1965 through 1985. Mean monthly discharge for the Deschutes River at the mouth and near Madras is shown in Tables 1.5 and 1.6, respectively. Peak flows generally occur during the period from December to March.

PGE manages the Pelton/Round Butte hydroelectric complex under FERC license No. 2030 and their State of Oregon hydroelectric license. The CTWS, through the Warm Springs Power Enterprises, owns and operates the hydroelectric project at the Pelton Reregulating Dam. However, PGE has the FERC hydroelectric license for the three dam hydroelectric complex.

Flow into the lower Deschutes River is regulated at RM 100 by Pelton Reregulating Dam. Under terms of the FERC operating license for the Pelton/Round Butte hydroelectric complex, flows can drop below 3,500 cfs from March through June or below 3,000 cfs during the remainder of the year only if inflow into the reservoirs falls below these flows. PGE adopted a guideline to limit changes in river elevation below Pelton Reregulating Dam to no more than 0.1 foot per hour and no more than 0.2 foot per 24 hours during the primary fishing season of May 15 to October 31, or no more than 0.1 foot per hour and no more than 0.4 foot per 24 hours during the remainder of the year.

The cumulative water storage capacity present in reservoirs in the Deschutes River basin may have changed flow regimes and may have altered the aquatic habitat in the lower Deschutes River. Storing and later releasing water may have altered the timing and magnitude of high flow events resulting in moderated flows that transport less bedload and large woody material.

Principal east side tributaries are of the lower Deschutes are Buck Hollow, Bakeoven, and Trout creeks. Drainage area of these tributaries is approximately 690 square miles. These streams are generally characterized as rainfall and spring fed.

Principal west side tributaries of the lower Deschutes River are White and Warm Springs rivers and Shitike Creek. Drainage areas for these tributaries are 417, 526, and 76 square miles, respectively. Mean monthly flows for these tributaries are shown in Tables 1.7, 1.8 and 1.9, respectively. The west side streams are generally characterized as being fed by snowmelt.

Deschutes tributary streams with little or no drainage area on the slope of the Cascade Range seasonally have very little flow or are intermittent in summer and fall. Degradation of the riparian areas of these tributaries has accentuated the seasonality of the flows. Vegetation loss and soil compaction along the stream bank reduces infiltration rates and increases runoff during precipitation events. The result is higher flows in winter and spring and low or intermittent flows in summer and fall.

The amount and seasonal pattern of precipitation affects the flow regime of the streams in the subbasin. Average annual precipitation ranges from about 100 inches in the Cascade Range to 9 to 14 inches in the eastern portion of the subbasin. Annual snowfall is about 200 inches at the crest of the Cascade Range and decreases to about 15 inches at lower elevations.

Approximately 25 percent of the total annual precipitation falls from May to October, although occasional intense thunderstorms may occur over the subbasin during summer. Rain falling on snow in late winter and spring when the ground is frozen or saturated can cause rapid increases in stream flow and destructive flooding. Summer thunderstorms can result in flash flooding in east side tributaries.

Water Quality

Water quality data for the lower Deschutes River are shown in Tables 1.10 and 1.11. DEQ's statewide pH standard (pH not to exceed 8.5) is exceeded in the lower Deschutes River 17% of the time at the river mouth, and is exceeded 14% of the time at river mile 1.4. Dissolved oxygen levels at the river mouth fall below the 90% saturation standard 40% of the time from June to October. This lowered level of dissolved oxygen could impact the development of incubating fish eggs or later life stage development.

Water temperatures frequently exceed the current state water quality standard (50 degrees Fahrenheit for waters containing bull trout) in the lower Deschutes River and tributaries (55°F for waters containing salmonids) during summer and fall. The high temperatures are directly associated with seasonally high air temperatures and are aggravated in many tributary streams by the broad, shallow, degraded channels. Fish production generally begins to decline when water temperatures exceed 68°F and total mortality usually occurs if water temperatures exceed 77°F for several days. Only extended periods of very cold weather causes ice formation in the lower Deschutes River. Anchor ice can cause complete mortality of incubating embryos (Figure 1.10) (Meehan 1982). This conditions rarely exists in the lower Deschutes River.

Water turbidity can affect fish production in the lower Deschutes River subbasin. Juvenile fishes are sight feeders. Meehan (1982) reported that suspended sediment in excess of 50 NTU at water temperatures above 41°F generally reduces feeding success, growth, and competitive ability (Figure 1.11). Chronically turbid waters, particularly during the spring, can substantially reduce growth of fish fry.

Turbidity can cause physical discomfort or injury to fish, depending upon the concentration and the duration of exposure. High stream flow, combined with elevated turbidity, also interferes with the fishes natural abilities to detect and avoid predators. Predation can occur during periods of prolonged high water turbidity in all streams in the subbasin. Fish seek refuge from high levels of turbidity by moving to quieter eddies or backwaters along the stream margin. This unnatural concentration of fish can result in increased losses from predators.

Consumptive Water Use

The existing water rights for the lower Deschutes River basin are summarized in Table 1.2. Principal consumptive uses of surface waters are irrigation, industrial, and municipal uses. Non-consumptive uses include hydroelectric generation, recreation, protection of aquatic life, and wildlife.

Several irrigation and water improvement districts have water rights for domestic and irrigation uses in the White River drainage. These districts obtain their water from diversions of tributaries of White River and storage reservoirs. Summer flows in nearly all the White River tributaries, except Barlow Creek, appear to be completely appropriated (ODFW et al. 1985).

Of the 2,500 acres irrigated in the Bakeoven Creek, Buck Hollow Creek, and Trout Creek drainages, about 2,100 are in the Trout Creek basin. Preliminary studies indicate that natural flows in the area are over-appropriated and are not adequate to meet irrigation needs in normal years. Excessive water withdrawals and livestock overgrazing of the riparian zone have stimulated a transition within some streams from a perennial to an intermittent flow condition (BOR 1981). Water withdrawal from Trout Creek, which often begins in March, limits fish migration and production. Water use in this drainage is poorly regulated and managed. Water use in the spring commonly exceeds the volumes permitted by water rights and application rates may be excessive.

Irrigated lands, located off the CTWS reservation, utilizing water from the lower Deschutes River and tributaries are shown in Figure 1.12.

The water rights of the CTWS have not been quantified. The State of Oregon through the Water Resources Department, the CTWS, and the federal government are currently in negotiations to quantify the on-reservation reserved water right. The CTWS rights to instream and consumptive uses of water from streams flowing through the reservation and groundwater underlying the reservation are federally protected, reserved rights pursuant to Winters vs. United States/207 U.S. 564 (1908). The CTWS Tribal Council regulates the use of water on the reservation under the Warm Springs Water Code. Additionally, the CTWS treaty-secured off-reservation fishing rights require the maintenance of sufficient water quantity and quality to support all aquatic resources at usual and accustomed fishing areas.

Instream Water Rights

The Instream Water Right Act of 1987 (ORS 537.332) allows ODFW, OSPRD, and DEQ to apply for water rights to maintain instream flows for designated uses. WRD, the agency responsible for managing waters of the state, reviews and certifies instream water right applications. WRD is also responsible for enforcement of instream water rights (IWRs).

It is the policy of the Oregon Fish and Wildlife Commission (OAR 635-400-005) to apply for IWRs on waterways of the state to conserve, maintain and enhance aquatic and fish life, wildlife, and fish and wildlife habitat to provide optimum recreational and aesthetic benefits for present and future generations of citizens of this state (OAR 635-400-005). The long-term goal of this policy is to obtain an IWR on every waterway exhibiting fish and wildlife values.

One provision of the Instream Water Right Act provides for the conversion of previously established (prior to September 27, 1987) minimum perennial stream flows to IWRs. Upon conversion, the effective date of the minimum perennial stream flow is retained, giving them seniority over water rights established at a later date. The only converted minimum perennial stream flows in the lower Deschutes River subbasin are in the White River system (Table 1.12.)

ODFW adopted administrative rules (OAR 635-400-000 through 635-400-040) for the IWR program in October, 1989. These rules define ODFW policies, methodologies to be used to determine instream flows required for fish and wildlife, and generally govern the agency's internal IWR application process.

ODFW adopted a five year plan for program implementation in April, 1990.

As required by rule (OAR 635-400-020), ODFW prioritized streams needing instream water rights based, in part, on whether the following factors were present: (1) sensitive, threatened or endangered species; (2) state scenic waterways or federal wild and scenic rivers;

(3) native anadromous fish species; (4) court, legislature, or commission-mandated priorities; and (5) potential threats to the aquatic ecosystem.

Information required to make a determination on the above-listed factors was provided by ODFW. Once priorities were established, IWR applications were completed and sent to WRD for consideration.

In the lower Deschutes River subbasin, 18 IWR applications have been filed with WRD for consideration (Table 1.13).

Instream Water Rights Monitoring

In order for IWRs to be effective, stream flows must be monitored. In each IWR application, ODFW requests that WRD establish a gage at an appropriate location if none already exists. The likelihood of this happening for each IWR is extremely remote, at least in the short term.

By law, WRD is responsible for monitoring stream flows and regulating junior users in times of shortage. In reality, WRD is currently under-staffed at the field level (Watermaster offices) to adequately monitor instream flows. If instream water rights are to be of value, ODFW district personnel will need to be cognizant of instream flows established to maintain fish populations and habitat and be willing to monitor flows for compliance.

IWRs, because of their generally more recent filing dates, tend to be the most junior water right on any particular stream. For IWRs that are most junior in priority date, there are no junior users to be regulated in order to achieve target instream flows. There are, however, two IWRs in the lower Deschutes River subbasin that are the result of conversion of minimum perennial stream flows. These IWRs have older priority dates and water rights with junior dates could be regulated in times of shortage.

Water Rights Application Review

As mentioned above, WRD is the single state agency responsible for formulating and implementing integrated water resource management policies and programs. Part of the WRD mandate is managing out-of-stream appropriations of water to beneficial uses. In considering requests for water withdrawals (OAR 690-11-000 through 690-11-235), WRD relies on other state agencies, including ODFW, to critically review and comment on water right applications. In preparing its comments, ODFW considers potential impacts of proposed withdrawals on fish and wildlife populations and habitats that support these public resources.

ODFW's water right application review process relies on district fisheries personnel to investigate proposed appropriations. Water right application information is sent to the appropriate biologist for assessment by headquarters staff. ODFW's review comments are formulated and submitted to WRD for consideration.

Water Diversion Screening

Unscreened irrigation diversions negatively impact a variety of aquatic resources in the subbasin. Fish, particularly downstream migrant salmonids, can enter unscreened diversions and end up in agricultural fields where they become stranded and die. Screening ten irrigation diversions in the Trout Creek system prevented the loss of approximately 13,000 juvenile steelhead in 1988 (ODFW unpublished data). There are four unscreened gravity irrigation diversions on lower Deschutes River tributaries with anadromous fish. These unscreened diversions are all located on one ownership along Trout Creek.

There are 18 unscreened diversions in the White River watershed. These diversions are above White River Falls and impact resident fish. Resident fish have undoubtedly been lost in these diversions, but there is no data to quantify this loss.

Sedimentation

There are two primary sources of sediment in the subbasin. Natural sediment originates from glacial action on the southeast slope of Mount Hood. Sedimentation associated with man's influence on the watershed is the other major source.

Mainstem White River seasonally carries a heavy load of glacial silt. The suspended sediment load in the upper White River is greatest in September and October, when White River Glacier experiences the most rapid melting. Sediment transport in lower White River is greatest in November and December (59,422 tons/month) and is associated with stream flow from increased rainfall (ODFW et al. 1985).

Agricultural activities, including livestock grazing, are a source of sediment reaching the lower Deschutes River and its tributary streams. Storm water runoff and irrigation waste water carry sediment from the uplands to the streams. Intensive farming associated with dry land grain production occurs in the northern and eastern portions of the subbasin and irrigated farming of potatoes, mint, grass seed, hay, and other crops occurs in the southern and western portions of the subbasin. Much of the cropland in the northern portion of the subbasin is classified as highly erodible and thus is subject to compliance with the Food Security Act of 1985. Some of the cropland is now in the Conservation Reserve Program (CRP) and has been taken out of agricultural production for at least 10 years. Farmers have planted these CRP lands with cover crops to reduce erosion. Alternative tillage methods, terracing, and sediment dams are also being used on some agricultural lands to reduce erosion.

Timber management activities throughout the watershed have contributed to stream turbidity and sedimentation. Runoff from disturbed soil and an intricate road system have been important sediment contributors.

The CTWS retro-fitted the Pelton Reregulating Dam for hydroelectric generation in 1980. Construction and removal of a large complex of earth-fill and sheet pile coffer dams was necessary to complete construction. Considerable quantities of silt and sediment were released into the lower Deschutes River from this project.

There have been other natural and human related events that have resulted in large quantities of silt and sediment entering the lower Deschutes River. One particularly catastrophic event resulted from an irrigation canal breach near Frog Springs Creek in October, 1988. The resulting torrent of water sent thousands of cubic yards of sediment into the lower Deschutes River at river mile 90.5.

Heavy sedimentation of stream beds can have serious adverse impacts on fish populations. Some fish spawn in the gravel and cobble of the stream bed. Sedimentation of these areas can effectively interfere with the flow of water through the gravel. Reduced intergravel flow reduces oxygen supply and interrupts the removal of metabolic wastes from incubating eggs or pre-emergent fry. Sedimentation can therefore significantly limit fish embryo survival.

Instream Substrate and Structure

The Pelton/Round Butte hydroelectric complex, as well as other storage reservoirs in the Deschutes River basin, have prevented the natural recruitment of gravel and other bedload to the lower Deschutes River. This has resulted in a reduction in the quantity and quality of spawning gravel present in the three mile reach immediately downstream from the Pelton Reregulating Dam (Huntington 1985). Without continuous recruitment of new gravels, the existing gravel quality degrades as siltation and gravel cementing occurs. Reduced gravel recruitment and may allow aquatic vegetation to take root in former spawning areas, resulting in a further loss of spawning habitat.

Once rooted aquatic vegetation becomes established on gravels used for fish spawning, the accumulation of silt and other fine material escalates, which provides suitable sites for other vegetation to establish. When rooted aquatic vegetation successfully invades spawning gravels, these areas are no longer suitable for fish spawning and the productive potential of the river is decreased.

In general, the more instream habitat diversity created by large woody material, the greater the rearing potential. The abundance of juvenile trout and steelhead in second and third order streams is closely correlated with the amount of cover (Figure 1.13). Woody material is an important component of salmonid habitat in small streams. Woody material is important for enhancing rearing habitat during summer and providing refuge cover during winter floods. Large woody material in smaller rivers and streams creates much of the habitat diversity necessary for salmonid production in the stream channel and off-channel areas. Logs and root wads in the stream trap gravels, form pools and velocity breaks, and provide cover. In essence, woody material helps create the variety of depths, velocities, and substrates utilized throughout the fresh water residence of salmonids (Everest et al. 1982). Large woody material also provides a nutrient reservoir for aquatic ecosystems (Meehan 1982).

The Pelton/Round Butte hydroelectric complex, as well as other storage reservoirs in the Deschutes River basin, have stopped the recruitment of large woody material from upstream sources into the lower Deschutes River. Generally degraded riparian areas throughout much of the Deschutes River basin has resulted in less recruitment of woody material to the system over time. The role of large woody material in smaller river systems has been the subject of much study and is relatively well understood (Sedell et al. undated). The role and importance of large woody material in river channels as large as the lower Deschutes River is, however, less well documented. PGE, as a part of their relicensing studies, is currently undertaking several studies relative to fish habitat utilization and river channel dynamics that may clarify the role of large woody material in the lower Deschutes River.

Cover

Riparian areas in the subbasin have been impacted in several ways since settlers came to the area over 100 years ago. Grazing by cattle, sheep, and horses, farming practices, timber harvest, road construction and maintenance, and railroad construction and maintenance have degraded riparian areas throughout the subbasin. These land uses have changed the character of the riparian areas by reducing or eliminating vegetation, compacting soil, and decreasing stream bank stability.

A well developed riparian area can act to reduce the extremes of flow. Well developed stream channels and associated higher water tables hold more water during the wet season and release water slowly during the dry season allowing streams to flow year-round.

Riparian areas also act to maintain cool water temperatures during summer. Shading by vegetation, particularly on small streams, helps keep water temperatures cool. The slow release of cool water from the water table throughout the year also tends to moderate stream temperatures.

Healthy riparian areas also reduce sediment input in the aquatic environment. Streamside vegetation reduces the erosive power of a stream and stabilizes and builds up banks by filtering and depositing sediments.

Riparian protection projects throughout the subbasin have shown dramatic benefits within several years of implementation. For example, riparian fencing in the Trout Creek and Warm Springs River systems and the lower Deschutes River has allowed vegetation to reestablish and stabilize stream banks. Alders are now common along portions of the lower Deschutes River where they had not been present in significant numbers before riparian exclosure fencing. Instream habitat projects on the Warm Springs River and Trout Creek have increased both quantity and quality of fish habitat.

Barriers and Obstacles

The major upstream barrier to fish migration in the basin is the Pelton/Round Butte hydroelectric complex. In addition, a natural barrier exists on White River.

Pelton Reregulating Dam, the farthest downstream of the three dam hydroelectric complex, blocks fish passage at RM 100 on the lower Deschutes River. Pelton Reregulating Dam was completed in 1958. Downstream fish passage facilities at the hydroelectric complex were inadequate and hatchery fish use began in 1968 to mitigate for lost fish production that historically occurred upstream from the project. Planning is currently underway to determine if fish passage can be reestablished at the hydroelectric complex (Ratliff et al. 1996). If passage is reestablished, a run of anadromous sockeye salmon may be the first to be reestablished. A research study by the ODFW on kokanee in Lake Billy Chinook will help determine the production potential for this species (Chilcote 1996).

Access for anadromous fish into the White River watershed is blocked by White River Falls at RM 2.2. The falls is a series of three natural waterfalls located in a deeply incised basalt canyon. The two upper falls are within 302 feet of each other and have a total drop of 141 feet. The lower falls is 1,109 feet downstream of the middle falls and has a drop of 15 feet. The total drop from the headwater of the upper falls to the tailwater of the lower falls is 180.5 feet, within a distance of 1,411 feet. Other natural or man-made barriers to fish migration within the White River drainage occur on Jordan, Tygh, Badger, Little Badger, Boulder, Clear, Threemile and Rock creeks. There are also a number of man-made obstructions in the form of diversion dams and road crossing culverts that delay or block migration of juvenile and adult trout in the White River system (Figure 1.14).

Fish movement in the Trout Creek and White River systems is frequently interrupted by the annual construction of temporary gravel dams used for diverting water into irrigation canals or ditches. Water often filters through these gravel dams, but there is no overflow to permit either upstream or downstream fish passage. There are several potential remedies for the fish passage problems associated with these gravel diversion structures. Permanent diversion structure with a functional fish ladder could be constructed in many cases. Diversions can also be converted to pumped withdraw and blocking the entire stream channel would not be necessary. Consumptive water rights can also be converted to instream water rights, which do not require any diversion or withdrawal apparatus.

FACTORS LIMITING FISH PRODUCTION IN SUBBASIN LAKES AND RESERVOIRS

Water Quantity

Water quantity is generally not a significant limiting factor for natural lakes in the lower Deschutes River subbasin. Cascade Mountain lakes generally experience only slight water level fluctuation, usually associated with normal seasonal climatic changes and evaporation.

Fluctuating water level in irrigation storage reservoirs in the subbasin limits their fish production potential. This seasonal change in water level reduces the volume and depth of the reservoir, thus limiting the production of aquatic invertebrates and zooplankton. ODFW has minimum pool agreements for Rock Creek and Pine Hollow reservoirs. These agreements insure that the maximum reservoir drawdown will not drop below an agreed upon level. This retention of a small pool of water provides continued angling opportunity and some assurance that the fish population will have adequate water to survive until the reservoirs begin to refill.

Clear Lake, located on Clear Creek in the upper White River drainage, is an irrigation storage reservoir that has no minimum pool agreement. This reservoir water level is often drawn down to the original stream channel and a small shallow pond. This extreme pool fluctuation limits fish production and recreational access to the lake. By late summer fish are concentrated in very limited habitat and the lower end of the one improved boat ramp is usually well above the water level.

Reductions in reservoir volume can also exacerbate water quality problems associated with water temperature, and several cases turbidity.

Water Quality

Water quality in natural lakes is generally not a factor limiting fish production in the subbasin. Natural lakes in the subbasin are all located at higher elevations. However, some of the shallower lakes may have surface water temperatures that periodically exceed current state temperature standards (55°F), but this usually only occurs for short periods in the late summer. These same shallow lakes may also periodically experience dissolved oxygen deficiency during winters when a combined and prolonged ice and snow cover is present. These periods of oxygen deficiency or are often aggravated by abundant aquatic vegetation that decomposes during the winter. This vegetative decomposition uses available dissolved oxygen from the lake water. The combination of prolonged ice and snow cover and decomposing organic material in shallow alpine lakes can depress dissolved oxygen levels below the lethal level for fish and winter kill results. Ellis et al. (1946) determined that salmonids develop respiratory difficulties when dissolved oxygen drops below 5 parts per million (ppm) and levels of 3 ppm are lethal for fresh water fishes.

Small and medium size reservoirs and ponds located at lower elevation in the subbasin often experience surface water temperatures that exceed state water quality standards. These temperature extremes are usually associated with summer and early fall weather and may be further aggravated by insufficient inflow. These same reservoirs may experience depressed oxygen levels at or near the lake bottom that are intolerable to fish. The combination of high surface water temperatures and low dissolved oxygen near the lake bottom can effectively restrict fish distribution to a rather narrow band of the water column where there is tolerable temperatures and adequate dissolved oxygen. This type of limited fish distribution, associated with water quality deficiencies can limit a reservoir's fish production.

Water turbidity is a problem in at least two reservoirs in the subbasin. The biggest problem is at Pine Hollow Reservoir where there is no boat speed limit on approximately half of the reservoir from July until the day after Labor Day. Water skiing is a popular activity during this period. The boat wakes associated with water skiing cause significant shoreline washing which appreciably increases reservoir water turbidity. Increased turbidity can interfere with light penetration in water and adversely affect plankton production and potentially fish feeding and growth. Water turbidity can also reduce angling opportunity and catch.

Water turbidity can also be a problem at drawdown reservoirs where wave action associated with wind or boats operated at reduced speeds cause shoreline erosion. The severity of this turbidity is generally less than the problem experienced at Pine Hollow Reservoir.

Cover in the Cascade Mountain lakes is often times associated with submerged or partially submerged trees that have fallen into the lakes. This structural diversity provides increased habitat for aquatic invertebrate production, as well as important hiding cover for juvenile and adult fish. The lack of regular recruitment of large woody material can significantly limit inwater structural diversity.

Clear Lake and Rock Creek Reservoir are excellent examples of reservoirs that contain good structural habitat diversity. Trees were removed from the drawdown zone, but most stumps were left in place. This large woody structure provides good habitat for aquatic insect and other invertebrate production. Unfortunately Pine Hollow Reservoir and most smaller reservoirs and ponds had the reservoir area cleared of most potential habitat diversity prior to initial flooding. This practice may limit natural aquatic insect and invertebrate production as well as reducing habitat diversity.

Seasonal water level fluctuations at the subbasin's drawdown reservoirs and smaller ponds and reservoirs often precludes the successful establishment of significant submerged or emergent aquatic vegetation. Establishment of this vegetation may also be precluded by the effects of wave action as well as the desiccation of the drawdown zone bordering the lake.

Spawning habitat in subbasin lakes and reservoirs is very restricted. With the exception of successful brook trout spawning in several of the Cascade Mountain lakes, there is no known successful trout spawning in other subbasin ponds or reservoirs. The substrate in most lakes and reservoirs is dominated by fine sediment, silt, or detritus. This substrate is physically unsuitable for successful salmonid egg development or hatching as the result of inadequate water circulation. Constant circulation of high quality water is essential for developing salmonid eggs to supply a continuous supply of dissolved oxygen and carry away metabolic wastes.

FISH HABITAT RESTORATION

Lower Deschutes River Fish Habitat Projects

ODFW has actively sought cooperators, partners, and volunteers in fish habitat restoration projects throughout the subbasin. These projects have been limited by available funding, materials, personnel limitations, and landowner participation. ODFW's strategy for implementing fish habitat restoration projects has been to prioritize potential projects, based on the type of fish involved. The highest priority has been anadromous species, followed by unique resident trout, and finally, all other indigenous fish species.

ODFW has implemented several fish habitat restoration projects on the lower Deschutes River (Table 1.14). Several of these projects have been cooperative projects with other state or federal agencies or private landowners. These projects have emphasized restoration of riparian vegetation along the river margin.

Restored streamside vegetation helps to shade shallow water habitat and moderates water temperature. Streamside vegetation as well as emergent aquatic vegetation provides cover for juvenile fish rearing and acts as an important nutrient source for the food chain, ultimately benefiting fish production. A healthy riparian vegetative community also acts as a natural filter that traps sediment, which helps to protect water and stream substrate quality.

In the 1980's, ODFW acquired ownership to more than 18 miles of lower Deschutes River shoreline from the mouth upstream. Riparian restoration efforts began shortly after the property was acquired. Approximately 16 miles of livestock exclusion fencing, upland water developments, and several livestock river access water lanes were constructed. In 1983, ODFW worked cooperatively with the BLM and the Deschutes Club to excluded livestock from approximately twelve miles of the east bank of the river between Nena and Cove creeks. ODFW, CTWS, ODOT and volunteers have also maintained vehicle and livestock barriers along a 1.5 mile section of river immediately upstream from the Warm Springs/Highway 26 Bridge.

The BLM has implemented changes in lower Deschutes River livestock grazing allotments including riparian exclosures, reduced grazing seasons, and reduced animal numbers (Table 1.14). These actions should result in an upward trend in riparian and instream habitat.

CTWS has implemented some livestock grazing reforms on that portion of the reservation bordering the river. This includes livestock exclusion fencing and off-river water developments designed to encourage riparian and aquatic vegetation restoration (Table 1.15).

Lower Deschutes River Tributary Fish Habitat Projects

ODFW has implemented a number of habitat projects on ODFW lands or in cooperation with private landowners and federal land managers on lower Deschutes River tributaries. These projects include exclosures to prevent livestock grazing in riparian areas, addition of instream structure and spawning gravel, stream bank stabilization, and installation of protective fish screens on pump and gravity water diversions. These projects are summarized in Table 1.16.

Federal land management agencies have undertaken a number of fish habitat projects on various lower Deschutes River tributaries. These projects are summarized in Table 1.17.

CTWS has implemented a number of fish habitat restoration and enhancement projects on their reservation. These projects include stream bank stabilization, addition of instream structure, and screening on a water diversion. A summary of CTWS fish habitat projects is presented in Table 1.15.

Lake and Reservoir Fish Habitat Enhancement

Fish habitat enhancement associated with ponds, reservoirs and lakes has been limited to livestock exclosures on several of the small ponds in the White River drainage. .

Proposed Fish Habitat Restoration Projects

A watershed restoration project was initiated in the Buck Hollow Creek watershed in 1991. The goal of this project is restoration of upland, riparian, and instream habitat in this watershed. There are at least five more years of implementation planned for this project. The intent is to begin remedial measures in the upper watershed and then proceed downstream. ODFW has been working closely with the SWCD's from Wasco and Sherman counties, as well as the CTWS, NRCS, BPA, BLM, WRD, private landowners, and the Governor's Watershed Enhancement Board to achieve desired fish habitat benefits.

The Wasco County SWCD is moving ahead with plans to implement a watershed restoration project similar to the Buck Hollow Project on the Bakeoven Creek watershed. Actual initiation of the project may depend on the completion of the Buck Hollow Project.

The BLM is reviewing management and use of livestock grazing allotments in the lower Deschutes River subbasin. These evaluations have resulted in some changes in livestock management that would result in an upward trend for riparian and instream habitat on the lower Deschutes River and tributaries.

Future Fish Habitat Opportunities

There are numerous opportunities for improving fish habitat in the lower Deschutes River subbasin (Table 1.18). These opportunities include flow recovery, riparian restoration and protection, restoration of instream structural diversity, installation of fish screens, and supplementation of spawning gravel.

There also fish habitat improvement opportunities for ponds, reservoirs and lakes with the lower Deschutes River subbasin. There are a number of ponds that would benefit from protection from livestock grazing and the possible introduction of structure. Reservoirs would benefit from the introduction of structure, and establishment of a diverse vegetative community in the drawdown zone. Lakes would also benefit from the introduction and retention of structure.

A feature common to many subbasin irrigation reservoirs that contain fish populations is drawdown. Fish production and recreation could be potentially enhanced by minimizing drawdown at these reservoirs. A change in water right or a water right transfer would be needed to reflect this change in use.

MANAGEMENT CONSIDERATIONS

Water quality and/or quantity in the lower Deschutes River and tributaries and the White River system has been adversely affected by consumptive water withdrawals, removal of riparian vegetation, and upland erosion and the associated sedimentation of stream substrate. Water temperature in subbasin streams seasonally exceeds state water quality standards.

White River originates from White River Glacier on Mount Hood. This river annually flushes large quantities of glacial sand and silt into the lower forty six miles of the lower Deschutes River. White River occasionally discharges enough glacial flour to significantly increase turbidity in the lower Deschutes River. This turbidity can be so severe that it eliminates all effective angling.

Aquatic habitat diversity on many subbasin streams has been adversely affected by removal of riparian vegetation, catastrophic flood damage, streambank and upland erosion, stream sedimentation, past timber harvest practices, and stream channelization.

Modifications in livestock grazing along some subbasin streams, including season of use and exclosures, have resulted in substantial improvement or protection for riparian vegetation during the past ten years.

The Pelton/Round Butte hydroelectric complex has interrupted recruitment of spawning gravel and large woody material into the lower Deschutes River immediately downstream from the project.

Fish passage has been blocked on the lower Deschutes River by the Pelton/Round Butte hydroelectric complex. White River Falls has prevented upstream fish migration into White River for thousands of years. Irrigation diversion structures on several tributaries are effective seasonal barriers to fish migration.

Unscreened irrigation diversions or pump intakes adversely affect fish production in Trout Creek and the White River system.

Water quality and quantity in subbasin reservoirs has been significantly affected by annual drawdown, as well as shoreline erosion and associated turbidity.

MANAGEMENT DIRECTION

Objectives and actions contained in these management directions will be used to set district work plans that form the basis for monitoring and evaluation programs. Completion of actions listed under an objective contribute to the meeting of that objective. Many actions cannot be accomplished under current levels of funding. If funding continues to be limited, ODFW will pursue completion of actions according to priorities as funds become available.

Policies

Policy 1. *Habitat protection and restoration will be given priority over supplementation to reach natural fish production goals.*

Policy 2. *It is the intent of ODFW through accomplishment of objectives presented in this plan to cooperate with other state, federal, and private groups and the Confederated Tribes of the Warm Springs Reservation of Oregon to protect fish habitat and maintain the diversity of native fishes.*

Objective 1. Improve the quality and quantity of aquatic and riparian habitat.

Assumptions and Rationale

1. High quality aquatic and riparian habitat is necessary for optimum fish production.
2. The Pelton/Round Butte hydroelectric complex has changed fish habitat in the lower Deschutes River.
3. Adequate amounts of clean, cool water, food organisms, cover, and spawning areas for fishes are components of high quality habitat.
4. Unscreened irrigation diversions kill indigenous fish.

Actions

Action 1.1. Achieve and maintain full vegetative potential for all riparian areas along the lower Deschutes River and tributaries.

Action 1.2. Work with Pelton/Round Butte hydroelectric complex FERC permittee and CTWS to place spawning gravel in the three mile reach of the lower Deschutes River from the Pelton Regulation Dam to Shitike Creek to mitigate for the loss of natural spawning gravel recruitment.

Action 1.3. Work with Pelton/Round Butte hydroelectric complex FERC permittee and CTWS to understand the role and importance of large woody material for fish and fish habitat in the lower Deschutes River.

Action 1.4. Achieve and maintain protective fish screening on all unscreened water diversions or pump intakes within the lower Deschutes River subbasin.

Objective 2. Establish and maintain instream water rights on all streams in the lower Deschutes River subbasin which exhibit fish and wildlife values.

Assumptions and Rationale

1. Water quantity is as important as water quality for fish production.
2. Deschutes River basin water development and use has affected lower Deschutes River flows.
3. Most streams in the subbasin, other than the Deschutes River, are fully appropriated or over-appropriated for consumptive water withdrawal.
4. Fish production is limited by stream flow in most tributaries in the subbasin.
5. Restoration of stream flows will increase the fish production capacity of the subbasin.

Actions

Action 2.1. Apply for instream water rights on streams with existing flow data.

Action 2.2. Encourage or work cooperatively with other agencies or interested parties to acquire water rights for conversion to instream rights to enhance degraded aquatic habitat in lower Deschutes River tributaries.

Action 2.3. Identify where and when stream flows are deemed inadequate to support populations of fish and aquatic resources four out of five years.

Action 2.4. Conduct instream flow studies, using approved methodologies, on all existing or potential fish bearing streams in the lower Deschutes River subbasin.

Action 2.5. Where surface flows are identified as inadequate, request that the depleted stream be withdrawn from further appropriations during the critical months.

Action 2.6. Review and comment on water right applications.

Action 2.7. Measure instream flows for compliance with established instream water rights as necessary.

Action 2.8. When instream flows are found to be below levels protected by instream water rights, inform the local Watermaster for enforcement.

Action 2.9. Encourage WRD to monitor consumptive water use to verify that use does not exceed individual rights.

Objective 3. Maintain or improve upland watershed conditions to sustain the long-term production of high quality water.

Assumptions and Rationale

1. Land uses in the watershed can adversely affect water quality.
2. Storm runoff from crop and rangeland periodically contributes high sediment loads to the lower Deschutes River and tributaries.
3. A well developed corridor of riparian vegetation along streams will result in improved summer and fall flow, as a result of increased stream bank water storage.
4. Water quality in streams, lakes, or reservoirs is directly dependent upon the condition of its watershed.
5. Fish management objectives can not be achieved without an adequate quantity of appropriate quality water.

6. Agriculture, livestock grazing, timber harvest practices, urban development, and road construction/maintenance have the potential to degrade watershed conditions and decrease water quality.
7. Existing land and resource management plans for public lands provide an adequate management framework for protection of fish habitat.
8. Funding for implementation of management plans does not always give high priority to protection of fisheries or maintenance of high quality water.

Actions

Action 3.1. Support implementation of existing land and resource management plans on public land.

Action 3.2. Determine the condition and trend of riparian vegetation along the lower Deschutes River and tributaries.

Action 3.3. Encourage public and private land managers to implement riparian protection and/or restoration measures along the Deschutes River and tributaries.

Action 3.4. Work with NRCS and SWCD's to implement farm conservation plans designed to reduce erosion.

Action 3.5. Work with DOF and private timber land owners to minimize erosion from forest management activities.

Action 3.6. Work with federal land management agencies to minimize erosion from public lands.

Objective 4. Maintain or improve water quality in the lower Deschutes River and tributaries.

Assumptions and Rationale

1. Irrigation return water may carry agricultural chemicals, fertilizers, silt, sediment and animal waste into the lower Deschutes River and tributaries.
2. Water temperature in the lower Deschutes River and tributaries regularly exceeds state water quality standards as a result of low flow, degraded stream channels and degraded riparian habitat.
3. Fish production is limited by water quality.

Actions

Action 4.1. Work cooperatively with DEQ, the federal Environmental Protection Agency and CTWS to sample water quality at key sites where pollution problems are suspected.

Action 4.2. Monitor water temperatures in the lower Deschutes River and tributaries.

Action 4.3. Encourage private landowners, federal land managers, NRCS, and SWCD's to resolve sediment runoff problems associated with crop and rangelands.

Action 4.4. Encourage private landowners, NRCS, and SWCD's to resolve agricultural chemical, fertilizer, silt, sediment, and animal waste runoff problems associated with crop and rangelands, or confined animal feeding operations.

Action 4.5. Encourage DEQ to establish a sediment standard in streams that includes a beneficial use protection standard for percent fines in spawning gravel.

Objective 5. Improve fish passage at manmade barriers within the lower Deschutes River subbasin.

Assumptions and Rationale

1. Fish movement in a number of streams in the subbasin are seasonally or totally blocked by manmade structures or activities.
2. Barriers blocking fish movement in subbasin streams can fragment or isolate fish populations reducing their overall viability.
3. Fish passage will not be provided at natural fish migration barriers.

Actions

Action 5.1. Initiate an inventory of manmade fish barriers on subbasin streams.

Action 5.2. Assist responsible parties in developing remedial measures to eliminate seasonal and total fish passage barriers.

Action 5.3. Assist with evaluating potential fish passage upstream of the Pelton/Round Butte hydroelectric complex during the FERC relicensing process of that facility. A draft plan and schedule for evaluating the potential for fish passage has been developed (Ratliff et al. 1996).

Objective 6. Protect or enhance aquatic and riparian habitat in subbasin lakes, reservoirs, ponds, wetlands, and seeps.

Assumptions and Rationale

1. Aquatic habitat is lacking in drawdown reservoirs and some natural lakes.
2. Aquatic habitat diversity in lakes and reservoirs results in better fish cover, aquatic food production, and ultimately better fish production.
3. Water use and subsequent drawdown of irrigation reservoirs could be reduced with more efficient delivery and use of irrigation water.
4. A well developed riparian plant community around lakes and reservoirs helps to provide shoreline stability, overhead shade and cover, a natural source of organic nutrients, and a source of future large woody material.
5. Enhancement opportunities for fish habitat in drawdown reservoirs may be severely limited by the primary use of the reservoir.

Actions

Action 6.1. Encourage the USFS to enhance aquatic habitat diversity in lakes, reservoirs, wetlands, and seeps within the Mount Hood National Forest.

Action 6.2. Encourage irrigation districts and the BOR to improve aquatic habitat diversity within their reservoirs.

Action 6.3. Encourage irrigation districts to implement more efficient measures for delivery and use of irrigation water.

Action 6.4. Encourage public and private land managers to implement measures to protect and enhance riparian habitat around lakes, ponds and reservoirs.

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SECTION 1. HABITAT

FIGURES AND TABLES

Table 1.1. Land ownership in the lower Deschutes River subbasin.

Ownership	Area (sq. miles)	Percentage of Total
Tribal Lands [a/]	560	21
US Forest Service	285	11
Bureau of Land Management	108	4
State of Oregon	57	2
Private	1,645	62

a/ Lands held in trust on and off the Warm Springs Reservation by the United States government for the benefit of the Confederated Tribes of the Warm Springs Reservation of Oregon and individual tribal members.

Table 1.2. Summary of water rights (cfs) for the lower Deschutes River subbasin. a/

Beneficial use	White River	Trout Creek	Deschutes & other tribs.	Total
Aquatic life	60.00b/	--	--	60.00
Domestic	0.48	0.61	0.33	1.42
Domestic/Livestock	0.17	--	--	0.17
Fire protection	1.38	--	--	1.38
Fish	0.20	--	71.48	71.68
Fish/Wildlife	0.07	--	--	0.07
Industrial/Manufacturing	1.61	--	--	1.61
Irrigation	138.94	44.07	12.68	195.69
Irrigation/Domestic	3.37	--	--	3.37
Irrigation/Domestic/Livestock	7.44	3.41	0.34	11.19
Irrigation/Livestock	--	0.15	--	0.15
Livestock	1.20	0.02	0.07	1.29
Livestock/Wildlife	0.03	--	--	0.03
Municipal	1.00	0.23	5.06	6.29
Power	12.00	--	--	12.00
Recreation	15.01	--	0.25	15.26
Total	242.90	48.49	90.21	381.60

a/ Water rights information on the Confederated Tribes of the Warm Springs Reservation of Oregon is not available.

b/ Instream water right is 60 cfs July 1 to February 15, 100 cfs February 16 to 29, 145 cfs March 1 to May 31 and 100 cfs June 1 to 30.

Table 1.3. Lower Deschutes River resident trout habitat inventory.

			Limiting Factors							
Stream	Stream Miles	Fish Species	Natural Barrier	Manmade Barrier	Low Flow	Temp. Extremes	Instream Cover	Sedimen-tation	Riparian	Spawning Gravel
White River	2.0-45.3	Rb/Wf/Bt	grad				X	glacial		
Tygh Creek	0.0-18.0	Rb	grad	divers	X					
Jordan Creek	0.0-11.5	Rb				X			range/ forest	X
Badger Creek	0.0-22.0	Rb	grad	divers	X	X	X		range	
L. Badger Creek	0.0- 4.2	Rb	jams							
Threemile Creek	0.0-17.4	Rb		divers	X	X	X		X	
Rock Creek	0.0-13.7	Rb/Lb		dam	X	X		X	X	
Gate Creek	0.0-13.0	Rb		culverts divers	X	X	X	X	X	X
Boulder Creek	0.0-11.4	Rb/Bt		divers	X					X

(continued)

Table 1.3. (continued) Lower Deschutes River resident trout habitat inventory.

			Limiting Factors							
Stream	Stream Miles	Fish Species	Natural Barrier	Manmade Barrier	Low Flow	Temp. Extremes	Instream Cover	Sedimen-tation	Riparian	Spawning Gravel
Forest Creek	0.0-2.0	Rb		divers	X					
Clear Creek	0.0-11.8	Rb/Bt		dam divers						
Frog Creek	0.0-7.5	Rb/Bt		divers	X					
Barlow Creek	0.0- 6.0	Rb/Bt	grad	culvert						
Buck Creek	0.0-1.5	Rb/Bt	grad							
Bonney Creek	0.0- 3.5	Rb/Bt						bank erosion	range	
Iron Creek	0.0-4.3	Rb								X

grad = gradient barrier
jams = log jams
divers = diversion dam
dam = irrigation storage reservoir
forest = timber harvest
range = rangeland

Table 1.4. Lower Deschutes River anadromous fish habitat inventory.

Stream	Stream Miles	Fish Species	Limiting Factors							
			Natural Barrier	Manmade Barrier	Low Flow	Temp. Extremes	Instream Cover	Sedimen -tation	Riparian	Spawning Gravel
Deschutes River	0.0-100.0	StS/Rb ChF/ChS		HE						
Gordon Creek	0.0- 1.0		ALD/ grad					crop		
Fall Creek	0.0-1.5	StS/Rb	ALD		X	X	X	crop/SBE	X	X
Harris Creek	0.0-0.3	StS/Rb	ALD/ falls				X	crop/ range	X	X
Bull Run	0.0-2.0	StS/Rb	ALD		X	X		crop/ range	X	X
Sixteen Canyon	0.0-0.7	StS/Rb	ALD		X	X	X	crop/ range	X	X
Macks Canyon	0.0-2.0	StS/Rb	grad/ flow		X	X	X	crop/ range	X	
Ferry Canyon	0.0-2.5	StS/Rb	ALD/ flow		X	X	X	crop/ range	X	
Oak Brook	0.0-3.0	StS/Rb	ALD/ flow		X	X	X	crop/ range	X	
Jones Canyon	0.0-2.0	StS/Rb	ALD/ flow		X	X	X	crop/ range	X	X
Buck Hollow Cr.	0.0-26.0	StS/Rb	flow		X	X	X	crop/ range	X	

(continued)

Table 1.4. (continued) Lower Deschutes River anadromous fish habitat inventory.

			Limiting Factors							
Stream	Stream Miles	Fish Species	Natural Barrier	Manmade Barrier	Low Flow	Temp. Extremes	Instream Cover	Sedimen -tation	Riparian	Spawning Gravel
Finnegan Creek	0.0-3.0	StS/Rb	grad		X	X		crop/ range	X	
Thorn Creek	0.0-3.0	StS/Rb	flow		X	X	X	crop/ range	X	
White River	0.0-2.0	StS/Rb	falls					glacial		X
Bakeoven Creek	0.0-9.2	StS/Rb	flow		X	X	X	crop/ range	X	
Trail Creek	0.0-2.0	StS/Rb			X	X	X	range	X	
Deep Creek	0.0-8.0	StS/Rb			X	X	X	range	X	X
Robin Creek	0.0-1.0	StS/Rb	flow/ grad		X	X	X	range	X	X
Stag Canyon	0.0-2.0	StS/Rb	grad	culvert	X	X	X	range	X	
Wapinitia Creek	0.0-8.0	StS/Rb	flow		X	X	X	crop/ range	X	X
Nena Creek	0.0-2.0	StS/Rb	ALD/ cat		X	X	X	range	X	X
Eagle Creek	0.0-4.0	StS/Rb	ALD/ flow		X	X	X	range		
Cove Creek	0.0-1.5	?	ALD/ grad		X	X	X	range	X	X
Trout Creek	0.0-48.0	StS/Rb	flow	divers	X	X	X	crop/ range		

(continued)

Table 1.4. (continued) Lower Deschutes River anadromous fish habitat inventory.

Stream	Stream Miles	Fish Species	Limiting Factors							
			Natural Barrier	Manmade Barrier	Low Flow	Temp. Extremes	Instream Cover	Sedimen -tation	Riparian	Spawning Gravel
Tenmile Creek	0.0-6.0	Sts/Rb	flow/ grad		X	X	X	range		X
Mud Springs	0.0-1.5	StS/Rb		culvert		X	X	crop/ range		X
Hay Creek	0.0-	--	flow/ cat	ditched	X	X				
Antelope Creek	0.0-5.0	StS/Rb		headcut	X	X	X	crop/ range	X	X
Ward Creek	0.0-10.5	StS/Rb	flow		X	X	X	range	X	
L. Trout Creek	0.0-2.0	StS/Rb	flow/ grad		X	X	X	range	X	
Whetstone Creek	0.0-1.0	StS/Rb	flow/ grad		X	X	X	range	X	X
Clover Creek	0.0-1.5	StS/Rb	flow		X	X	X	range	X	X
Board Creek	0.0-3.0	StS/Rb	flow		X	X	X	range	X	X
Amity Creek	0.0-5.0	StS/Rb	flow		X	X	X	range/ forest	X	
Foley Creek	0.0-6.0	StS/Rb	flow/ grad		X	X	X	range/ forest	X	
Barber Creek	0.0-1.0	StS/Rb	flow		X	X	X	range/ forest	X	X

(continued)

Table 1.4. (continued) Lower Deschutes River anadromous fish habitat inventory.

Stream	Stream Miles	Fish Species	Limiting Factors: Natural Barrier	Manmade Barrier	Low Flow	Temp. Extremes	Instream Cover	Sedimen -tation	Riparian	Spawning Gravel
Martin Creek	0.0-2.0	StS/Rb	flow/ grad		X	X	X	range/ forest	X	X
Big Log Creek	0.0-1.5	StS/Rb	flow/ grad		X	X	X	range/ forest	X	
Cartwright Cr.	0.0-1.5	StS/Rb	flow/ grad		X	X	X	range/ forest	X	X
Opal Creek	0.0-3.0	StS/Rb	flow/ grad		X	X	X	range/ forest	X	X
Auger Creek	0.0-2.0	StS/Rb	flow/ grad		X	X	X	range/ forest	X	
Potlid Creek	0.0-2.0	StS/Rb	flow/ grad		X	X	X	range/ forest	X	
Frog Springs Cr.	0.0-0.8	StS/Rb	grad			X	X	crop	X	X
Warm Springs R.	0.0-40.0	StS/ChS Bt/Rb								
Beaver Creek		Sts/ChS								
Mill Creek	0.0-7.0	StS/ChS Bt/Rb	falls							
Boulder Creek										
Shitike Creek		STS/ChS BuT/Rb								

Table 1.4. (continued) Lower Deschutes River anadromous fish habitat inventory.

HE = hydroelectric complex
ALD = alluvial deposit
falls = waterfall
flow = low/intermittent flow
grad = gradient barrier
cat = cataract

crop = cropland runoff
range = rangeland
forest = timber harvest
SBE = stream bank erosion

Table 1.5. Mean monthly discharge (cfs) for the Deschutes River at the mouth, USGS Station 1410300, 1965-85.

Month	Discharge	Month	Discharge
January	7,844	July	4,732
February	7,508	August	4,477
March	7,407	September	4,535
April	6,862	October	4,809
May	6,097	November	5,589
June	5,457	December	6,627

Table 1.6. Mean monthly discharge (cfs) for the Deschutes River near Madras, USGS Station 14092500, 1965-85.

Month	Discharge	Month	Discharge
January	5,809	July	4,124
February	5,517	August	4,020
March	5,632	September	4,049
April	5,297	October	4,258
May	4,555	November	4,830
June	4,357	December	5,265

Table 1.7. Mean monthly discharge (cfs) for White River at Tygh Valley, USGS Station 14101500, 1965-85.

Month	Discharge	Month	Discharge
January	736	July	185
February	715	August	129
March	621	September	121
April	590	October	139
May	655	November	238
June	420	December	490

Table 1.8. Mean monthly discharge (cfs) for Warm Springs River near Kah-Nee-Ta Hot Springs, USGS Station 14097100, 1973-85.

Month	Discharge	Month	Discharge
January	656	July	290
February	703	August	263
March	623	September	260
April	547	October	266
May	528	November	330
June	417	December	553

Table 1.9. Mean monthly discharge (cfs) for Shitike Creek near Warm Springs, USGS Station 14092885, 1975-85.

Month	Discharge	Month	Discharge
January	111	July	92.4
February	135	August	59.3
March	111	September	49.3
April	98.3	October	50.8
May	127	November	78.7
June	136	December	129

Table 1.10. Water quality data for the Deschutes River. All quantities are median values for 1986 (US Environmental Protection Agency's Storet System)

Parameter	Units	Station Location: Mouth	Station Location: Warm Springs Bridge
Nitrogen			
NH^{3+}, NH^{4-}	mg/l as N	0.020	0.025
NO^2, NO^3	mg/l as N	0.020	0.130
Phosphorus			
Dissolved, Total	mg/l as P	0.099	0.092
Dissolved, Total	mg/l as P	0.045	0.068
Total Organic Carbon	mg/l	2.0	<1.0
Calcium, Dissolved	mg/l	7.7	7.6
Magnesium, Dissolved	mg/l	4.8	5.1
Sodium, Dissolved	mg/l	9.1	10.0
Potassium, Dissolved	mg/l	1.9	--
Chloride, Total	mg/l	2.0	--
Sulfate, SO^4	mg/l	2.0	--

Table 1.11. Physical characteristics of the Deschutes River at the mouth, USGS Station 14103000. All quantities are median values from October 1982 to January 1988.

Parameter	Fall	Winter	Spring	Summer
pH	8.1	7.7	8.2	8.4
Temperature (F)	49.0	43.0	55.0	64.0
Dissolved Oxygen (mg/l)	11.8	12.5	11.0	10.5
Specific Conductivity (US/cm)	130.0	128.0	127.0	126.0
Turbidity (NTU)	2.0	4.2	7.0	2.6
Alkalinity (mg/l as CaCO)	65.0	67.0	63.0	60.0
Hardness (mg/l as $CaCO_3$)	44.0	46.0	45.0	43.0

Table 1.12. Certificated instream water rights for the lower Deschutes River subbasin.

Stream	Limits		app.#	cert.#	date
	Upstream (RM)	Downstream (RM)			
White River	2.0	0.0	MPS	59751	01/10/80
White River	2.0	0.0	MPS	59750	02/20/62
White River	USFS boundary	0.0	070088	64196	10/02/89

Table 1.13. Instream water right program application summary.

Stream > Parent stream	Limits		Species	App #	Date
	Upstream	Downstream			
Antelope Cr. > Trout Cr.	Grub Hollow Cr.	Mouth	StS, Rb	071797	08/12/91
Badger Cr. > Tygh Cr.	Pine Cr.	L. Badger Cr.	Rb, Bt	072063	12/03/91
Bakeoven Cr. > Deschutes R.	Deep Cr.	Mouth	StS, Rb	071796	08/12/91
Buckhollow Cr.> Deschutes R.	Macken Canyon	Mouth	StS, Rb	071795	08/12/91
Clear Cr. > White R.	Clear Lake Dam	Mouth	Rb, Bt	072065	12/03/91
Crane Cr. > White R.	Swamp Cr.	Mouth	Rb, Bt	072064	12/03/91
Deschutes R. > Columbia R.	Pelton Dam	Mouth	StS, Rb	070087	10/02/89
Deschutes R. > Columbia R.	Pelton Dam	Mouth	ChF, Sts, Rb, Bt	071194	01/10/91
Forest Cr.> Crane Cr.	Headwaters	Mouth	Rb	072062	12/03/91
Frog Cr. > Clear Cr.	Frog Lk. Outlet	Mouth	Rb, Bt	072061	12/03/91
Little Badge Cr. > Tygh Cr.	Headwaters Sprgs.	Mouth	Rb	071794	08/12/91
Threemile Cr. > White R.	Headwaters	Mouth	Rb	071799	08/12/91
Trout Cr. > Deschutes R.	Clover Cr.	Antelope Cr.	StS, Rb	070339	05/09/90
Trout Cr. > Deschutes R.	Antelope Cr.	Mouth	StS, Rb	070247	03/21/90
Tygh Cr. > White R.	Badger Cr.	Mouth	Rb	072066	12/03/91
Tygh Cr. > White R.	Jordan Cr.	Badger Cr.	Rb	072067	12/03/91
Tygh Cr. > White R.	Untrib	Jordan Cr.	Rb	070268	12/03/91
White River > Deschutes R.	Iron Cr.	N.F. Boundary	StS, Rb, Bt	071800	08/12/91

Table 1.14. Lower Deschutes River fish habitat protection and restoration projects.

River Reach (miles)	Project Sponsor	Livestock Fencing Riparian Pasture	Livestock Fencing Exclosure	Shoreline Treated	Year Completed
1.0-12.5	ODFW		8.5	19.5	1986
12.5-17.0	ODFW		6.5	13.0	1988
17.0-18.3	ODFW		1.3	1.3	1983
18.3-19.0	ODFW		0.7	0.7	1988
19.0-24.0	BLM		5.0	5.0	1990's
24.0-24.3	BLM		0.3	0.3	1960's
24.3-34.5	BLM	10.2		10.2	1990's
25.6-25.8	BLM		0.2	17.0	1990's
34.5-41.5	BLM	7.0		7.0	1990's
44.5-51.5	BLM	7.0		7.0	1990's
52.5-53.0	BLM	0.5		0.5	1990's
53.0-53.5	ODFW TD Rod & Gun		0.375	0.375	1975
53.5-58.5	BLM		5.0	5.0	1990's
58.5-72.0	ODFW/BLM TD Rod & Gun Deschutes Club		10.0	13.5	1983
87.5-93.0	BLM	5.5		5.5	1980's
94.0-95.5	BLM		1.5	1.5	1980's
95.5-96.0	BLM	0.5		0.5	1990's
97.0-98.5	ODFW		1.5	1.5	1970's
	TOTALS	30.7	40.875	109.375	

Table 1.15. Fish habitat restoration and enhancement projects by Confederated Tribes of Warm Springs Reservation (Fritsch, personal communication).

Stream	Reach (miles)	Year	Passage	Instream Structures	Riparian Fencing (miles)	Rock Riprap (yds^3)	Juniper Riprap	Upland Water
Mill Creek	9.0	1984	falls by-pass					
Mill Creek	6.0 - 7.5	1987		155				
Mill Creek	6.25 - 7.0				1.5			1
Beaver Cr.	14.0 - 14.5 18.6 - 19.7 20.2 - 20.3 20.8 - 20.9	1986		185		470		
Beaver Cr.	14.6 - 16.1	1988			3.0			
Beaver Cr.	0.4 - 1.6	1988		180	(boulders)		160	(trees)
Beaver Cr.	14.6 - 19.1	1993-94			10.0			
Shitike Cr.	0.8 - 2.8	1988-89		806			164	(trees)
Coyote Cr.	0.0 - 10.0	1993-94			10.0			
Deschutes R.	68.0 - 73.0	1994			5.0	(riparian pasture)		4
Deschutes R.	79.0 - 80.0	1994			0.15	(exclosure)		

Table 1.16. Lower Deschutes River tributaries - Oregon Department of Fish and Wildlife fish habitat restoration projects.

Stream	Reach (miles)	Year Treated	Fence Constructed (miles)	Bank Riprap (feet)	Instream Structures	Fish Screens	Spawning Gravel (yards)
Trout Cr. & Tribs.	Mouth to headwater	1986-94	132.1	20,923	4,764	35	750
Bakeoven Cr.	2.5	1990	1.6				
Jordon Cr.	1.2	1980's	2.0				

Table 1.17. Lower Deschutes River tributaries - miscellaneous fish habitat enhancement and restoration projects.

Stream	Stream Reach (miles)	Project Sponsor	Bank Riprap (feet)	Fence (miles)	Instream Structures	Year
Buck Hollow Creek	26-30	SWCD	1,500	1.0		1990's
Threemile Creek	14-15	USFS		2.0	50	1970's
Rock Cr.	10-11.5	USFS		3.0	75	1970

Table 1.18. Lower Deschutes River and tributaries fish habitat restoration opportunities.

Stream	Habitat Limiting Factors	Potential Treatment	Estimated Miles of Stream
Deschutes R.	Structure, Riparian	Structure	50
	Sediment, Temp.	Fencing	30
Buck Hollow Cr. & Tributaries	Riparian, Temp.	Fencing	28
	Flow, Sediment	Riparian	28
	Structure	Structure	24
		H_2O Development	
Bakeoven Cr. & Tributaries	Riparian, Temp.	Fencing	20
	Flow, Sediment	Riparian	10
	Structure	Structure	10
		H_2O Development	20-40
Trout Creek	Riparian, Temp.	Fencing	20
	Flow, Sediment	Riparian	20
	Structure	Structure	20
		H_2O Development	30-100
		H_2O Conversion	
		Screening	
White River & Tributaries	Riparian, Temp.	Fencing	20-30
	Flow, Sediment	Riparian	10
	Structure	Structure	5-10
		H_2O Development	
		H_2O Conversion	
		Screening	
Misc. Deschutes Tributaries	Riparian, Temp.	Fencing	30-40
	Flow, Sediment	Riparian	10
	Structure	Structure	15-20
		H_2O Development	30-50

(continued)

Table 1.18. (continued) Lower Deschutes River and tributaries fish habitat restoration opportunities.

Stream	Habitat Limiting Factors	Potential Treatment	Estimated Miles of Stream
Warm Springs R. & Tributaries	Riparian, Temp. Flow, Sediment Structure	Fencing Riparian Structure H_2O Development	
Deschutes R. Tributaries (Reservation)	Riparian, Temp. Flow, Sediment	Fencing Riparian H_2O Development	

Structure = Instream structure
Riparian = Riparian enhancement/planting
Fencing = Riparian livestock pasture or exclosure fencing
H_2O Development = Development of off-stream stock watering sites
H_2O Conversion = Conversion of consumptive to instream rights
Screening = Protective fish screens on pumps and diversions

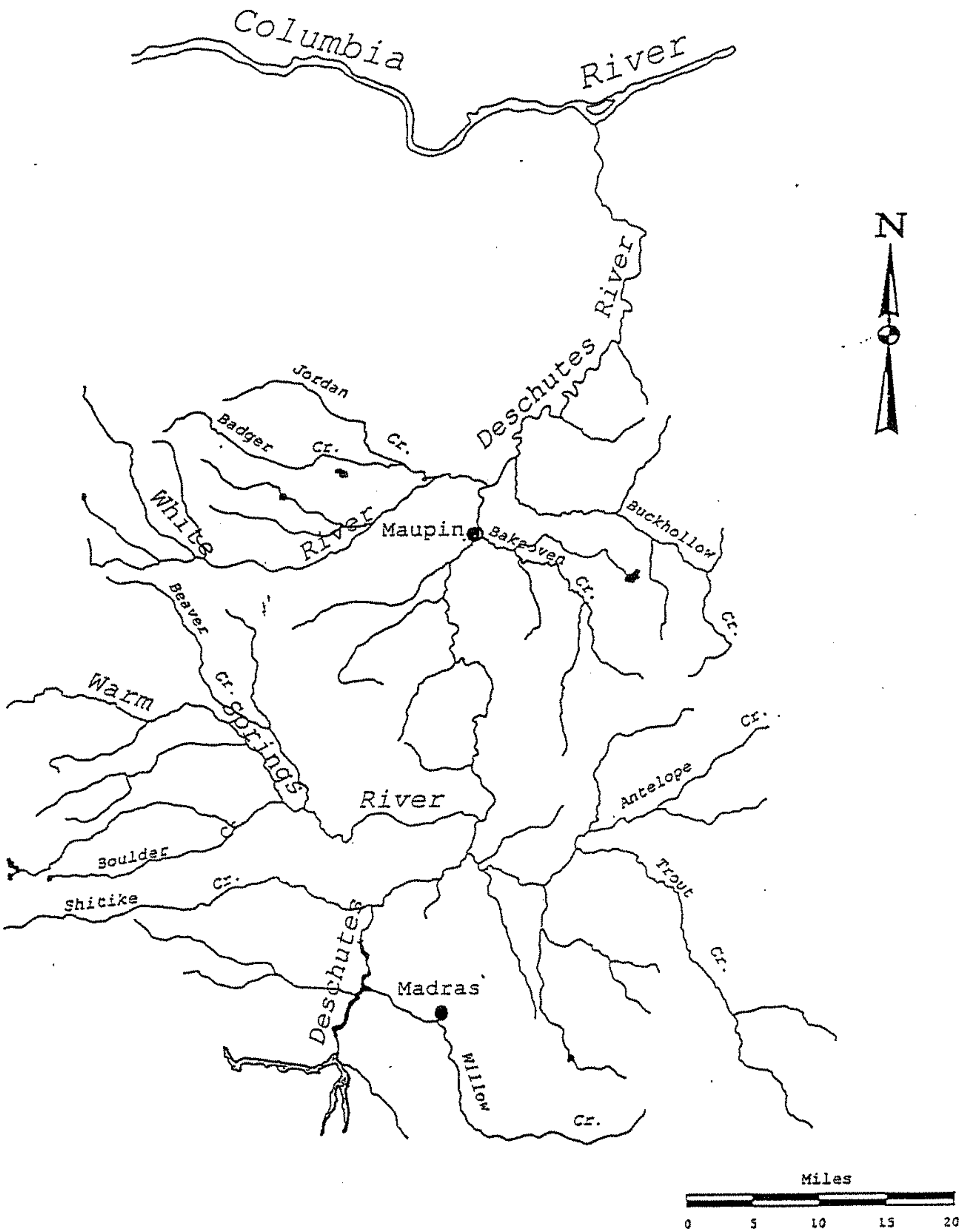

Figure 1.1. Deschutes River Subbasin.

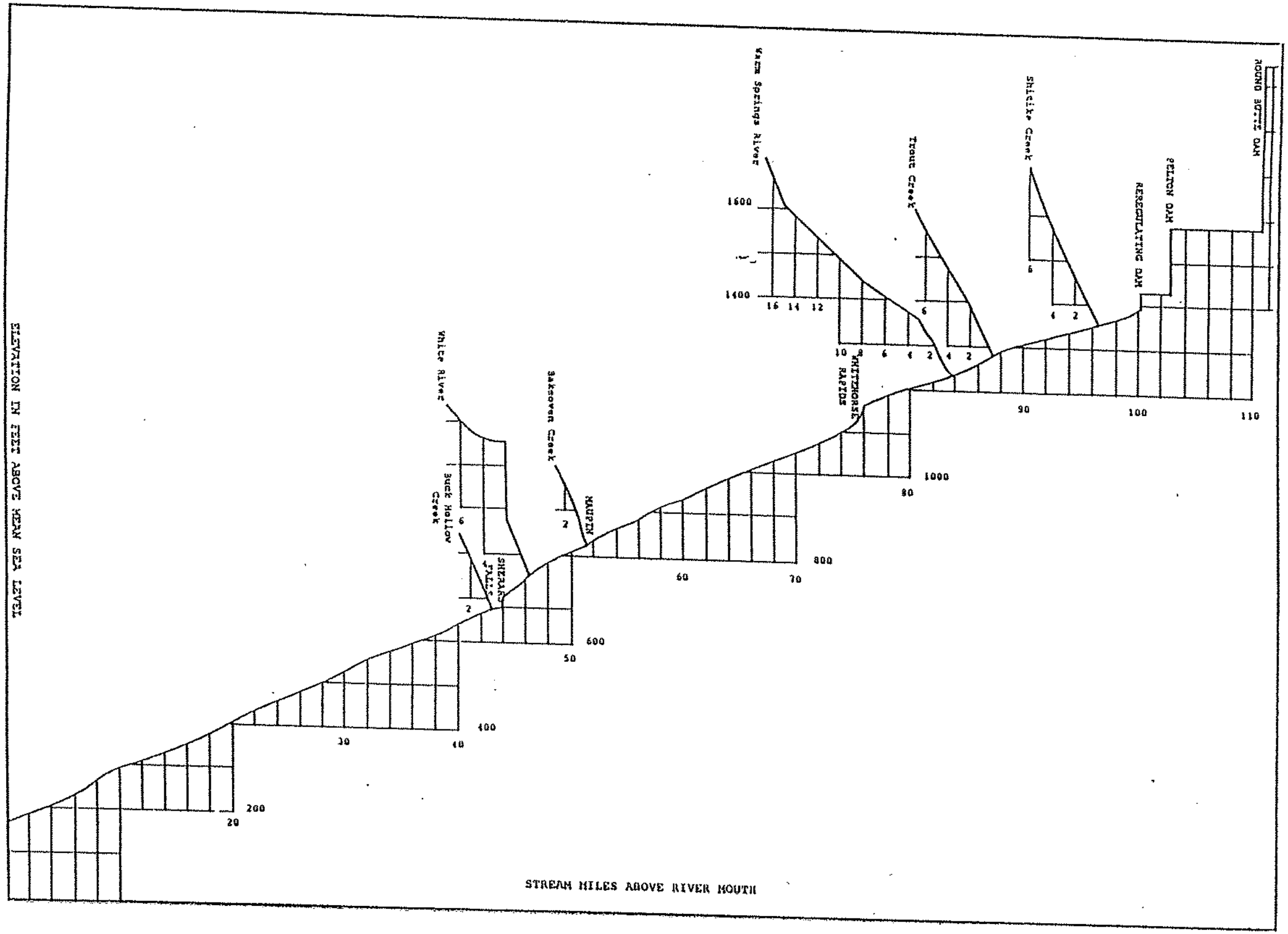

Figure 1.2. Lower Deschutes River profile, Round Butte Dam to Columbia River.

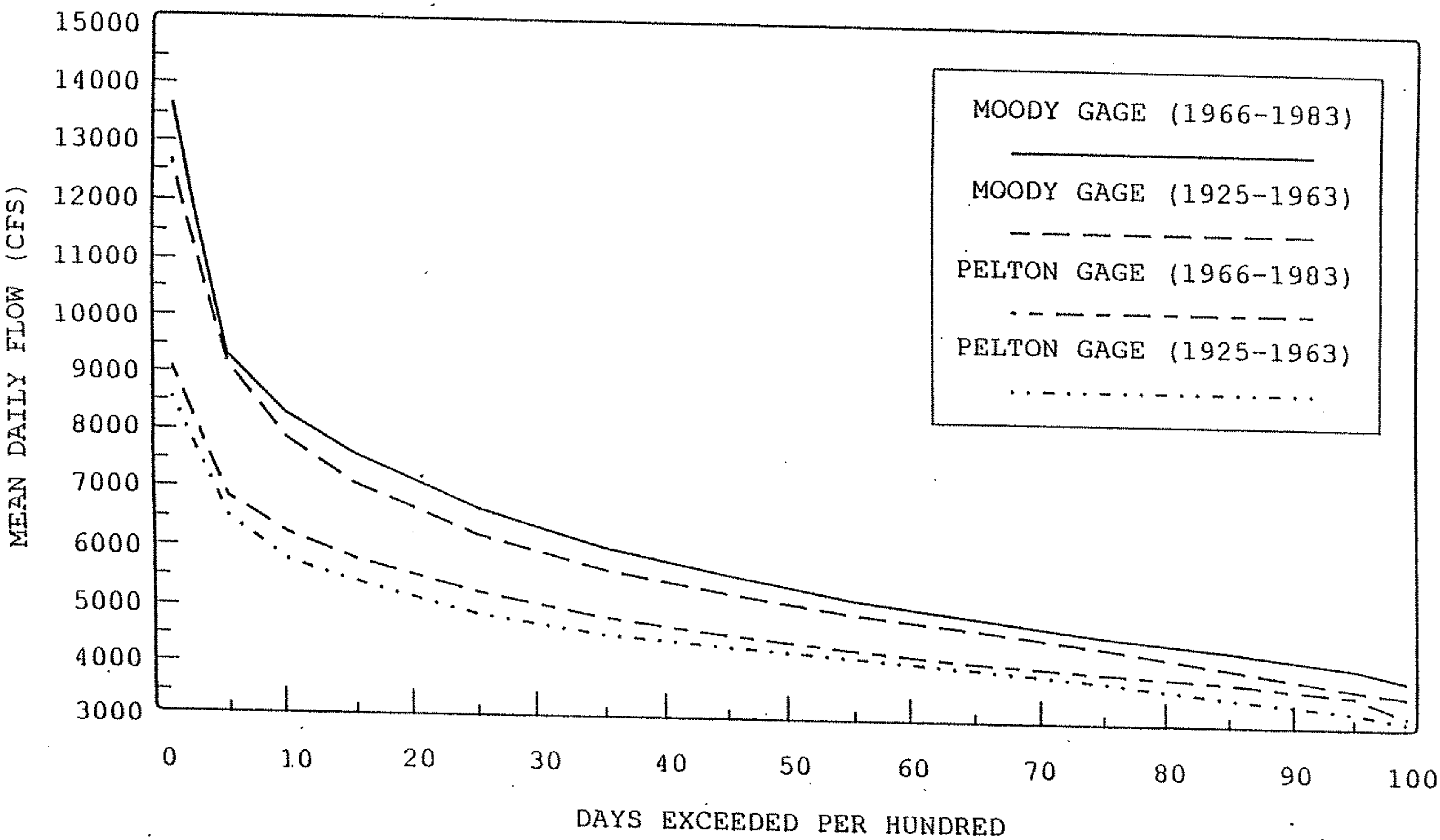

Figure 1.3. Deschutes River flow duration curves, before and after Pelton/Round Butte hydroelectric complex.

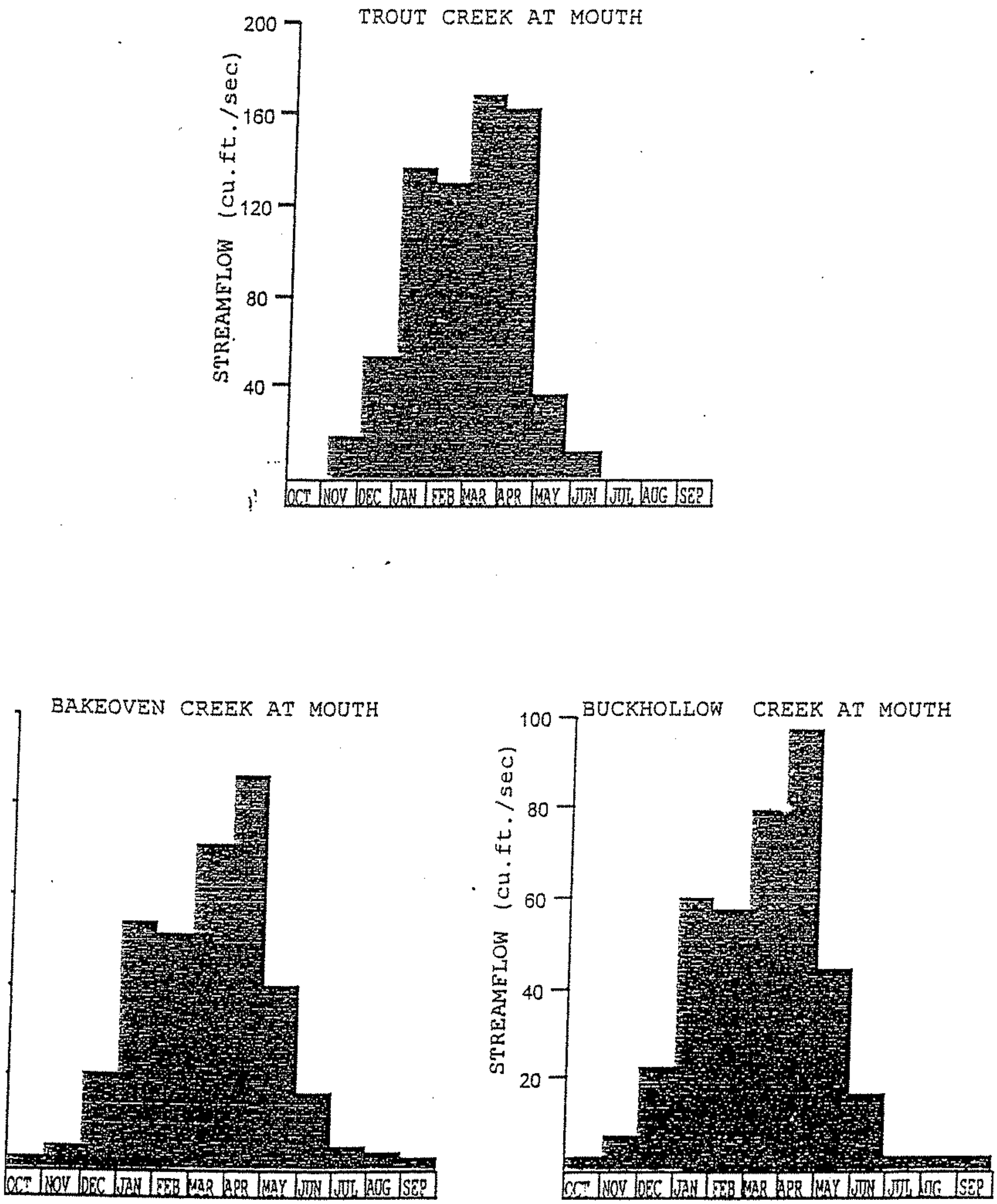

Figure 1.4. Average monthly flows in Trout, Bakeoven and Buck Hollow Creeks, lower Deschutes River subbasin.

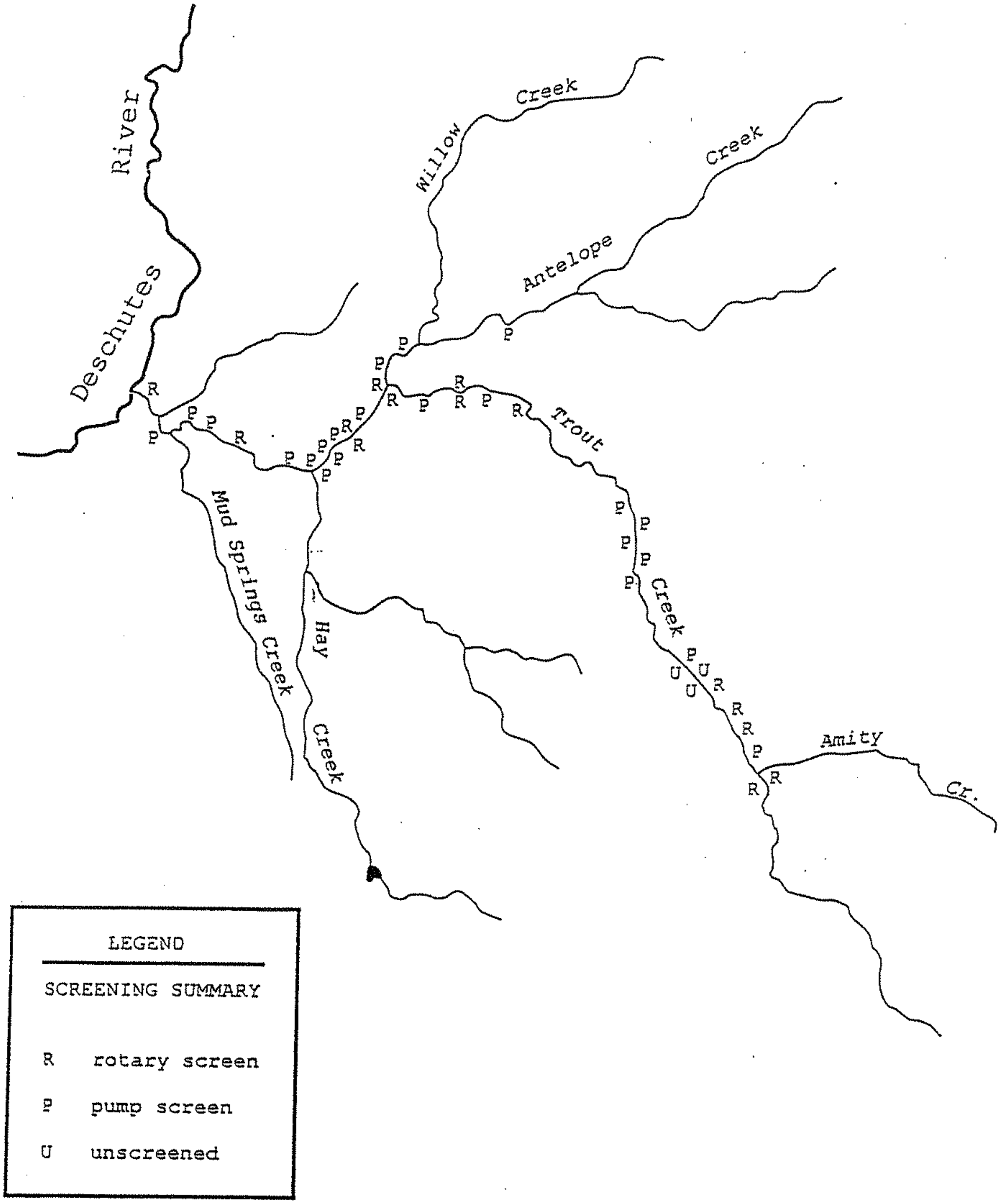

Figure 1.5. Lower Deschutes River subbasin fish screening.

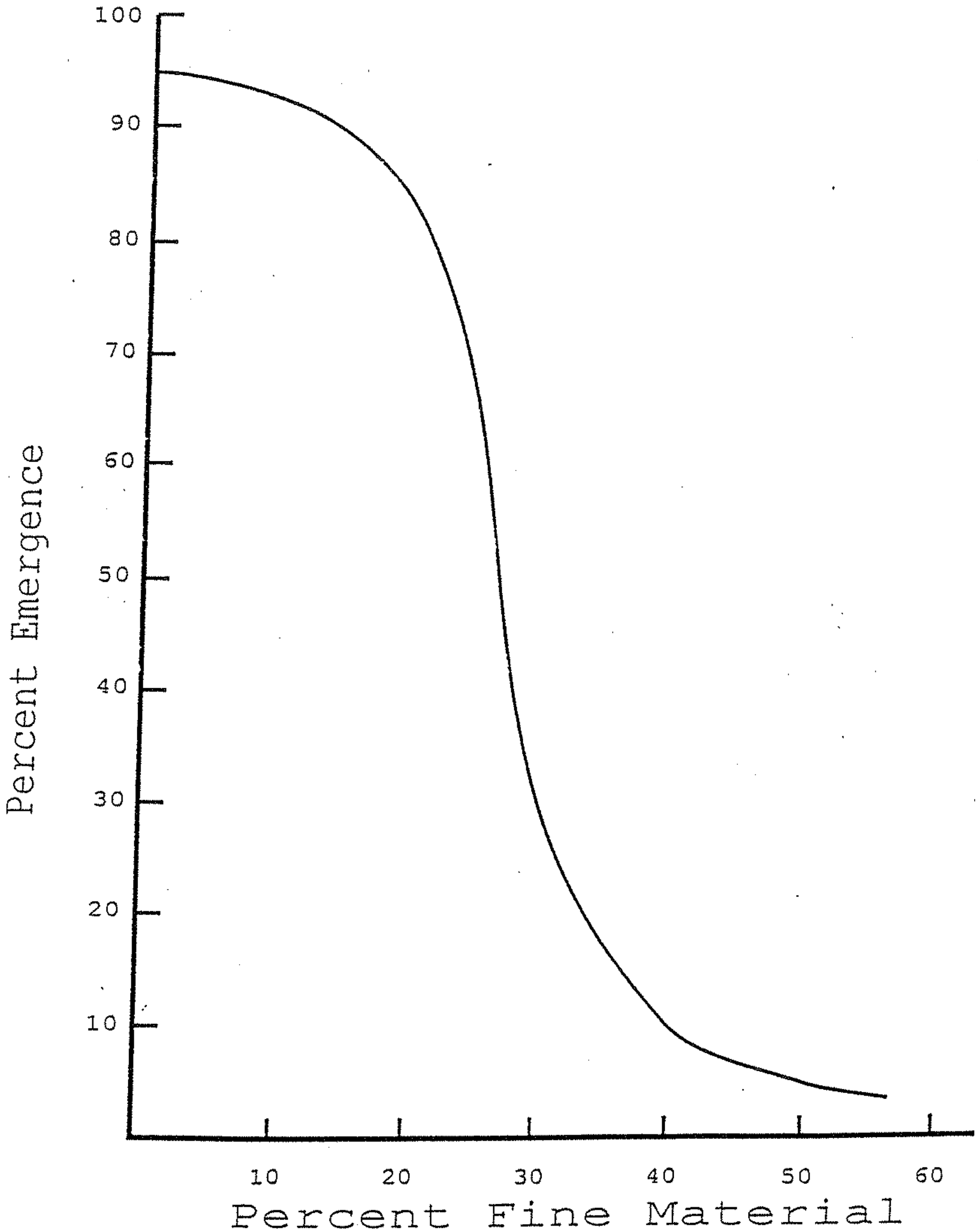

Figure 1.6. Effects of fine substrate material on emergence of fish.

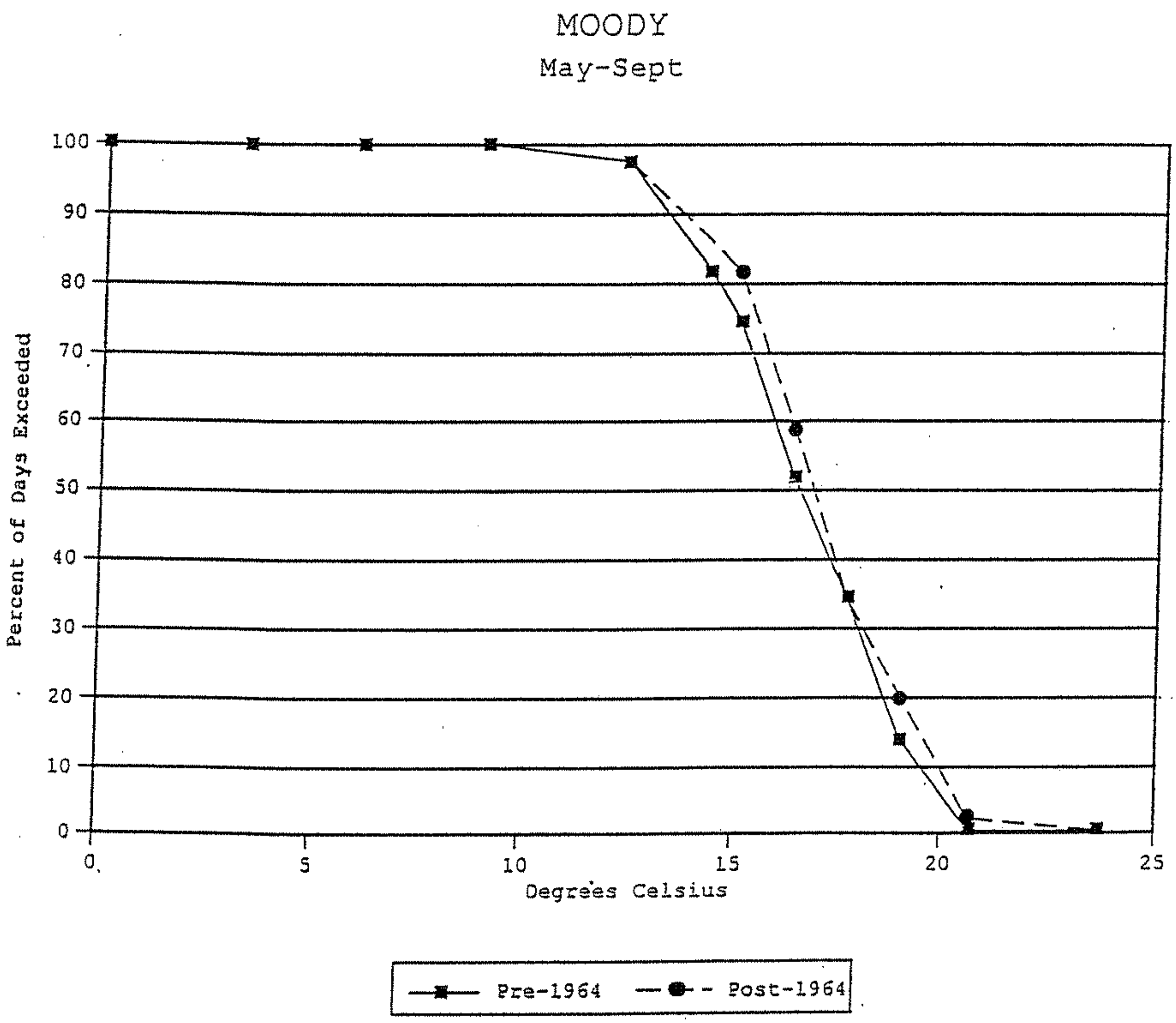

Figure 1.7. Minimum temperatures at river mile 1.4, by month. Period of record (1955-62) compared with the years 1963, 1964 and 1965, lower Deschutes River.

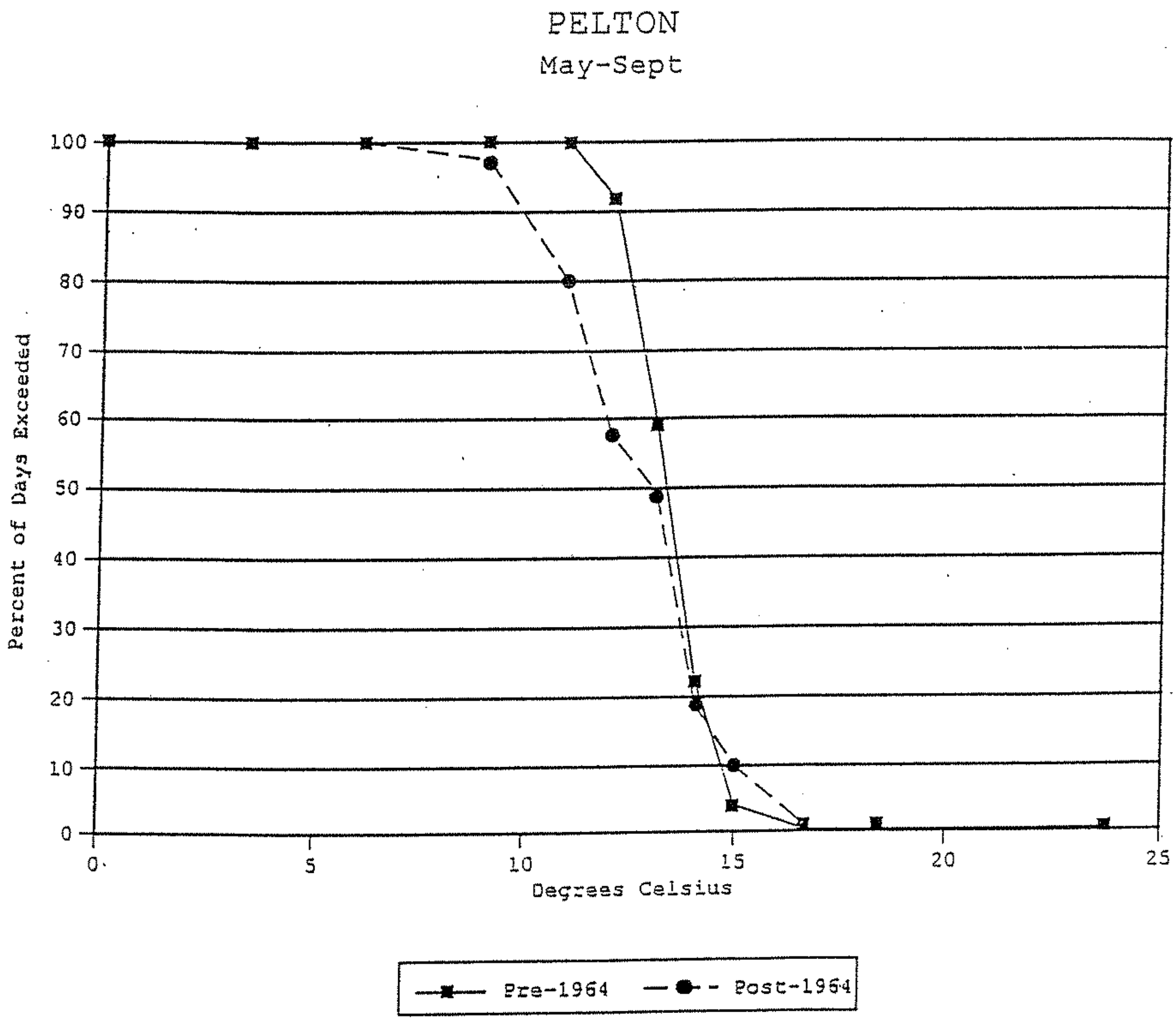

Figure 1.8. Minimum temperatures at river mile 100, by month. Period of record (1955-62) compared with the years 1963, 1964 and 1965, lower Deschutes River.

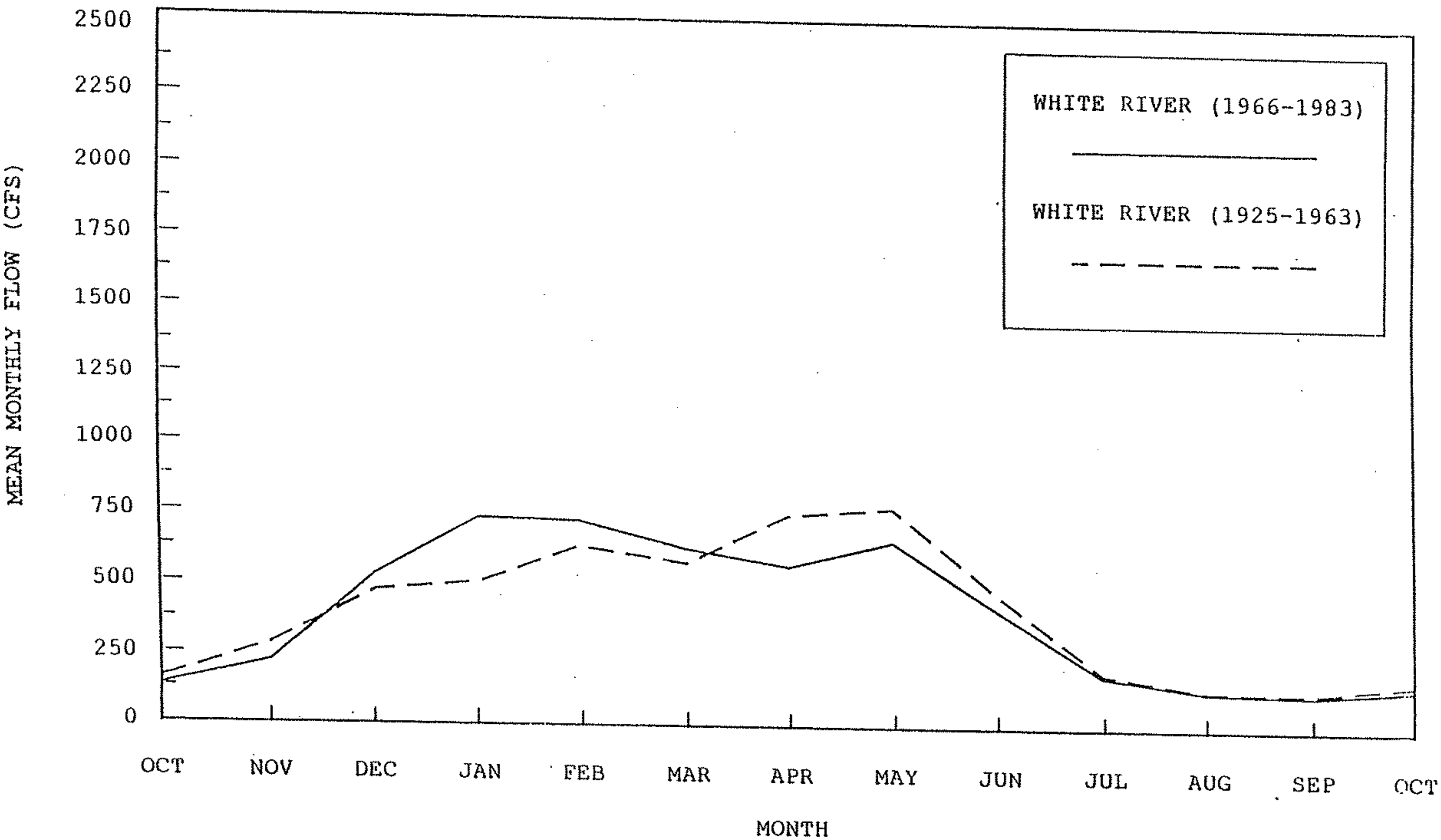

Figure 1.9. Mean monthly flows for White River, before and after logging in the basin.

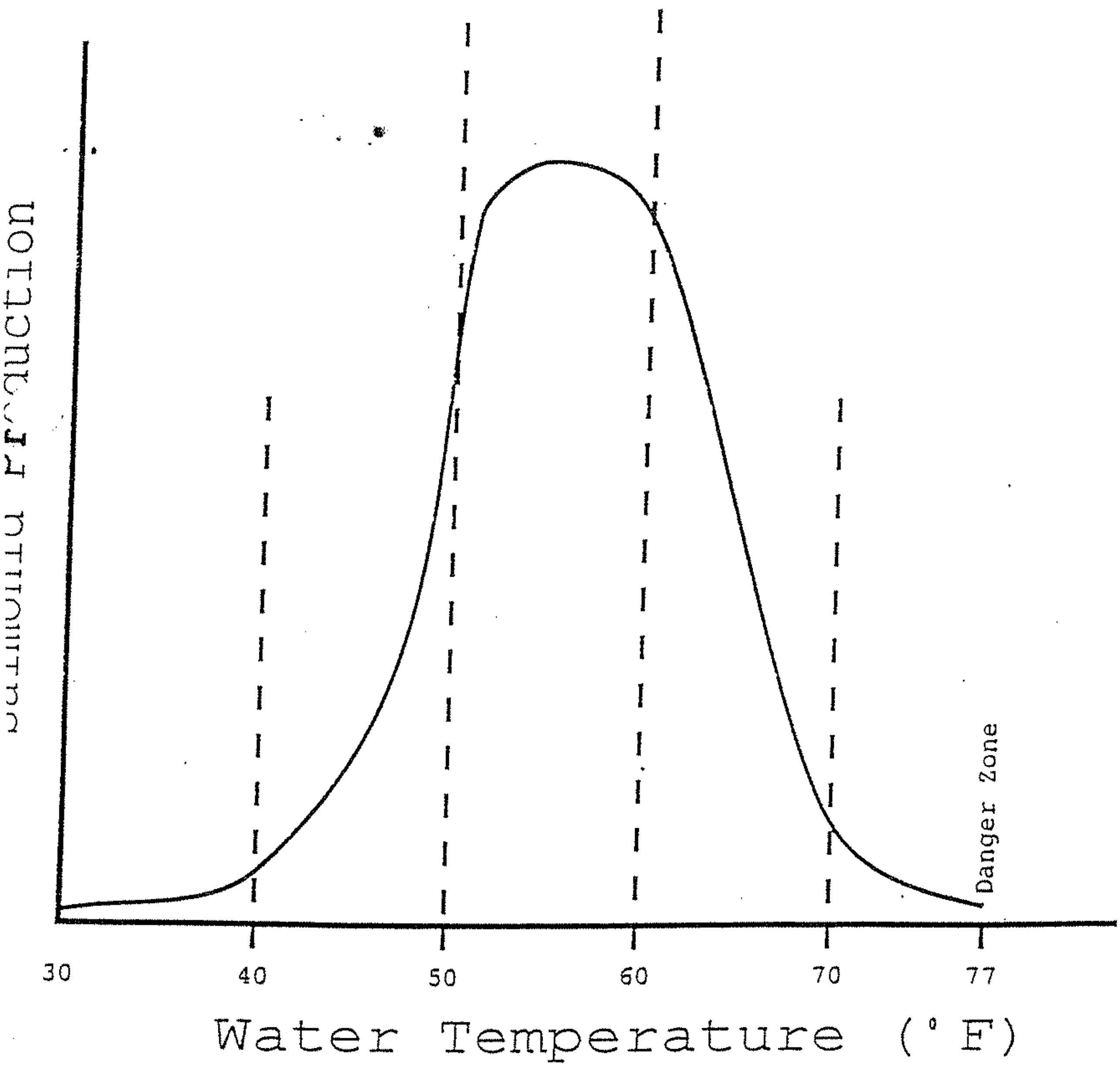

Figure 1.10. The relationship between water temperature and salmonid production.

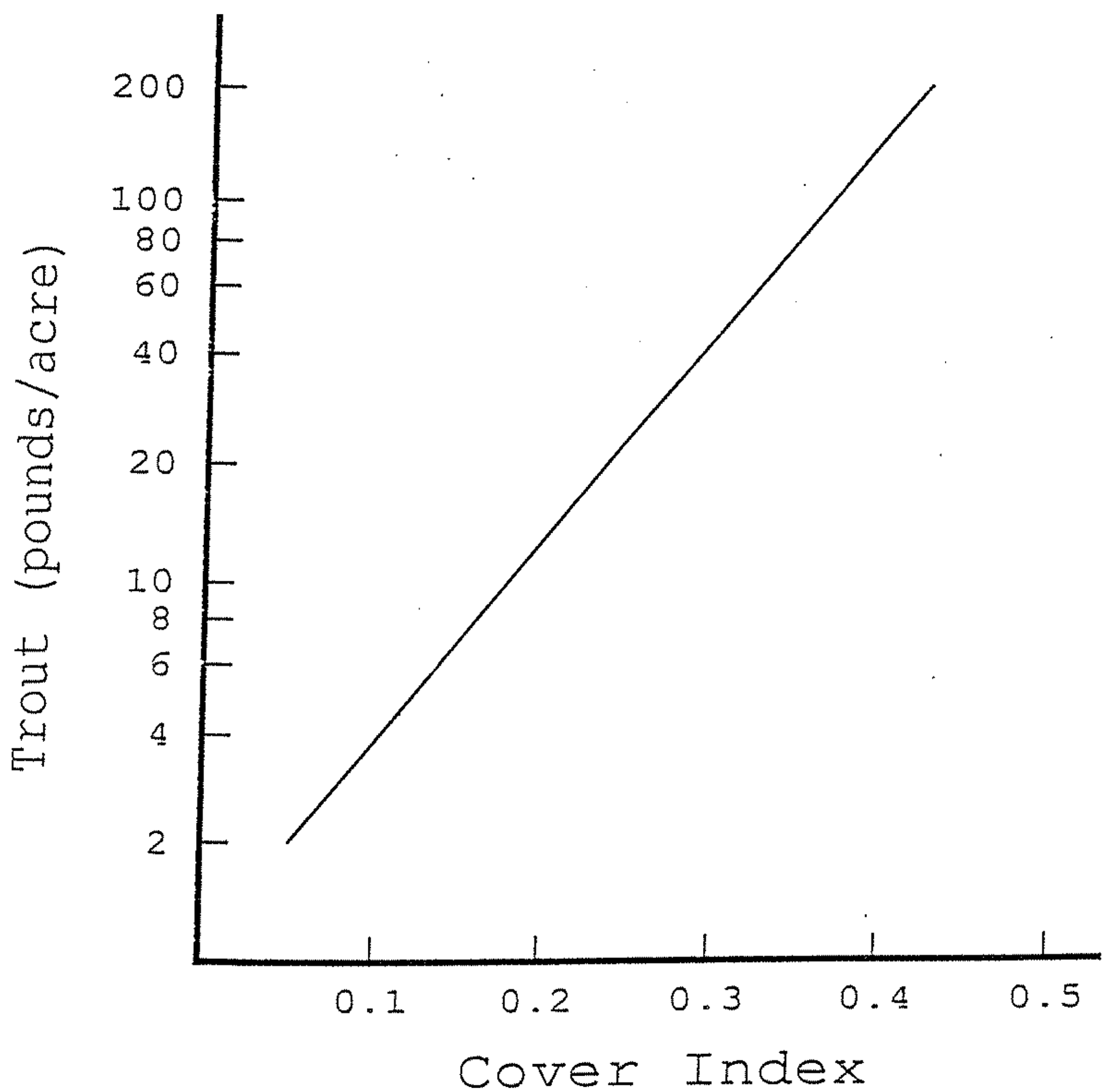

Figure 1.11. The relationship between turbidity and growth of steelhead trout fry.

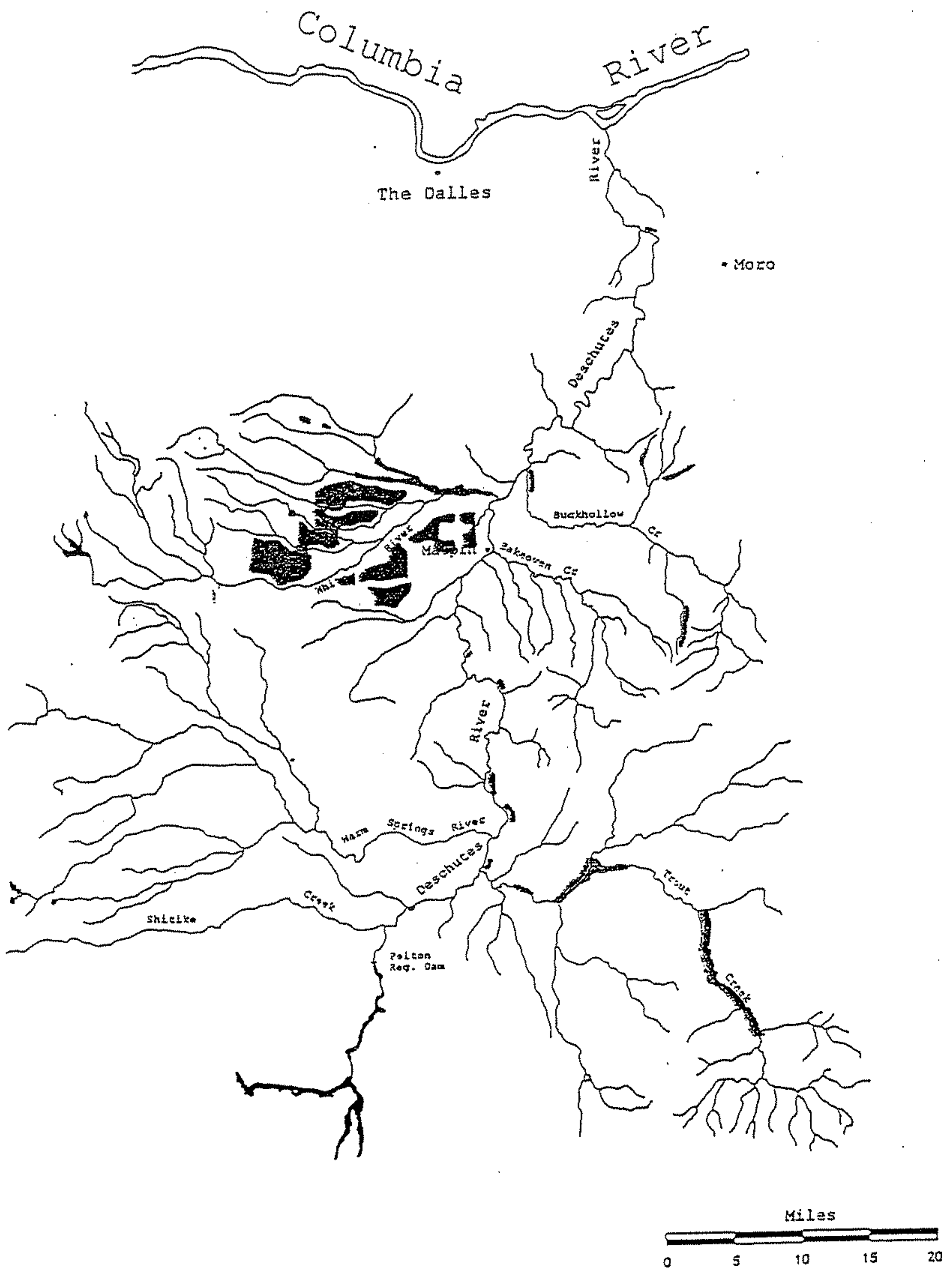

Figure 1.12. Irrigated lands in the lower Deschutes River subbasin.

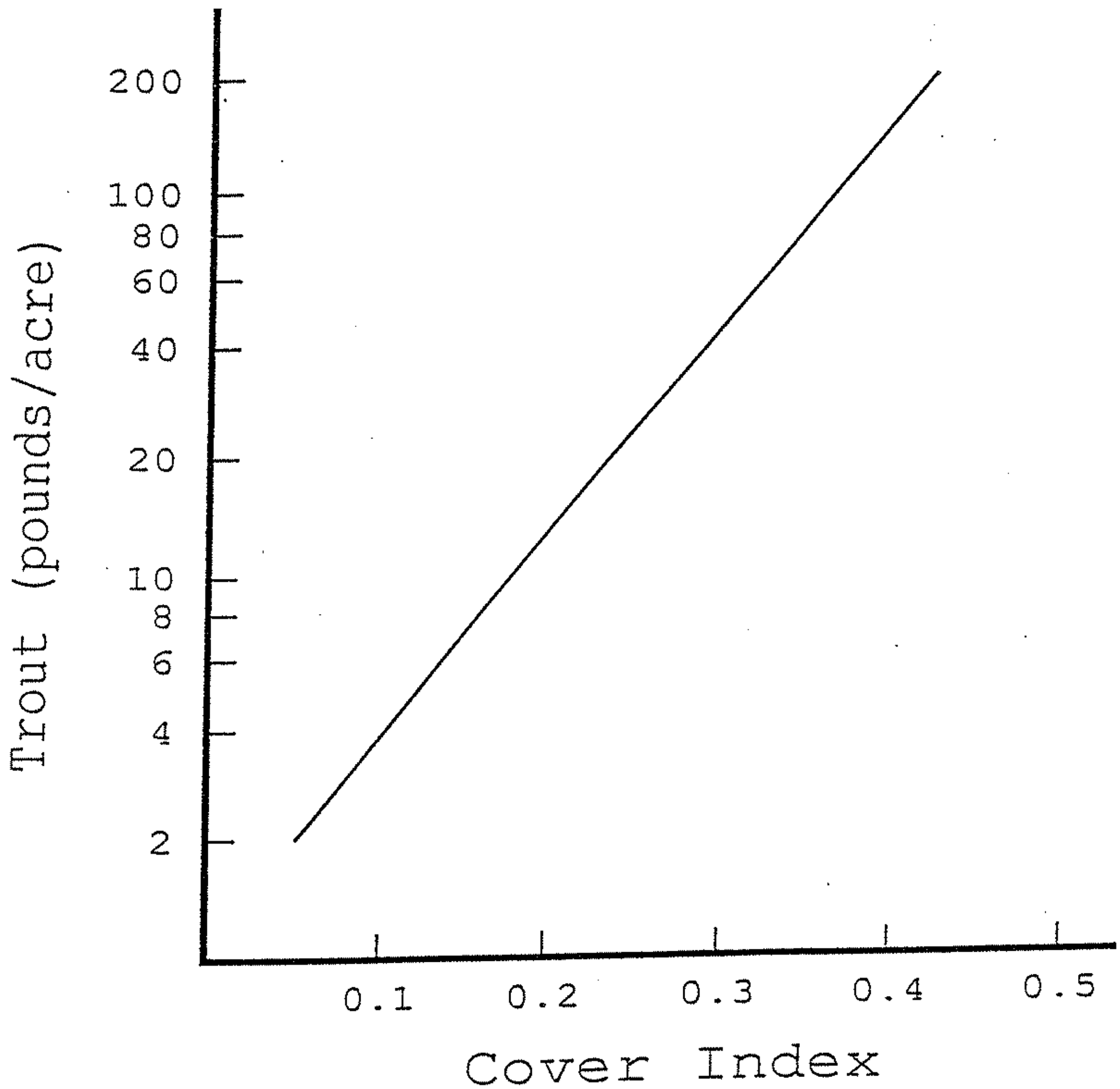

Figure 1.13. The relationship between cover and trout production

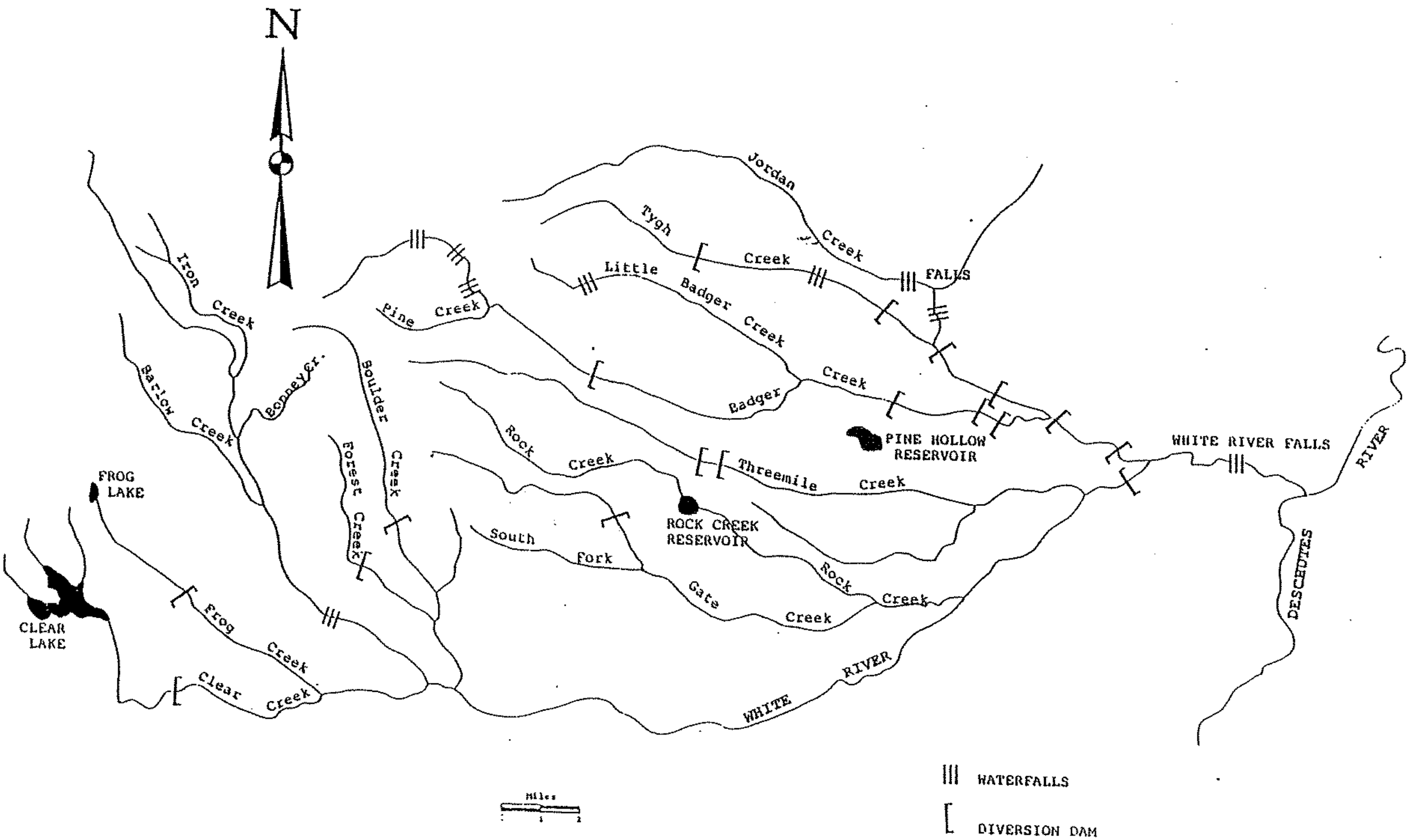

Figure 1.14. Impassable waterfalls and irrigation diversion dams on the White River.

LOWER DESCHUTES RIVER SUBBASIN FISH MANAGEMENT PLAN
SECTION 2. TROUT IN STANDING WATERS

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TROUT IN STANDING WATERS

BACKGROUND AND STATUS

This section covers management of standing waters (lakes, reservoirs, and ponds) of the lower Deschutes River subbasin. Non-indigenous stocks of cutthroat, and brook trout have been stocked in standing waters in the lower Deschutes River subbasin. Brown trout have been stocked in Lake Simtustus, formed by Pelton Dam.

Standing waters, for purposes of this plan, include all those lakes, reservoirs and ponds in the lower Deschutes River subbasin that are periodically stocked with hatchery trout. These waters were largely created by man and did not historically or presently contain indigenous trout.

For the purposes of this plan, it is assumed that current stocking policies for standing waters do not significantly impact indigenous fish, except where indigenous fish are present in the inflow or outflow streams of these standing waters. These exceptions will be noted and management concerns listed.

Standing water bodies in the lower Deschutes River subbasin have been grouped into three categories:

1. Cascade Mountain Lakes
2. High Use Lakes and Reservoirs
3. Small Ponds

Cascade mountain lakes, due to an overall similarity in fish management goals from lake to lake, are discussed as a group.

High use lakes and reservoirs, due to differences in management goals and the diversity of angling experiences they provide, are discussed separately. Specific management direction is offered for each water body in this group.

Small ponds are discussed as a group and a single management direction is offered for the group.

Most trout found in the standing water bodies in the lower Deschutes River subbasin have been introduced. Most of the Cascade Mountain lakes were thought to not contain fish until they were stocked by the Oregon Game Commission, ODFW's predecessor, or early pioneers. The Oregon Game Commission started stocking Cascade Mountain lakes in the early 1920's. There are no records of the unofficial introductions and those of the Oregon Game Commission were lost in a fire at the headquarters office in 1936. Both rainbow and brook trout were packed into the remote Cascade Mountain lakes by early settlers.

SPECIES PRESENT

The Oak Springs and Cape Cod strains of rainbow trout, *Oncorhynchus mykiss,* are stocked in most high use lakes, ponds, and in a few of the Cascade Mountain lakes. These strains are fall spawners, thought to be non-migratory, and have been domesticated for many generations. Additionally, these stocks are susceptible to mortality from a myxosporean parasite, *Ceratomyxa shasta,* found in the mainstem lower Deschutes River but not its tributaries. These factors are thought to decrease the potential for interbreeding with indigenous spring spawning redband trout in the lower Deschutes River subbasin.

Cutthroat trout, *Oncorhynchus clarki lewisi* (Girard), were obtained from the Washington Department of Game (now the Washington Department of Fish and Wildlife) from their brood source at Twin Lakes in eastern Washington. They have been stocked only in Monon Lake in the lower Deschutes River subbasin. They are not found in any other running or standing waters in the subbasin.

Brook trout, *Salvelinus fontinalis,* are found primarily in the Cascade Mountain lakes and headwater tributaries to White River.

Brown trout, *Salmo trutta,* are found in the lower Deschutes River, primarily in the area immediately downstream from the Pelton Reregulating Dam. These fish have passed through the hydro-electric complex from upstream reservoirs.

Hatchery Production

Trout angling opportunity in standing waters of the lower Deschutes River subbasin that sustain the highest fishing pressure is maintained by annual stocking of hatchery fish. A listing of species and numbers of hatchery fish stocked into subbasin waters in 1995, a representative year, is presented in Table 2.1. High use lakes are stocked with legal-sized rainbow trout or legal-sized trout and fingerling rainbow trout, depending upon the productivity and angling pressure in an individual water body. Small ponds are generally stocked with legal-sized rainbow trout each spring but may also be supplemented with fingerling rainbow trout. Cascade mountain lakes are generally stocked by helicopter with fingerling trout every other year.

Most high use lakes in the subbasin are irrigation storage reservoirs with large seasonal pool fluctuations. This fluctuating water level significantly reduces lake productivity and these lakes generally requires stocking legal-sized trout to sustain a fishery. Several lower elevation reservoirs are also stocked with fingerling rainbow trout early in the spring to provide some late season angling opportunity after most of the legal-sized trout have been harvested.

Reservoirs stocked with fingerling trout are usually stocked at a rate of at least 250 fingerling per surface acre, with the objective of achieving legal size by fall or the following spring. Legal-sized trout, averaging three fish per pound (8-12 inches), are stocked in lakes where fingerling stocking can not sustain the fishery and in lakes where an immediate legal-sized trout is desired.

Cascade Mountain lakes capable of maintaining populations of legal-sized trout were stocked annually by airplane starting in 1960. These lakes are located primarily in roadless or wilderness areas. Since the 1980's, these lakes have generally been stocked by helicopter every other year. These lakes are stocked with at least 100 fingerlings per surface acre.

Lakes with road access and heavy angling pressure are stocked annually. Both fingerling and legal-sized trout have been stocked in Rock Creek and Pine Hollow reservoirs since 1990. Clear, Olallie, Frog and Badger lakes are stocked with legal-sized rainbow trout. Stocking rates are adjusted as data is gathered on growth, survival, and catch rate.

Oak Springs and Cape Cod strains of rainbow trout are used as the legal-sized hatchery product in lower Deschutes River subbasin standing waters. These exotic stocks are believed to contribute minimally to natural production because of suspected low survival in the wild, the differences between these fall spawners and the indigenous spring spawning rainbow trout, and their susceptibility to *C. shasta* infection and mortality. These hatchery stocks are also thought to migrate little from the point of stocking, compared to other rainbow trout hatchery stocks, limiting interactions with indigenous populations in inflow and outflow streams.

Management Concerns

Populations of genetically unique rainbow trout are found in the White River system (Current et al. 1990). These fish exhibit genetic and morphological characteristics similar to redband trout found in the Fort Rock Basin of south Central Oregon. Steps have been taken to insure that hatchery rainbow trout do not interbreed with these populations.

Hatchery trout stocked into lakes, reservoirs, and ponds of the subbasin may escape upstream or downstream and hybridize with the indigenous rainbow trout present in the flowing waters of the subbasin. Wherever a reservoir, lake, or pond is fed by or drains into a stream with indigenous rainbow trout, compliance with the Oregon's Wild Fish Management Policy is needed. For a hatchery program of this type, Oregon's Wild Fish Policy and associated guidelines specify that no more than 5% of the spawning population can be of hatchery origin. If the population is out of compliance, measures such as outlet screening, reduced stocking, or increased harvest of the hatchery fish need to be implemented to assure indigenous fish populations are not impacted by fish stocking practices.

Migration of brook trout from Cascade Mountain lakes into flowing waters of the lower Deschutes River subbasin is of particular concern. Brook trout are known to hybridize with bull trout resulting in a sterile hybrid and serious damage to indigenous bull trout populations.

CRITICAL UNCERTAINTIES

Brook Trout

1. Do ongoing stocking program affect the abundance and distribution of indigenous fish species in the streams below the standing water bodies?
2. Do ongoing stocking program pose a genetic threat to the sensitive bull trout populations in the Warm Springs River or the lower Deschutes River?

Rainbow Trout

1. Are hatchery rainbow trout leaving the standing waters of the subbasin and, if so, what are the impacts on indigenous species?
2. Are fall spawning hatchery rainbow trout stocks reverting to spring spawners after stocking?
3. Are hatchery rainbow trout escaping from standing waters in the White River system and entering areas with genetically unique rainbow trout?

Cutthroat Trout

1. Are West Slope cutthroat trout stocked in Monon Lake isolated from other waters?

Brown Trout

1. At what rate are brown trout entering the lower Deschutes River from upstream reservoirs?
2. Are brown trout adversely affecting indigenous fish in the lower Deschutes River?

CASCADE MOUNTAIN LAKES

Background and Status

Twelve Cascade Mountain lakes in the lower Deschutes River subbasin are managed for recreational angling utilizing hatchery fish. These lakes are located east of the summit of the Cascades from Mt. Jefferson north to Jean Lake, approximately 25 miles south of Hood River, Oregon (Figures 2.1 and 2.2). All twelve lakes are located on the U.S. Forest Service (USFS) Mount Hood National Forest and are managed under its Land and Resource Management Plan (USDA 1990).

Most of these lakes were historically barren of fish, likely because they are located in geologically young areas and have not been connected with other water bodies or they were isolated by natural fish barriers. In cooperation with the USFS, ODFW has stocked a variety of trout species in these waters since the 1920's.

In addition to these 12 lakes, 7 lakes located on lands managed by the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) are stocked by ODFW with hatchery trout in cooperation with the CTWS. These lakes were historically located in the McQuinn Strip within the USFS Mount Hood National Forest. The McQuinn is an area bordering the CTWS reservation that was omitted from the original reservation due to a survey error. The McQuinn Strip was transferred from the USFS to the CTWS in 1992. ODFW continues to stock trout in these lakes since the CTWS continues to allow public access and angling there.

Because there are no indigenous fish in these lakes, application of Oregon's Wild Fish Management Policy (OAR 635-07-501 to 529) for these lakes is much more limited.

Habitat

Stocked fingerling trout rely on the natural productivity of a Cascade Mountain lake to reach legal-size in one or two years. Consequently, the success of the stocking program is contingent upon maintaining the productivity of these waters. Natural factors limit the productivity of fish populations in these lakes. Habitat deficiencies may include a lack of cover, winter kill associated with long periods of ice cover and shallow water depth, and the lack of abundant food sources (Appendix A, Figures 2.3 through 2.22).

Management of lands and resources bordering the Cascade Mountain lakes addressed here is described in the USFS Mount Hood National Forest Land and Resource Management Plan (USDA 1990), or land management plans implemented by the CTWS.

USFS management of federally designated wilderness, unique scenic area, old growth lands, or unroaded recreation lands (where all twelve lakes not on CTWS lands are located) is generally compatible with ODFW management guidelines for primitive or semi-primitive fisheries. These lands do not have programmed timber harvest but may allow other activities associated with mineral development, range, forest health, and fire management that potentially affect the natural productivity of these lakes (USDA 1990).

Fisheries and Fish Management

Cascade Mountain lakes were first stocked by USFS and Oregon Game Commission personnel utilizing packhorses. From the early 1950's through the early 1980's, stocking was done by fixed-wing aircraft. Since termination of stocking with the fixed-wing aircraft, stocking has been done annually or biennially with helicopter or backpacks.

Prior to stocking, limnological information was gathered at each lake to determine if it would support fish life. One or more species of trout were stocked if the lake appeared to be suitable. Fish stocked in the past included several races of rainbow trout and brook trout. Presently fish stocking decisions are guided by periodic lake surveys, harvest surveys, historical records, and anecdotal information from anglers. ODFW has determined that eighteen of the twenty four lakes covered in this plan are capable of sustaining trout throughout the year (Table 2.2). The Cascade Mountain lakes covered by this plan that are not stocked with fish generally have water quality problems associated with water depth. These lakes have been found to experience winter kill at a higher frequency than the lakes that are stocked.

ODFW currently stocks brook trout (original brood unknown, possibly from New Jersey), coastal rainbow trout (referred to as Cape Cod stock, originally from McCloud River, California), Deschutes River rainbow trout (original brood from the lower Deschutes River), and West Slope cutthroat trout (Twin Lakes, Washington stock) in Cascade Mountain lakes covered by this plan. Brook trout and Cape Cod rainbow trout are fall spawners, while Deschutes River rainbow trout and Twin Lakes cutthroat trout are spring spawners. Inventories have generally shown little natural reproduction in the Cascade Mountain lakes, although brook trout have successfully spawned in some lakes. There are no known populations of indigenous fish in any of these lakes.

ODFW currently manages Cascade Mountain lakes under the Basic Yield Management Alternative (OAR 635-500-115(4)) or the Features Species and Waters Alternative (OAR 635-500-115(2)) for trout. Fisheries under these alternative are generally consumptive in nature and production is based on fingerling stocking and the lake's natural rearing capability. One objective of the Cascade Mountain lakes program is to provide angling diversity in Oregon. This diversity may be measured in difficulty of access, the overall setting, or the uniqueness or combination of species available at each lake.

ODFW has found that brook, rainbow and cutthroat trout are best suited to provide a legal-sized fish within one or two years and meet management intent. Lakes have been stocked on an annual basis in the past but, due to current budgetary limitations, aerial stocking is generally conducted biennially.

The stocking rate for each lake depends on size, depth, productivity, angler catch rate, survey information, and past experience. The target size for fish at stocking is approximately 150 to 200 fish per pound. This small size makes aerial stocking easier due to space and weight limitations for the aircraft. Survival and catch rates vary annually for individual lakes and from lake to lake and the numbers of fish stocked are adjusted accordingly.

There is no conclusive data to confirm movements of hatchery fish out of Cascade Mountain lakes covered in this plan, but this potential risk to downstream indigenous fish populations affects management alternatives. Information on each lake's outlet and inlet has been compiled from periodic lake surveys (initiated as early as 1932), from maps, and from field observations of ODFW field personnel (Table 2.3). Lakes discussed in this plan have outlets that are ephemeral and usually only flow during periods of high precipitation or spring snow melt. Lake outlet status is important because Oregon's Wild Fish Management Policy (OAR 635-07-501 to 529) and associated guidelines directs ODFW to not introduce non-indigenous fish into locations where impacts to indigenous populations might occur from hybridization, competition, disease introduction, or predation. Brook trout interbreeding with indigenous bull trout is an example one such concern. Dambacher et al. (1992) found negative interactions between introduced brook trout and indigenous bull trout in Sun Creek (Crater Lake National Park). Interbreeding between brook trout and bull trout in Sun Creek resulted in sterile offspring and eventually diminished numbers of bull trout.

In recent years there has been a growing concern about the potential impacts of fish stocking on native lake ecosystems. Herpetologists are concerned that stocking fish into lakes may disrupt amphibian populations. Blaustein et al. (1993) found mortality in western toad, *Bufo boreas,* eggs from the fungus *Saprolegnia ferax* in three Central Oregon Cascade Mountain lakes. While *Saprolegnia sp.* occurs naturally in these lakes, it is also a common pathogen of hatchery fish. Although *Saprolegnia sp.* appears to be an acute cause of mortality in *B. boreas* eggs, research suggests that their susceptibility may be exacerbated by increased levels of ultraviolet-B radiation measured at these lakes (Blaustein et al. 1994). It is unknown at this time if stocking hatchery fish, changes in the earth's ozone layer, or both are contributing to losses of amphibian.

Liss et al. (1991) found that introduced fish populations in Washington Cascade Mountain lakes 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 candidate species for protection under the federal Endangered Species Act and ODFW lists it as a Vulnerable species on the Oregon Sensitive Species List (OAR 635-100-040). The spotted frog, *Rana pretiosa,* also occurs in this region and is listed as a Critical species on the Oregon Sensitive Species List. It is difficult to assess impacts of fish stocking on historic and current distribution and abundance of these amphibians since baseline data on amphibians is not available. Hopefully, further research and additional inventories of native amphibians will assist in answering these questions.

The issues discussed above suggest a need for ODFW to examine the stocking program for the Cascade Mountain lakes with regard to potential ecological impacts to natural ecosystems. ODFW is committed to the conservation of endemic ecosystems and will work with the USFS to identify lakes appropriate for fish introduction. In 1985, through its representative the International Association of Fish and Game Agencies, ODFW signed a Memorandum of Understanding with the USFS stating that recreation management, including fish stocking, in wilderness areas of Oregon would be addressed cooperatively through the development of Wilderness Management Plans. To date, the format and protocol for addressing these issues in Wilderness Management Plans has yet to be developed. The Lower Deschutes River Subbasin Fish Management Plan, this document, will provide interim management direction until new fish stocking policies for these lakes are developed jointly with USFS and the CTWS.

Overall recreational pressure at some Cascade Mountain lakes may be approaching or exceeding acceptable limits. Angling is one activity that may be contributing to this heavy use. Other factors such as distances to the trailhead, ease of terrain, distance to neighboring lakes, or outstanding scenic values also effect levels of use. It may be possible to redistribute some angler use through reduction or discontinuation of fish stocking, removal of trail access, or other management actions. However, these issues will be resolved in the Wilderness Management Plan process.

Since the 1960's, ODFW has had a commitment to not stock any additional Cascade Mountains lakes covered by this plan. An additional six lakes in this region of the Cascade Mountains are not stocked (Table 2.2). These lakes range in size from two to five acres.

Currently Cascade Mountain lakes east of the Cascade crest are open for angling from late April to the end of October (general Oregon trout season) with a ten fish daily bag limit, and a six inch minimum length. Non-motorized boats are allowed.

Access

Most of the Cascade Mountain lakes covered by this plan are located within roadless or wilderness areas and can only be reached by non-motorized, non-wheeled means. Early season access is generally limited because of persistent snow on road and trails.

Management Direction

Objectives and actions contained in the adopted alternative will be used to set district work plans that form the basis for monitoring and evaluation programs. Completion of actions listed under an objective contribute to the meeting of that objective. Many actions cannot be accomplished under current levels of funding. If funding continues to be limited, ODFW will pursue completion of actions according to priorities as funds become available.

Policies

Policy 1. *Cascade Mountain lakes addressed in the lower Deschutes River Subbasin Fish Management Plan will be managed for natural and hatchery production consistent with the Basic Yield (OAR 635-500-115(4)) or Featured Species (OAR 635-500-115(2)) management alternative for trout.*

Policy 2. *Hatchery rainbow, cutthroat and/or brook trout will be periodically stocked into the suitable Cascade Mountain lakes addressed in this plan.*

Objective 1. Provide diverse angling opportunities for trout in the Cascade Mountain lakes in the lower Deschutes River subbasin.

Assumptions and Rationale

1. Since suitable spawning habitat is lacking in most of these lakes, periodic stocking with brook, rainbow, or cutthroat trout must conducted to maintain a recreational fishery.
2. There is considerable public interest in retaining diverse angling opportunities.
3. Angling opportunities in CTWS lakes within the McQuinn Strip is determined by the CTWS.
4. Diversity may be measured in terms of difficulty of access, overall setting, or the trout species or combination of species available at each lake.

5. Continued angling opportunities in lakes on the Mount Hood National Forest depends on the USFS adherence to the Land and Resource Management Plan.
6. The CTWS manage their fisheries consistent with conservation. The CTWS are co-managers in meeting subbasin management plan objectives and will be involved in fish management activities in the lower Deschutes River subbasin at all levels. All action items pertaining to CTWS interests will be conducted in cooperation with them as co-managers.

Actions

Action 1.1. Periodically stock lakes located on the Mt. Hood National Forest with hatchery rainbow, brook, and/or cutthroat trout.

Action 1.2. Work with the CTWS to keep lakes within the McQuinn Strip area managed by CTWS open for public access and angling.

Action 1.3. In cooperation with the CTWS, periodically stock lakes open for public access within the McQuinn Strip.

Action 1.4. Periodically inventory trout populations for size, growth, condition factor, and species composition.

Action 1.5. Periodically monitor angler effort and catch.

Action 1.6. Continue to adjust the lake stocking program to correspond with lake productivity and angler use.

Action 1.7. Continue to work with the USFS and CTWS to maintain the productivity of these lakes through good management of the surrounding upland habitat.

Action 1.8. Work with Washington Department of Fish and Wildlife to insure a reliable source of Twin Lakes cutthroat for stocking Cascade Mountain lakes.

Objective 2. Minimize the impacts of hatchery trout on the production and genetic integrity of adjacent populations of indigenous trout.

Assumptions and Rationale

1. Some high lakes may have outlets that may allow hatchery fish access to the lower Deschutes, Clackamas, or North Santiam rivers, all of which contain indigenous fish populations.
2. Where Cascade Mountain lakes have connections to waters containing indigenous trout, maximizing harvest, changing species stocked, or eliminating stocking could reduce potential impacts on the indigenous populations.
3. The Cape Cod stock of hatchery rainbow trout used for stocking spawns in the fall and is thought to make up less than 5% of the spawning population where they are used.
4. Updated information on the status of individual lake outlets is needed.
5. The CTWS manage their fisheries consistent with conservation. The CTWS are co-managers in meeting subbasin management plan objectives and will be involved in fish management activities in the lower Deschutes River subbasin at all levels. All action items pertaining to CTWS interests will be conducted in cooperation with them as co-managers.

Actions

Action 2.1. Survey tributaries of the Cascade Mountain lakes covered in this plan to determine if indigenous trout populations are present and if hatchery trout stocked in the lakes are impacting indigenous populations.

Action 2.2. Continue to use hatchery stocks that demonstrate a minimum of migratory behavior or are unable to spawn with indigenous fish populations due to differences in spawning timing.

Action 2.3. Continue to use a fall spawning stock in lakes where hatchery rainbow trout are stocked. Continue releases unless it is determined the Oregon's Wild Fish Management Policy and associated guidelines are not being met.

Action 2.4. Determine if Oregon's Wild Fish Management Policy and associated guidelines are being met. Modify hatchery fish releases accordingly.

Action 2.5. Determine outlet condition of those lakes listed in Table 2.2 with unknown status.

Action 2.6. Do not stock brook trout into lakes which have outlets into drainages containing bull trout.

Objective 3. Manage Cascade Mountain lake fisheries consistent with management plans developed jointly with the USFS and the CTWS.

Assumptions and Rationale

1. Recent research suggests that introduced hatchery fish negatively impact native amphibian, macro-invertebrate, and plankton populations in high elevation lakes. It is unknown if these actions are causing a serious depletion in the abundance or distribution of amphibians and macro-invertebrate populations in these lakes.
2. Some effects of introduced hatchery fish on Cascade Mountain lake ecosystems may be irreversible.
3. Anglers attracted to the opportunity created by hatchery stocking may be contributing to habitat damage at some Cascade Mountain lakes.
4. The CTWS manage their fisheries consistent with conservation. The CTWS are co-managers in meeting subbasin management plan objectives and will be involved in fish management activities in the lower Deschutes River subbasin at all levels. All action items pertaining to CTWS interests will be conducted in cooperation with them as co-managers.

Actions

Action 3.1. Work with USFS and CTWS to determine if stocking fish in the Cascade Mountain lakes has negatively affected the ecosystem.

Action 3.2. Work with the appropriate land management agency to determine the cause and extent of habitat deterioration around these lakes. Manage the fishery to minimize the problem if the attraction of people to the fishery is the source of the damage.

Action 3.3. Cooperate with the USFS and CTWS to identify lakes that have intrinsic values that may preclude fish stocking and evaluate whether stocking should continue.

Action 3.4. Identify aquatic habitat enhancement opportunities with the CTWS and USFS and then develop enhancement plans for project implementation.

SMALL PONDS

This group of standing waters includes man made or natural small ponds with public access in the lower Deschutes River subbasin that are stocked periodically with rainbow trout or support warmwater gamefish (Table 2.4). Small ponds discussed in this section of the plan are generally located on the USFS Mount Hood National Forest or the White River Wildlife area and generally have good road access. Bibby Pond is located on private property with a public access agreement with the landowner. These ponds did not historically contain indigenous trout and fish management in these is not affected by Oregon's Wild Fish Management Policy.

Small ponds discussed in this plan are:

Baker Pond

Located on the northern boundary of the White River Wildlife Area, approximately three miles west of Friend, Oregon (Appendix A, Figure 2.23). This pond is filled with spring runoff and a small spring. The pond is stocked with fingerling rainbow trout and supports a population of brown bullhead catfish.

Bibby Pond

This 13.5 acre pond is located five miles west of Kent (Appendix A, Figure 2.24) relies on spring runoff for filling. Bibby Pond was chemically treated in 1990 to eliminate an unauthorized introduction of brown bullhead catfish (Table 2.5). The pond is stocked annually with legal-size rainbow trout.

Cody Ponds

This group of four small ponds is located on the White River Wildlife area immediately east of Rock Creek Reservoir (Appendix A, Figure 2.25). The water level in these ponds is dependent on irrigation water. These ponds contain largemouth bass and bluegill.

Happy Ridge Ponds

This group of five small ponds is located on the White River Wildlife Area and the Mount Hood Forest on the ridge between Badger and Tygh creeks (Appendix A, Figure 2.26). These ponds are filled with surface runoff or irrigation water. They have previously been stocked with largemouth bass and bluegills.

Smock Prairie Ponds

Nine acre Smock Prairie Reservoir and one acre Smock Prairie Pond are located within the White River Wildlife area four miles north of Pine Grove (Appendix A, Figure 2.27). Water level in both ponds is dependent on irrigation water. Smock Prairie Reservoir is stocked annually with legal and fingerling rainbow trout. Smock Prairie Pond has previously been stocked with largemouth bass and bluegill.

Legal-sized rainbow trout are stocked in Smock Prairie Reservoir and Bibby Pond to support a fishery in the spring and early summer. Smock Prairie Reservoir and Baker Pond are stocked with fingerling rainbow trout, which grow during the summer to provide legal-sized trout for fall harvest. Warmwater gamefish present in Cody Ponds, Happy Ridge Ponds, and Smock Prairie Pond were stocked after the initial construction of a pond or after the loss of the former fish population. Natural production makes it unnecessary to stock these ponds with warmwater fish on a put and take basis.

There are concerns about the possibility of fish escaping from public and private ponds and impacting indigenous trout populations in the streams that feed or drain these ponds. Ponds stocked with rainbow trout need to be evaluated to ensure that they will not escape into flowing waters of the White River system and negatively impact genetically unique indigenous rainbow trout populations. Although ODFW requires private ponds to be screened to prevent fish from leaving the pond, it is impossible to enforce the situation without a site visit to each pond requesting a fish transportation permit. Therefore, ODFW will only allow hatchery rainbow trout and certain warmwater species, both from an approved source, for stocking in private ponds of the lower Deschutes River subbasin.

Management Direction

Objectives and actions contained in the adopted alternative will be used to set district work plans that form the basis for monitoring and evaluation programs. Completion of actions listed under an objective contribute to the meeting of that objective. Many actions cannot be accomplished under current levels of funding. If funding continues to be limited, ODFW will pursue completion of actions according to priorities as funds become available.

Policies

Policy 1. *Small ponds with public access containing warmwater gamefish will be managed for warmwater fish consistent with the basic yield management alternative for warmwater fish (OAR 635-500-055(1(d))).*

Policy 2. *Small ponds with public access containing trout will be managed for hatchery production of trout consistent with the basic yield alternative for trout (OAR 635-500-115(4)).*

Policy 3. *To protect native species and desired introduced species, other fish, including but not limited to, non-indigenous salmonids, smallmouth bass, spotted bass, yellow perch, channel catfish and all other members of the catfish family, muskellunge, walleye, northern pike, striped bass, hybrid bass, and koi will not be approved for use in public or private waters covered by this plan.*

Policy 4. *Only rainbow trout, largemouth bass, bluegill and black crappie from sources approved by the ODFW may be considered for introductions into private ponds in the lower Deschutes River subbasin.*

Objective 1. Provide angler opportunity for a consumptive fishery by stocking legal-sized or fingerling rainbow trout, or warmwater gamefish in the small ponds addressed in this plan.

Assumptions and Rationale

1. The consumptive demand for naturally produced trout and warmwater gamefish is greater than the lakes and streams in the lower Deschutes River subbasin currently provide.
2. Additional angling opportunities can be provided through periodic releases of fingerling and or legal-sized rainbow trout or warmwater gamefish into ponds that otherwise would be void of fish.

Actions

Action 1.1. Periodically evaluate angling pressure and harvest rates of trout and warmwater game fish at small ponds so that stocking practices may be modified to better meet angler demand and utilization.

Action 1.2. Determine appropriate stocking frequency and timing for fingerling and legal-sized rainbow trout to maximize harvest opportunities.

Action 1.3. Develop an angling brochure for the small public ponds in the lower Deschutes River subbasin.

Action 1.4. Develop plans to enhance aquatic habitat to benefit fishery resources in these small ponds.

Action 1.5. Evaluate the opportunities to develop other small fishing ponds on public lands or with cooperative agreements with private landowners.

HIGH USE LAKES AND RESERVOIRS

High use lakes and reservoirs, as defined by this plan, include all those lakes and reservoirs suited as intensive fisheries for either trout, warmwater gamefish or both. High use lakes and reservoirs are Olallie, Clear, Frog, and Badger lakes, and Rock Creek and Pine Hollow reservoirs (Appendix A, Figure 2.28 through Figure 2.33). These waters are located at both higher and lower elevations in the lower Deschutes River subbasin. They support the bulk of the standing water fishing pressure in the subbasin. Access to these waters is generally good, although access for the physically challenged angler is limited. These waters are usually large and frequently used for irrigation storage and water contact recreation.

Compliance with Oregon's Wild Fish Management Policy is not an issue at most of these waters since they were constructed by man and the historic stream habitat has been significantly altered. Indigenous fish are found, however, in the inlet or outlet streams of several of these waters. Where applicable, special actions will be listed to address Oregon's Wild Fish Management Policy in these streams.

Streams above and/or below these lakes and reservoirs will have to be inventoried for indigenous trout populations. Morphological and/or genetic characteristics will be used to determine whether an indigenous trout population exists. Lake stocking rates would have to be brought into compliance with Oregon's Wild Fish Management Policy if an indigenous trout population is found and the population is out of compliance. One potential alternative would be to install screens or barriers to protect indigenous trout populations in these streams from the non-indigenous hatchery fish in the lakes.

All of these waters are stocked annually with legal-sized rainbow trout or a combination of legal-sized and fingerling rainbow trout. Several of the lakes are also annually stocked with excess brood rainbow trout from ODFW's Oak Springs Hatchery. Number of excess brood rainbow trout available for stocking varies from year to year due to hatchery needs. Stocking rates were established for these lakes, based on the full pool acreage for each water body.

These lakes are all managed with an emphasis on trout production. However, Rock Creek and Pine Hollow reservoirs contain populations of warmwater game fish as the result of unauthorized introductions by the public. Rock Creek and Pine Hollow reservoirs are open to angling year around. The remaining high use lakes are open during the regular angling season (late April through October).

Because the species composition and management goals for these waters are different, separate policies, objectives, and actions are presented for each.

Badger Lake

Background and Status

Badger Lake is a 35 acre irrigation storage reservoir formed by a small dam on Badger Creek. It is located 28 miles south of Hood River, Oregon and 9 miles southeast of Mount Hood within the USFS Mount Hood National Forest Badger Creek Wilderness Area (Appendix A, Figure 2.28). Badger Lake sits at an elevation of 4,500 feet and has a maximum depth of 35 feet. This reservoir was constructed more than sixty years ago by the Badger Creek Irrigation

District. The lake does experience some annual pool level fluctuation associated with irrigation withdrawals.

Access to Badger Lake is over a single primitive road. USFS regulations prohibit the use of trailers on the last three miles of road leading into the lake because the road is rough, narrow, and steep. The primitive nature of the access road likely limits angler use. The USFS maintains a small campground located a short distance below the Badger Lake Dam and there are a number of primitive camp sites located around the lake. Boating use on this lake is restricted to non-motorized craft.

Badger Lake supports a popular trout fishery maintained with annual stocking of approximately 6,000 legal-sized rainbow trout (Table 2.6) and a naturally reproducing population of brook trout. Brook trout have not been stocked in the lake for more than forty years. Continued stocking with legal-sized rainbow trout is contingent upon the maintenance of public motor vehicle access to the lake. If the road is closed to access, hatchery fish management will be aerial releases of fingerling trout, likely every two years.

Annual stocking of legal-size rainbow trout is necessary at Badger Lake to provide angling opportunity greater than that which natural production alone would provide. The lake sits at a relatively high elevation where cold water, long winters, and a short growing season mean generally low natural productivity. Badger Lake also suffers periodic winter kill due to oxygen depletion during periods of extended ice cover.

It is unknown if hatchery rainbow trout are reproducing in the lake or its small tributaries. Extensive sampling in Badger Creek downstream from Badger Lake in 1984 and 1985 did not reveal any hatchery origin rainbow or brook trout (ODFW et al. 19985). This suggests that there is little or no downstream movement of fish out of Badger Lake.

Management Direction

Policies

Policy 1. *Brook trout shall be managed for natural production consistent with the Basic Yield Management Alternative for trout (OAR 635-500-115(4)). No hatchery brook trout shall be stocked.*

Policy 2. *Rainbow trout shall be managed for hatchery production consistent with the Basic Yield Management Alternative for trout (OAR 635-500-115(4)).*

Objective 1. Provide a diverse, consumptive angling opportunity for hatchery rainbow trout and naturally produced brook trout.

<u>**Assumptions and Rationale**</u>

1. This fishery shall be of a general consumptive nature.
2. Stocking of legal-sized rainbow trout is the only way to maintain current angler use levels at Badger Lake.
3. Reasons for poor natural trout production at Badger Lake are likely related to:
   a. High elevation lake with cold water.
   b. Low natural productivity.

   c. Long winters and a short growing season.
   d. Periodic winter kill.

4. Factors controlling natural production of brook trout are largely unknown, but production may be limited by lack of suitable spawning and early rearing habitat.
5. Legal-sized rainbow trout should survive better and contribute to the fishery at a higher rate than fingerling trout.
6. Primitive road access currently limits angler access at Badger Lake. If the USFS closes the access road, further restricting angler access, stocking rates and species may be adjusted to reflect angler use and logistic difficulties associated with fish stocking.
7. Annual lake level drawdown will occur to satisfy downstream irrigation demands.

Actions

Action 1.1. Annually stock approximately 6,000 legal-sized rainbow trout as soon as the access road is free of snow.

Action 1.2. Coordinate with the USFS to periodically evaluate abundance, growth, recruitment, and condition of the brook trout population in Badger Lake through net sampling, snorkeling, or angler interviews to determine if natural production can sustain the existing trout fishery.

Action 1.3. Coordinate with the USFS to evaluate if natural production of rainbow trout is occurring, through net sampling, snorkeling, or angler interviews.

Objective 2. Minimize impacts of hatchery trout stocked in Badger Lake on the production and genetic integrity of downstream populations of indigenous redband trout in Badger Creek and the White River system.

Assumptions and Rationale

1. Previous sampling in Badger Creek downstream of Badger Lake and upstream of Bonney Crossing detected no brook trout or hatchery rainbow trout.
2. There are no physical barriers at the outlet of Badger Lake to prevent fish from migrating downstream.
3. Trout from Badger Lake could impact downstream redband populations if they leave the lake. Hatchery origin rainbow trout could cause genetic impacts by reproducing with indigenous redband populations. Brook trout could compete with redband trout for food and space.
4. Maximizing harvest of hatchery trout in Badger Lake, changing species stocked, or eliminating stocking could reduce potential impacts to the indigenous redband trout populations in Badger Creek and the White River system.
5. Elimination of legal-sized rainbow trout stocking in Badger Creek at Bonney Crossing after 1993 significantly reduced potential genetic impacts of hatchery rainbow trout on indigenous redband populations in Badger Creek and the White River system.
6. Future morphometric and phenotypic monitoring of Badger Creek and White River redband trout can determine if introgression from hatchery rainbow trout leaving Badger Lake is occurring.

Actions

Action 2.1. Periodically monitor Badger Creek downstream from Badger Lake to determine if hatchery rainbow trout or naturally produced brook trout from Badger Lake are impacting indigenous populations of redband trout. Genetic analysis of rainbow trout in Badger Creek may be necessary.

Action 2.2. Discontinue hatchery rainbow trout stocking in Badger Lake if monitoring indicates hatchery origin rainbow trout are impacting indigenous redband trout populations.

Action 2.3. Modify the stocking rate if less than 40% of the legal-sized rainbow trout are harvested by the end of the season (ODFW 1987).

Objective 3. Minimize annual lake level fluctuations associated with irrigation drawdown at Badger Lake.

Assumptions and Rationale

1. Current annual drawdown for downstream irrigation use reduces trout rearing habitat in Badger Lake.

Actions

Action 3.1. Cooperate with the Badger Lake Irrigation District and USFS to obtaining funds to repair the leaky distribution network in exchange for a higher minimum pool in Badger Lake.

Action 3.2. If water savings are achieved and higher minimum pool levels are realized, apply for a transfer of water rights with Oregon Department of Water Resources

Clear Lake

Background and Status

Clear Lake, an irrigation impoundment, is located at an elevation of 3,500 feet, 14 miles south of Mount Hood, and approximately one mile south of Highway 26 (Appendix A, Figure 2.29). The site of Clear Lake was a meadow and a small natural lake. A dam was built in 1937-38 to form an irrigation storage reservoir. In March, 1938 the dam had impounded less than eight vertical feet of water when the structure failed. No further attempts were made to impound water at this site until the Water Users Corporation of Juniper Flat and the Bureau of Reclamation (BOR) constructed Wasco Dam to form the present day reservoir in 1959. Wasco Dam is an earth-fill structure extending 46 feet above the streambed of Clear Creek. This structure creates a 557 acre reservoir with a maximum depth of 26 feet deep. Clear Lake has a total capacity of 13,060 acre-feet and an active capacity of 11,860 acre-feet. Since the new project has been in operation, the maximum pool elevation has never been reached but the reservoir has at times doubled the depth of the natural lake.

Trees were cut in the reservoir area before the dam was completed but many of the stumps remain to provide the only structural habitat diversity within the lake. The water outlet structure, located at the base of the dam was never screened to prevent fish movement out of the reservoir. This is an irrigation reservoir with a large annual pool fluctuation and no minimum pool.

Clear Lake is accessible by a paved USFS road which connects with gravel USFS roads that encircle more than half the lake. The USFS maintains a large campground and boat ramp. The boat ramp does not extend to the lowest pool elevations and boaters must negotiate a wide expanse of exposed lake bed to reach the lake by late summer. Boating use of the reservoir is limited by a 10 mile per hour speed limit.

This lake provides a popular trout fishery supported by annual stocking of legal and hatchery brood rainbow trout (Table 2.7). A naturally reproducing brook trout population is also present in Clear Lake. Brook trout are the predominant fish species present in Clear Creek downstream from Wasco Dam (ODFW et al. 1985).

Annual stocking of legal-size rainbow trout is necessary at Clear Lake to provide angling opportunity greater than that which natural production alone would provide. The lake sits at a relatively high elevation where cold water, long winters, and a short growing season mean generally low natural productivity. The extreme drawdown associated with irrigation water withdrawal limits productivity.

Management Direction

Policies

Policy 1. *Legal-sized rainbow trout shall be managed for hatchery production consistent with the intensive use management alternative for trout (OAR 635-500-115(5)).*

Policy 2. *Hatchery brood rainbow trout will also be managed for hatchery production consistent with the trophy fish management alternative for trout (OAR 635-500-115(3)).*

Policy 3. *Brook trout shall be managed for natural production consistent with the Basic Yield Management Alternative for trout (OAR 635-500-115(4)). No hatchery brook trout shall be stocked.*

Objective 1. Provide a diverse, consumptive angling opportunity for hatchery rainbow trout and naturally produced brook trout.

Assumptions and Rationale

1. This fishery shall be of a general consumptive nature.
2. Stocking of legal-sized and brood rainbow trout is the only way to maintain the current high use fisheries.
3. There is no known suitable spawning habitat for rainbow trout in Clear Lake and natural production of rainbow trout is unlikely to occur.

4. Reasons for poor trout production at Clear Lake are likely related to:
   a. Severe annual drawdown for downstream irrigation use.
   b. Long winters and a short growing season.
   c. Low natural productivity.
5. Legal-sized and excess brood rainbow trout should contribute to the fishery at a higher rate than fingerling trout.
6. Currently available hatchery legal-sized and brood rainbow trout and naturally produced brook trout will satisfy this objective in Clear Lake.
7. Factors controlling natural production of brook trout are largely unknown, but production may be limited by lack of suitable spawning, early rearing habitat, and severe annual reservoir drawdown.
8. Annual lake level drawdown will occur to satisfy downstream irrigation demands.

Actions

Action 1.1. Stock approximately 16,000 legal-sized rainbow trout as soon as access road is snow free, usually late spring or early summer. Typically, releases are split between May and June each year.

Action 1.2. Stock excess hatchery brood rainbow trout (5-10 lbs./fish) from Oak Springs hatchery, as available.

Action 1.3. Coordinate with the USFS to periodically evaluate abundance, growth, recruitment, and condition of the brook trout population in Clear Lake through net sampling, snorkeling, or angler interviews to determine if natural production can sustain the existing trout fishery.

Action 1.4. Coordinate with the USFS to determine if natural production of rainbow trout is occurring.

Objective 2. Minimize impacts of hatchery trout stocked in Clear Lake on the production and genetic integrity of downstream populations of indigenous redband trout in Clear Creek and the White River system.

Assumptions and Rationale

1. Previous stream inventories in Clear Creek downstream from Clear Lake and above the confluence of White River have observed naturally producing brook trout. It is unknown if the distribution of brook trout in Clear Creek is stable or expanding but since brook trout have been in Clear Lake for at least 50 years, it is likely that downstream populations have occupied all suitable habitat.
2. It would be difficult, if not impossible, to completely eradicate naturally reproducing brook trout in Clear Creek.
3. There are no physical barriers at the outlet of Clear Lake to prevent fish in the lake from migrating downstream.
4. Maximizing harvest of hatchery trout in Clear Lake, changing species stocked, or eliminating stocking could reduce potential impacts to the indigenous redband trout populations in Clear Creek and the White River system.

5. Hatchery rainbow trout migrating downstream from Clear Lake could impact indigenous redband populations through competition or introgression.
6. Morphometric and phenotypic monitoring of Clear Creek and White River redband trout can determine if introgression from hatchery rainbow trout leaving Clear Lake is occurring.

Actions

Action 2.1. Periodically monitor Clear Creek, downstream of Clear Lake, to determine if hatchery rainbow trout from Clear Lake are impacting downstream indigenous populations of redband trout. Genetic analysis of rainbow trout sampled may be necessary.

Action 2.2. Screen the outlet of Clear Lake or discontinue hatchery rainbow trout stocking if downstream monitoring indicates genetic introgression with indigenous redband trout populations.

Action 2.3. Modify the stocking rate if less than 40% of the legal-sized rainbow trout are harvested by the end of the season (ODFW 1987).

Objective 3. Enhance fish habitat for adult cover and juvenile rearing.

Assumptions and Rationale

1. Annual lake drawdown for irrigation uses severely reduces present fish rearing habitat in Clear Lake.
2. Removal of lake-bed vegetation during initial reservoir construction and lack of aquatic vegetation and structure in Clear Lake reduces aquatic food production and fish rearing habitat.
3. Addition of woody structure and vegetative plantings will result in a net increase in aquatic food and fish habitat in the reservoir.

Actions

Action 3.1. Plant native and exotic species of woody plants to provide cover, nutrient input, and erosion control.

Action 3.2. Plant sedges or annual or perennial grasses in areas of suitable habitat to control erosion and provide a source of immediate nutrient input as the lake fills in the spring.

Action 3.3. Anchor large woody debris (whole trees) on flats to provide improved fish habitat.

Action 3.4. Coordinate funding and volunteer efforts with the USFS, the BOR, and Juniper Flat Irrigation District to improve habitat in Clear Lake.

Objective 4. Minimize annual lake level fluctuations associated with irrigation drawdown at Clear Lake.

Assumptions and Rationale

1. Current annual drawdown for downstream irrigation use reduces trout rearing habitat in Clear Lake.

Actions

Action 4.1. Cooperate with the Juniper Flat Irrigation District, the BOR and USFS to obtaining funds to repair the leaky distribution network in exchange for a higher minimum pool in Clear Lake.

Action 4.2. If water savings are achieved and higher minimum pool levels are realized, apply for a transfer of water rights with Oregon Department of Water Resources.

Objective 5. Provide additional or improved boat access at Clear Lake during low water conditions.

Assumptions and Rationale

1. The boat ramp associated with Clear Lake Campground is unusable during low water conditions.

Actions

Action 5.1. Coordinate with the USFS, BOR, and Juniper Flat Irrigation District to extend the boat ramp at Clear Lake Campground.

Frog Lake

Background and Status

Frog Lake is a natural oligotrophic lake at the headwaters of Frog Creek. It lies at an elevation of 4,000 feet between Blue Box and Wapinitia passes, adjacent to Highway 26, approximately eight miles south of Government Camp, Oregon (Appendix A, Figure 2.30). A small alpine lake with very little annual pool level fluctuation, Frog Lake has a maximum depth of 11 feet and covers 11 acres. The lake has an intermittent, high water outlet that may flow for only a short time during snow melt. Boat use on the lake is restricted to non-motorized craft.

The popular trout fishery in Frog Lake is supported by annual stocking of legal-sized and hatchery brood rainbow trout (Table 2.8). The lake is small, has low natural productivity due to high elevation, shallow depth, frequent winter kill, and intense angling pressure. Frog Lake is especially dependent on annual stocking of hatchery fish use to maintain angling opportunity greater than that which natural production alone would provide.

Frog Lake is accessible from Highway 26 by a paved USFS road system. The lake has two USFS campgrounds, a picnic area, boat ramp, and a trail around the lake. The USFS has proposed construction of a fishing dock that would be accessible to the physically challenged but this project is still in the planning stage.

Frog Lake was chemically rehabilitated with rotenone on October 27, 1953 to remove a stunted brown bullhead catfish population (Table 2.5). The lake was subsequently restocked with rainbow and brook trout. The last release of brook trout occurred in 1957.

Brook trout are the only fish species found in Frog Creek for approximately the first eight miles downstream from Frog Lake (ODFW et al 1985). Legal-sized and hatchery brood rainbow trout stocked in the lake that are not harvested during the year they are stocked commonly die during the winter from oxygen depletion, a condition common in shallow, high elevation lakes with extensive periods of ice cover.

Management Direction

Policies

Policy 1. *Legal-sized rainbow trout shall be managed for hatchery production consistent with the intensive use management alternative (OAR 635-500-115(5)).*

Policy 2. *Hatchery brood rainbow trout will also be managed for hatchery production consistent with the trophy fish management alternative (OAR 635-500-115(3)).*

Objective 1. Provide a diverse, consumptive angling opportunity for hatchery produced fish.

Assumptions and Rationale

1. This fishery shall be of a general consumptive nature.
2. Stocking of legal-sized and brood rainbow trout is the only way to maintain the current high use fisheries.
3. There is no known suitable spawning habitat for rainbow trout in Frog Lake. Therefore, natural production of rainbow trout is unlikely to occur.
4. Reasons for poor trout production at Frog Lake are likely related to:
   a. High elevation lake with cold water.
   b. Low natural lake productivity.
   c. Very short growing season, with long winters.
   d. Periodic winter kill.
5. Legal-sized and excess brood rainbow trout contribute to this fishery at a higher rate than fingerling trout.
6. Currently available hatchery legal-sized and brood rainbow trout and naturally produced brook trout will satisfy this objective in Frog Lake.

Actions

Action 1.1. Stock approximately 6,000 legal-sized rainbow trout annually as soon as access road is snow free, usually late spring or early summer. Typically number stocked is split between months of May and June.

Action 1.2. Stock excess hatchery brood rainbow trout (5-10 lbs./fish) from Oak Springs hatchery as available.

Action 1.3. Coordinate with USFS to periodically interview anglers to monitor catch success.

Objective 2. Minimize impacts of hatchery trout stocked in Frog Lake on the production and genetic integrity of downstream populations of indigenous redband trout in Frog Creek and the White River system.

__Assumptions and Rationale__

1. Previous stream inventories in Frog Creek, downstream of Frog Lake have observed naturally producing brook trout throughout Frog Creek. Rainbow trout are only known to occur in the lower 0.4 miles of Frog Creek.
2. Since impacts from hatchery rainbow trout leaving Frog Lake are likely undetectable on redband trout in Frog Creek, monitoring to assess impacts of hatchery rainbow trout from Frog Lake on redband trout will be conducted in Clear Creek below the confluence of Frog Creek.
3. It would be difficult, if not impossible, to completely eradicate naturally reproducing brook trout in Frog Creek.
4. The intermittent nature of the outlet, high harvest rate of hatchery trout, and frequent winter kills combine to minimize downstream migration of hatchery trout into Frog Creek.

__Actions__

Action 2.1. Periodically monitor Clear Creek, downstream of Frog Lake, to determine if hatchery rainbow trout from Frog Lake are impacting downstream indigenous populations of redband trout. Genetic analysis of rainbow trout sampled may be necessary.

Action 2.2. Modify stocking rate if less than 40% of each release is caught before the season ends.

Olallie Lake

Background and Status

Olallie Lake, located at an elevation of 4,900 feet, ten miles north of Mount Jefferson, is in an area designated by the USFS as the Olallie Lake Scenic Area (Appendix A, Figure 2.31). This natural oligotrophic lake has a maximum depth of 48 feet and covers 240 surface acres. It has a very stable pool elevation. The lake is located near the headwaters of Mill Creek, tributary to the Warm Spring River. The outlet from Olallie Lake has a fixed panel screen assembly which prevents fish from leaving the lake. The screen assembly may also assist with maintaining water level in the lake. The lake outlet flows primarily during spring snow melt and enters a series of four lakes on the CTWS reservation - Long, Dark, Island and Trout lakes.

Olallie Lake supports a popular trout fishery and is stocked annually with legal-sized and hatchery brood rainbow trout (Table 2.9). This lake is also dependent on hatchery trout stocking to maintain a fishery owing to its high elevation, short growing season, low productivity, and intense angling pressure. Additionally, natural production is lacking in Olallie Lake due to a lack of suitable spawning habitat.

Olallie Lake has fair vehicle access from the USFS Skyline Road and gravel roads. Primitive roads encircle approximately seventy five percent of the lake shoreline. The USFS maintains three campgrounds, boat ramps, and a fishing dock for the physically challenged. The lake has a small resort with boat and cabin rentals, a small store with groceries and tackle shop, and a primitive boat launch. Boat use of the lake is restricted to non-motorized craft.

Management Direction

Policies

Policy 1. *Legal-size rainbow trout shall be managed for hatchery production consistent with the intensive use management alternative (OAR 635-500-115(5)).*

Policy 2. *Brood rainbow trout will also be managed for hatchery production consistent with the trophy fish management alternative (OAR 635-500-115(3)).*

Objective 1. Provide a diverse, consumptive angling opportunity for hatchery produced fish.

Assumptions and Rationale

1. This fishery shall be of a general consumptive nature.
2. Stocking legal-sized trout is the only way to maintain this high use fishery.
3. There is no known suitable spawning habitat for rainbow trout in Olallie Lake. Therefore, natural production of trout is unlikely to occur.
4. Reasons for poor trout production at Olallie Lake are likely related to:
   a. High elevation lake with cold water.
   b. Low natural productivity.
   c. Long winters and a short growing season.
   d. Periodic winter kills
5. Legal-sized trout should survive better and contribute to the fishery at a higher rate than fingerling trout.
6. Currently available hatchery legal-sized and brood rainbow trout will satisfy this objective.
7. Road access may currently limit angler use at Olallie Lake. If the road access is improved, fish stocking rates may need to be adjusted to satisfy angler demand.
8. In-water habitat structure is considered adequate to provide habitat for fish to satisfy this objective. Olallie Lake's location within the USFS designated Olallie Lake Scenic Area could preclude introduction of structure.

Actions

Action 1.1. Stock approximately 15,000 legal-sized rainbow trout as soon as the access road is snow free, which is usually late spring or early summer.

Action 1.2. Stock hatchery rainbow brood trout (5-10 lbs./fish) from Oak Springs Fish Hatchery, as available.

Action 1.3. Coordinate with the USFS to periodically interview anglers to monitor catch success.

Objective 2. Minimize impacts of hatchery trout stocked in Olallie Lake on the production and genetic integrity of downstream populations of indigenous redband trout in the Warm Springs and lower Deschutes Rivers.

Assumptions and Rationale

1. The outlet screen at Olallie Lake prevents the outmigration of hatchery trout into downstream waters.

Actions

Action 2.1. In cooperation with CTWS, periodically monitor Mill Creek to determine if hatchery rainbow trout from Olallie Lake are impacting downstream indigenous fishes. Genetic analysis of rainbow trout sampled may be necessary.

Action 2.2. Modify stocking rate if less than 40% of legal-size hatchery trout stocked are caught before the end of the angling season.

Action 2.3 Periodically check the status of the outlet screen at the outlet of Olallie Lake.

Pine Hollow Reservoir

Background and Status

Pine Hollow Reservoir, constructed cooperatively by the Pine Hollow Cooperative Irrigation District and the Oregon Game Commission in 1969, is located at an elevation of 1,850 feet, six miles west of Tygh Valley (Appendix A, Figure 2.32). Pine Hollow Reservoir has a maximum depth of 50 feet and covers 235 acres surface acres at full pool. Primarily an irrigation storage reservoir with a minimum pool for fish and recreation, the annual pool fluctuation approaches 20 feet. A cooperative agreement between the Pine Hollow Cooperative Irrigation District and ODFW specifies that the reservoir will remain within one foot of full pool until at least July 1, each year. In addition, the reservoir has a minimum pool of more than 102 surface acres with a maximum depth of twenty feet. ODFW pays the irrigation district each year for the amount of water left in the reservoir as a minimum pool for fish and wildlife.

Water used to fill Pine Hollow Reservoir originates primarily from Badger Creek and, to a lesser degree, from Three Mile Creek. Water is transported to the reservoir through a series of irrigation canals or ditches operated by the Badger Improvement District. The steep gradient of these ditches provides little opportunity for hatchery rainbow trout to move upstream to the ditch sources at Badger and Threemile creeks. The downstream discharge from this impoundment is channeled into the irrigation district's network of canals and ditches for irrigation and livestock watering. There is no opportunity for fish escaping from the lake to find their way into any portion of the White River system. The reservoir is managed so there is usually no overflow.

Wasco County constructed two roads into the lake. These lead to two public boat ramps which are usable at all pool elevations. Both boat ramps include parking and restroom facilities. The county maintains these improvements. Although land surrounding the lake is in private ownership, anglers and recreationists have full use of the impoundment by virtue of a ten-foot perimeter public easement around approximately ninety percent of the shoreline. The lake has one privately owned campground with store, restaurant, cabins, and boat rentals.

Pine Hollow Reservoir is a popular trout fishing lake that is stocked annually with legal-sized and fingerling rainbow trout (Table 2.10). The lake also supports populations of largemouth bass, brown bullheads, and green sunfish. These warmwater game fish populations were all established as the result of escapement from existing farm ponds or unauthorized introductions. Brown bullhead catfish were first observed during gillnet inventories in 1982 and largemouth bass were observed in 1983. Green sunfish appeared in 1986. Power boat use on the reservoir is restricted by a 10 mph speed limit from the day after Labor Day to July 1. Water skiing is allowed on the western two thirds of the lake from July 1 through Labor Day.

Habitat enhancement opportunities within Pine Hollow Reservoir are not practical at this time. The frequent pool drawdown, the abundance of lake shore homes, and seasonal high speed boat operation generally preclude the placement of artificial structure within the reservoir.

Management Direction

Policies

Policy 1. *Fingerling and legal-sized rainbow trout shall be managed for hatchery production consistent with the Basic Yield Management Alternative (OAR 635-500-115(4))*

Policy 2. *Largemouth bass, brown bullhead, and green sunfish populations resulting from unauthorized introductions shall be managed for natural production consistent with the Basic Yield Management Alternative for warmwater fish (OAR 635-500-055(1(d))).*

Policy 3. *Pine Hollow Reservoir shall be managed primarily for trout production.*

Objective 1. Provide diverse, consumptive angling opportunity for hatchery trout and warmwater game fish.

__Assumptions and Rationale__

1. This fishery will be of a general consumptive nature.
2. Fingerling trout are significantly less expensive to rear than legal-sized trout.
3. Survival and abundance of fingerling rainbow trout may be affected by the presence of warmwater game fish.
4. Brown bullhead and green sunfish may tend to over populate and stunt.
5. There is no known suitable spawning habitat for rainbow trout in Pine Hollow Reservoir. Natural production of rainbow trout there is highly unlikely.
6. Water turbidity associated with bank erosion resulting from high speed power boat operation may reduce overall lake productivity.

Actions

Action 1.1. Annually stock 20,000 fingerling and 12,000 legal-sized hatchery rainbow trout. Typically, legal-sized hatchery rainbow trout releases occur from March through May each year.

Action 1.2. Evaluate survival and catch with harvest surveys and periodic net and electro-fishing inventory.

Action 1.3. Modify the stocking rate if less than 40% of the legal-sized rainbow trout are harvested before the following year's releases.

Objective 2. Minimize impacts of hatchery trout stocked in Pine Hollow Reservoir on the production and genetic integrity of downstream populations of indigenous redband trout in the White River system and lower Deschutes River.

Assumptions and Rationale

1. Stocked rainbow trout do not reproduce in Pine Hollow Reservoir or in the water delivery system feeding the reservoir.
2. It is unlikely that stocked rainbow trout leave Pine Hollow Reservoir.

Actions

Action 2.1. Modify stocking rate if less than 40% of legal-size hatchery trout stocked are caught before the end of the angling season.

Rock Creek Reservoir

Background and Status

Rock Creek Reservoir is located five miles west of Wamic, Oregon at an elevation of 2,230 feet, (Appendix A, Figure 2.33). It covers 106 acres at full pool and has a maximum full pool depth of 55 feet. This is an irrigation storage reservoir and the annual pool level fluctuation approaches 45 feet. Typically, a minimum pool of 22 acre feet remains at the end of irrigation season for maintenance of aquatic life and recreation. ODFW does not pay for this minimum pool; rather, it is dead storage that can not be drafted from the reservoir.

Rock Creek Reservoir fills with water from Rock, Three Mile, and Gate creeks. Water from Three Mile and Gate creeks is transported to the reservoir through a series of canals operated by the Rock Creek District Improvement Company. Most water usually leaves the reservoir through the ditch system and is used for irrigation and livestock watering. Water that spills from the reservoir over the spillway enters Rock Creek below the dam and it is possible for hatchery origin rainbow trout to escape into Rock Creek. Fish can migrate upstream and spawn in Rock and Gate creeks. High gradient in the Threemile Creek ditch precludes hatchery trout from moving upstream into Threemile Creek.

Paved county and USFS roads provide good access to the reservoir. The reservoir has a USFS campground, day-use area, boat ramp, and a perimeter trail that extends partially around the lake on USFS land. The boat ramp is usable only at higher pool elevations. Construction of a second boat ramp at a more suitable location is needed to provide good launching conditions at all pool elevations.

Rock Creek Reservoir is a popular trout fishing lake and is stocked annually with fingerling, legal, and brood rainbow trout (Table 2.11). Boating on the reservoir is restricted to non-motorized craft. The lake does support a warmwater fishery that originated from unauthorized introductions. The lake was chemically rehabilitated October 19 and 20, 1961 to remove goldfish and brown bullhead catfish (Table 2.5). Largemouth bass and brown bullhead catfish were once again observed at the reservoir in 1973 and remain there to this day.

The reservoir area was cleared of trees prior to flooding. Stumps were not removed but much of that inwater habitat has deteriorated over time and structural habitat diversity is generally lacking at this time. Many of the constraints that currently prevent habitat enhancement at Pine Hollow Reservoir do not exist at Rock Creek Reservoir and habitat enhancement would benefit existing fish populations in Rock Creek Reservoir.

Management Direction

Policies

Policy 1. *Fingerling, legal-sized, and surplus brood rainbow trout shall be managed for hatchery production consistent with the Basic Yield Management Alternative (OAR 635-500-115(4)).*

Policy 2. *Largemouth bass, brown bullhead, and bluegill populations resulting from unauthorized introductions shall be managed for natural production consistent with the Basic Yield Management Alternative for warmwater game fish (OAR 635-500-055(1(d)))*

Policy 3. *Rock Creek Reservoir shall be managed primarily for trout production.*

Objective 1. Provide a diverse, consumptive angling opportunity for hatchery trout and warmwater game fish.

__Assumptions and Rationale__

1. This fishery will be of a general consumptive nature.
2. Fingerling trout are significantly less expensive to rear than legal-sized trout.
3. Survival and abundance of fingerling rainbow trout may be affected by the presence of warmwater game fish.
4. Brown bullhead and bluegill may tend to over populate and stunt.

__Actions__

Action 1.1. Annually stock approximately 20,000 fingerling, 16,000 legal-sized, and surplus brood hatchery rainbow trout, as available. Typically, releases occur from March through May.

Action 1.2. Periodically evaluate abundance, growth, recruitment, and condition of fingerling hatchery rainbow trout released into Rock Creek Reservoir through net sampling, electro-fishing, or angler survey to measure the cost effectiveness of this program.

Objective 2. Minimize impacts of hatchery trout stocked in Rock Creek Reservoir on the production and genetic integrity of indigenous redband trout populations above and below the reservoir.

__Assumptions and Rationale__

1. There are no physical barriers at the reservoir to prevent hatchery rainbow trout from migrating upstream into Rock Creek or downstream of the dam during periods of spill.
2. Suitable habitat for trout spawning exists in Rock Creek above the reservoir. It is unknown if hatchery trout in the reservoir are spawning upstream in Rock Creek.
3. Analysis of genetic samples from fish in the White River basin indicate there is a high degree of local isolation of the White River rainbow trout populations.
4. Rainbow trout in Rock Creek are significantly different genetically from rainbow trout of hatchery origin, or populations in Gate, Tygh, Little Badger and Threemile creeks.
5. Maximizing harvest of hatchery trout in Rock Creek Reservoir, changing species stocked, or eliminating stocking could reduce potential impacts on the indigenous redband trout populations in Rock Creek and the White River system.
6. Hatchery rainbow trout migrating upstream or downstream from Rock Creek Reservoir could impact indigenous redband populations through competition or introgression.
7. Future morphometric and phenotypic monitoring of Rock Creek Reservoir and White River redband trout can determine if introgression from hatchery rainbow trout leaving Rock Creek Reservoir is occurring.

__Actions__

Action 2.1. Periodically monitor Rock Creek, downstream of Rock Creek Reservoir, to determine if hatchery rainbow trout from Rock Creek Reservoir are impacting downstream populations of indigenous redband trout. Monitoring will likely take the form of electro-fishing representative habitat units with follow-up genetic analysis of rainbow trout sampled.

Action 2.2. Screen the outlet of Rock Creek Reservoir or discontinue hatchery rainbow trout stocking if downstream monitoring indicates genetic introgression with indigenous redband trout populations.

Action 2.3. Modify the stocking rate if less than 40% of the legal-sized rainbow trout are harvested before the following year's releases.

Objective 3. Enhance fish habitat for adult production and juvenile rearing.

Assumptions and Rationale

1. Removal of lake-bed vegetation during initial reservoir construction and lack of aquatic vegetation and structure in Rock Creek Reservoir reduces aquatic food production and fish rearing habitat.
2. Addition of woody structure and vegetative plantings will result in a net increase in aquatic food and fish habitat in the reservoir.

Actions

Action 3.1. Plant native and exotic species of woody plants to provide cover, nutrient input, and erosion control.

Action 3.2. Plant sedges or annual or perennial grasses in areas of suitable habitat to control erosion and provide a source of immediate nutrient input as the lake fills in the spring.

Action 3.3. Anchor large woody debris (whole trees) on flats to provide improved fish habitat.

Action 3.4. Coordinate funding and volunteer efforts with the USFS, BOR, and Lost and Boulder Ditch Company to improve habitat in Rock Creek Reservoir.

Objective 4. Minimize annual lake level fluctuations associated with irrigation drawdown at Rock Creek Reservoir.

Assumptions and Rationale

1. Current annual drawdown for downstream irrigation use reduces trout rearing habitat in Rock Creek Reservoir.
2. Annual reservoir level drawdown will continue to occur to satisfy downstream irrigation demands.

Actions

Action 4.1. Cooperate with the Rock Creek District Improvement Company and USFS to obtaining funds to repair the leaky distribution network in exchange for a higher minimum pool in Rock Creek Reservoir.

Action 4.2. If water savings are achieved and higher minimum pool levels are realized, apply for a transfer of water rights with Oregon Department of Water Resources

Objective 5. Provide additional or improved boat access at Rock Creek Reservoir during low water conditions.

Assumptions and Rationale

1. The boat ramp associated with Day Use Picnic Area is usable during low pool elevations.

Actions

Action 5.1. Coordinate with the USFS, BOR, and Rock Creek District Improvement Company to extend the boat ramp at Day Use Picnic Area.

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SECTION 2. TROUT IN STANDING WATERS

FIGURES AND TABLES

Table 2.1. Trout liberations in standing waters in the lower Deschutes River subbasin, 1995.

Water	Species	Size	Number
Badger Lake	Rainbow	3.8/lb. Legals	5,302
Baker Pond	Rainbow	55/lb. Fingerling	1,045
Bibby Pond	Rainbow	3.2/lb. Legals	1,002
Big Boulder Lake	Rainbow	285/lb. Fingerling	998
Little Boulder Lake	Rainbow	285/lb. Fingerling	528
Breitenbush Lake[a/]	Brook	264/lb. Fingerling	3,036
Brook Lake[a/]	Brook	264/lb. Fingerling	264
Catalpa Lake	Rainbow	285/lb. Fingerling	570
Clear Lake	Rainbow	2.8/lb. Legals	17,301
	Rainbow	4.6 lbs. Brood	250
Gibson Lake[a/]	Brook	264/lb. Fingerling	792
Frog Lake	Rainbow	3.0/lb. Legals	6,002
	Rainbow	7.4lbs. brood	331
Horseshoe Lake	Brook	264/lb. Fingerling	1,518
Jean Lake	Rainbow	285/lb. Fingerling	570
Jude Lake[a/]	Brook	264/lb. Fingerling	792
Mangriff Lake	Brook	264/lb. Fingerling	264
Nup-Te-Pa Lake[a/]	Brook	264/lb. Fingerling	264
Pine Hollow Res.	Rainbow	3.0/lb. Legals	14,295
	Rainbow	35/lb. Fingerling	20,142
Rock Creek Res.	Rainbow	3.0/lb. Legals	20,041
	Rainbow	4.1lbs. brood	548
Russ Lake[a/]	Brook	264/lb. Fingerling	792
Smock Prairie Res.	Rainbow	3.2/lb. Legals	2,000
	Rainbow	55/lb. Fingerling	2,035
Timber Lake	Brook	264/lb. Fingerling	1,518
Lower Twin Lake	Brook	264/lb. Fingerling	1,782
Upper Twin Lake	Brook	264/lb. Fingerling	792
Upper Lake	Brook	264/lb. Fingerling	990
View Lake	Brook	264/lb. Fingerling	990

a/ Lakes located within the Warm Springs Reservation, but open to public access.

Table 2.2. Cascade Mountain lakes in the Lower Deschutes River planning area.

Lake	Location	Size (acres)	Depth (feet)	Elevation (feet)	Fish stocked (1995) species	Fish stocked (1995) number	Mgmt Alt.[a]
Big Boulder	T4S R10E S5	11	17	4,600	Rb	1,000	BY
Little Boulder	T4S R10 ES4	6	5	4,800	BT	500	BY
Breitenbush[b]	T9S R8E S25	60	30	5,500	BT	3,000	BY
Brook[b]	T8S R81/2E S26	5	8	4,700	BT	250	BY
Catalpa	T4S R9E S14	3	8	4,100	Rb	500	BY
Cigar	T9S R8E S10	5	8	5,100	Unsuitable		
Eloise	T9S R8E S10	5	8	5,000	Unsuitable		
Gibson[b]	T9S R81/2E S24	6	14	5,800	BT	750	BY
Green Lake	T4S R9E S15	1.5	3	4,050	Unsuitable		
Horseshoe	T9S R8E S24	14	17	5,400	BT	1,500	BY
Jean	T3S R10E S17	6	18	4,800	Rb	500	BY
Jude[b]	T8S R8E S25	2	14	4,550	BT	750	BY
Mangriff	T9S R8E S13	1	14	5,000	BT	250	BY
Monon	T9S R8E S13	91	39	5,000	Ct	8,000	FS
Nup-Te-Pa[b]	T9S R8E S13	2	25	5,000	BT	250	BY
Oval	T3S R10E S1	2	8	5,200	Unsuitable		
Russ[b]	T8S R81/2E S26	5	8	4,700	BT	750	BY
Spinning	T4S R10E S5	3	4	4,400	Unsuitable		
Timber	T9S R8E S14	10	18	5,300	BT	1,500	BY
Top	T9S R8E S10	3	6	5,000	Unsuitable		
Lower Twin	T4S R9E S4	11	4	4,250	BT	750	BY
Upper Twin	T4S R9E S9	18	18	4,150	BT	2,000	BY
Upper	T9S R8E S15	8	14	5,150	BT	1,000	BY
View	T9S R8E S14	7	10	5,250	BT	1,000	BY

a/ Management Alternative: BY = Basic Yield, FS = Featured Species
b/ Lake located on the Warm Springs Reservation

Table 2.3. Outlet status of Cascade Mountain lakes.

Lake	Drainage	Outlet Status
Big Boulder	Boulder Cr./White R.	perennial outlet with irrigation valve
Little Boulder	Boulder Cr./White R.	ephemeral outlet southeast corner
Breitenbush	N.F. Breitenbush R.	perennial outlet southwest corner
Brook	Olallie Cr./Clack. R.	ephemeral outlet to Olallie Meadow
Catalpa	White River	ephemeral outlet east side
Gibson	Breitenbush Lake	ephemeral outlet
Horseshoe	Mill Cr./Warm Sprgs R. or Monon Lake ??	ephemeral outlet north end
Jean Lake	Badger Creek/White R.	perennial outlet0
Jude	Olallie Cr./Clack. R.	perennial outlet on south side
Mangriff	Olallie Lake/Mill Cr.	ephemeral outlet
Monon Lake	Olallie Lake/Mill Cr.	ephemeral outlet on north side
Nup Te Pa	Olallie Lake/Mill Cr.	ephemeral outlet on north side
Russ	Olallie Cr./Clack. R.	two ephemeral outlets
Timber	Olallie Lake/Mill Cr.	ephemeral outlet northeast corner
Twin, Lower	Barlow Cr./White R.	ephemeral outlet south end
Twin, Upper	Barlow Cr./White R.	ephemeral outlet southeast corner
Upper	Olallie Lake/Mill Cr.	ephemeral outlet northeast corner
View	Monon and Olallie L.	ephemeral outlet southeast corner

Table 2.4. Small ponds in the lower Deschutes River subbasin.

Pond/Reservoir	Location	Species Present
Baker Pond	R.12E.,T.3S. Sec 5 SWNE	Rb, Brb
Bibby Pond	R.16E.,T.4S. Sec 22 NESW	Rb
Big Boulder Pond	R.12E.,T.3S. Sec 29 NESW	LB, Bg
Cody Pond #1	R.11E.,T.4S. Sec 14 NWNW	LB
Cody Pond #2	R.11E.,T.4S. Sec 14 NWNW	LB
Cody Pond #3	R.12E.,T.4S. Sec 18 NWNW	LB, Bg
Cody Pond #4	R.12E.,T.4S. Sec 18 SWNW	LB, Bg
Cody Pond #5	R.12E.,T.4S. Sec 18 SENW	LB, Bg
C.K. Pond	R.12E.,T.3S. Sec 28 NESE	LB, Bg
Fire Pond	R.11E.,T.3S. Sec 36 SESW	LB
Gobbler Pond	R.11E.,T.3S. Sec 36 SWNE	LB, Bg
Happy Ridge Pond	R.12E.,T.3S. Sec 26 SWSW	LB, Bg
Smock Prairie Pond	R.11E.,T.5S. Sec 22 SWSE	LB
Smock Prairie Res.	R.11E.,T.5S. Sec 23 NWSE	RB

Fish Species: Rb=rainbow trout, LB=largemouth bass, Bg=bluegill

Table 2.5. A history of chemical rehabilitation projects in the lower Deschutes River subbasin.

Water Body	Date	Targeted Species	Chemical	Results
Frog Lake	10/27/53	Brown Bullhead	Rotenone 250 lbs. (powder)	Complete Kill
Rock Creek Reservoir	10/19/61 Black Bullhead estimated pop. 100,000+	Gold Fish 20 gallons (liquid)	Rotenone	Complete Kill
Bibby Pond	10/9/90	Brown Bullhead	Rotenone (powder)	Complete Kill

Table 2.6. Badger Lake seven year fish stocking record.

Year	Number Stocked	Type	Species
1995	5,302	legals	rainbow
1994	6,320	legals	rainbow
1993	6,373	legals	rainbow
1992	6,023	legals	rainbow
1991	5,991	legals	rainbow
1990	6,000	legals	rainbow
1989	5,253	legals	rainbow

Table 2.7. Clear Lake seven year fish stocking record.

Year	Number Stocked	Type	Species
1995	17,301	legals	rainbow
	250	brood	rainbow
1994	15,826	legals	rainbow
1993	16,062	legals	rainbow
	488	brood	rainbow
1992	16,008	legals	rainbow
1991	19,139	legals	rainbow
	240	brood	rainbow
1990	14,806	legals	rainbow
	562	brood	rainbow
1989	15,990	legals	rainbow
	534	brood	rainbow

Table 2.8. Frog Lake seven year fish stocking record.

Year	Number Stocked	Type	Species
1995	6,002	legals	rainbow
	331	brood	rainbow
1994	6,992	legals	rainbow
1993	6,002	legals	rainbow
	247	brood	rainbow
1992	4,631	legals	rainbow
	679	brood	rainbow
1991	6,037	legals	rainbow
	150	brood	rainbow
1990	5,986	legals	rainbow
	479	brood	rainbow
1989	6,032	legals	rainbow

Table 2.9. Olallie Lake seven year fish stocking record.

Year	Number Stocked	Type	Species
1995	16,181	legals	rainbow
	735	brood	rainbow
1994	12,280	legals	rainbow
1993	20,395	legals	rainbow
	460	brood	rainbow
1992	15,100	legals	rainbow
	1,477	brood	rainbow
1991	14,080	legals	rainbow
	469	brood	rainbow
1990	12,728	legals	rainbow
	515	brood	rainbow
1989	14,001	legals	rainbow
	681	brood	rainbow

Table 2.10. Pine Hollow Reservoir seven year fish stocking record.

Year	Number Stocked	Type	Species
1995	14,293	legals	rainbow
	20,142	fingerling	rainbow
1994	14,011	legals	rainbow
	17,035	fingerling	rainbow
1993	10,025	legals	rainbow
	20,000	fingerling	rainbow
1992	11,998	legals	rainbow
	38,057	fingerling	rainbow
1991	12,922	legals	rainbow
	20,020	fingerling	rainbow
1990	10,460	legals	rainbow
	41,266	fingerling	rainbow
1989	10,032	legals	rainbow

Table 2.11. Rock Creek Reservoir seven year fish stocking record.

Year	Number Stocked	Type	Species
1995	15,936	legals	rainbow
	20,041	fingerling	rainbow
	548	brood	rainbow
1994	15,999	legals	rainbow
	20,001	fingerling	rainbow
1993	17,091	legals	rainbow
	20,000	fingerling	rainbow
	609	brood	rainbow
1992	16,001	legals	rainbow
	20,054	fingerling	rainbow
	275	brood	rainbow
1991	16,033	legals	rainbow
	20,020	fingerling	rainbow
	295	brood	rainbow
1990	13,957	legals	rainbow
	15,015	fingerling	rainbow
	787	brood	rainbow
1989	11,970	legals	rainbow
	430	brood	rainbow

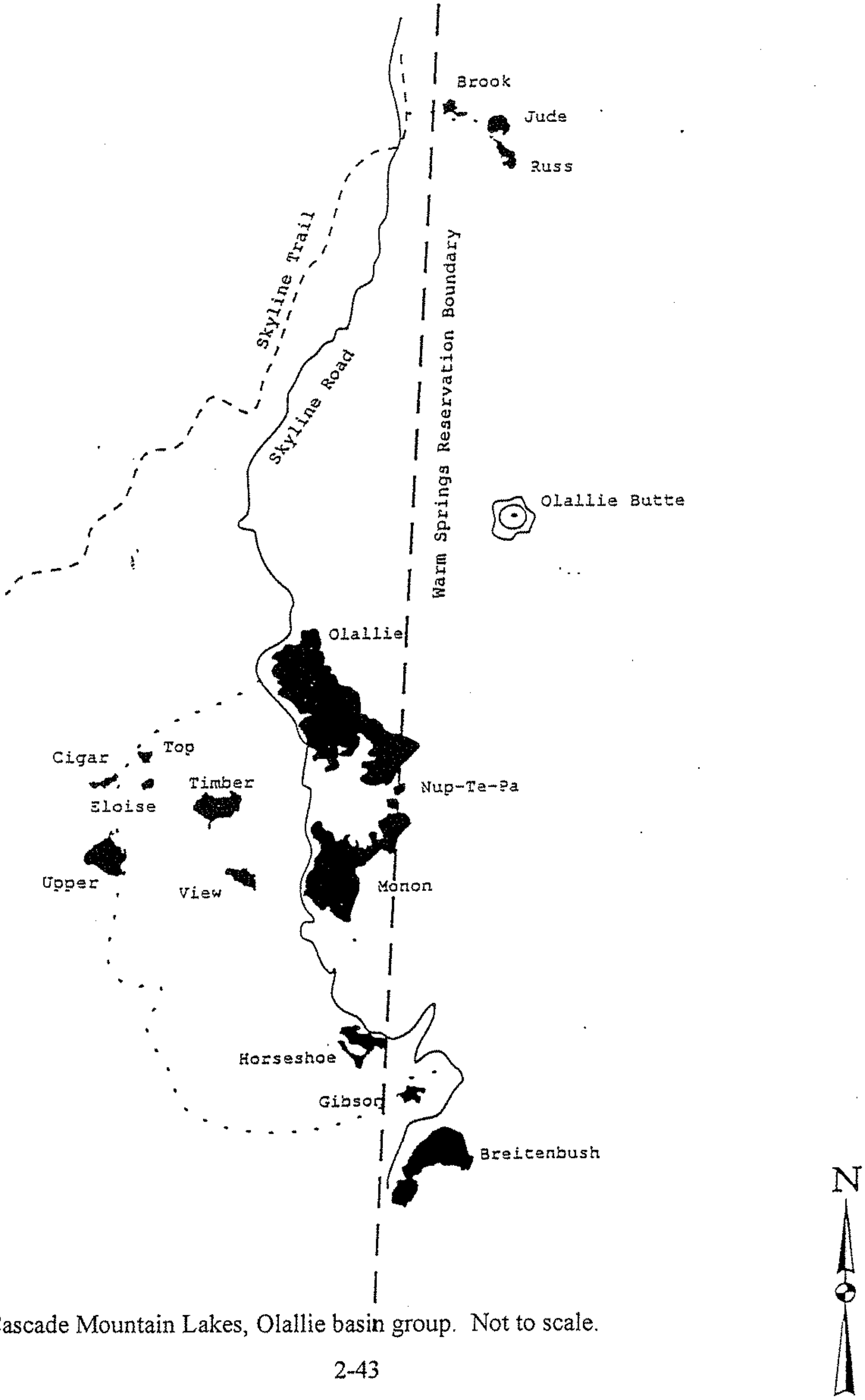


Figure 2.1. Cascade Mountain Lakes, Olallie basin group. Not to scale.

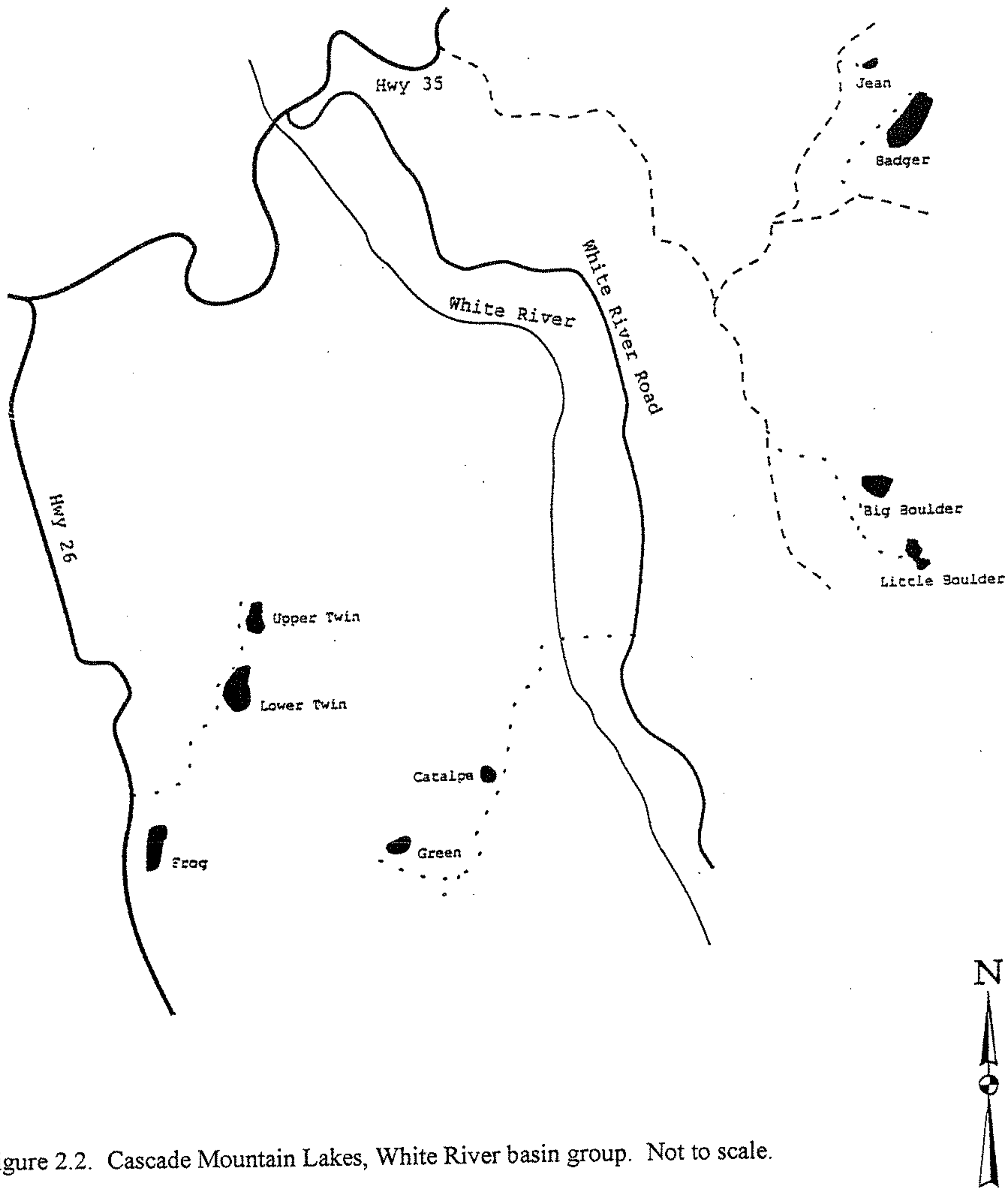


Figure 2.2. Cascade Mountain Lakes, White River basin group. Not to scale.

SECTION 2. TROUT IN STANDING WATERS

APPENDIX A

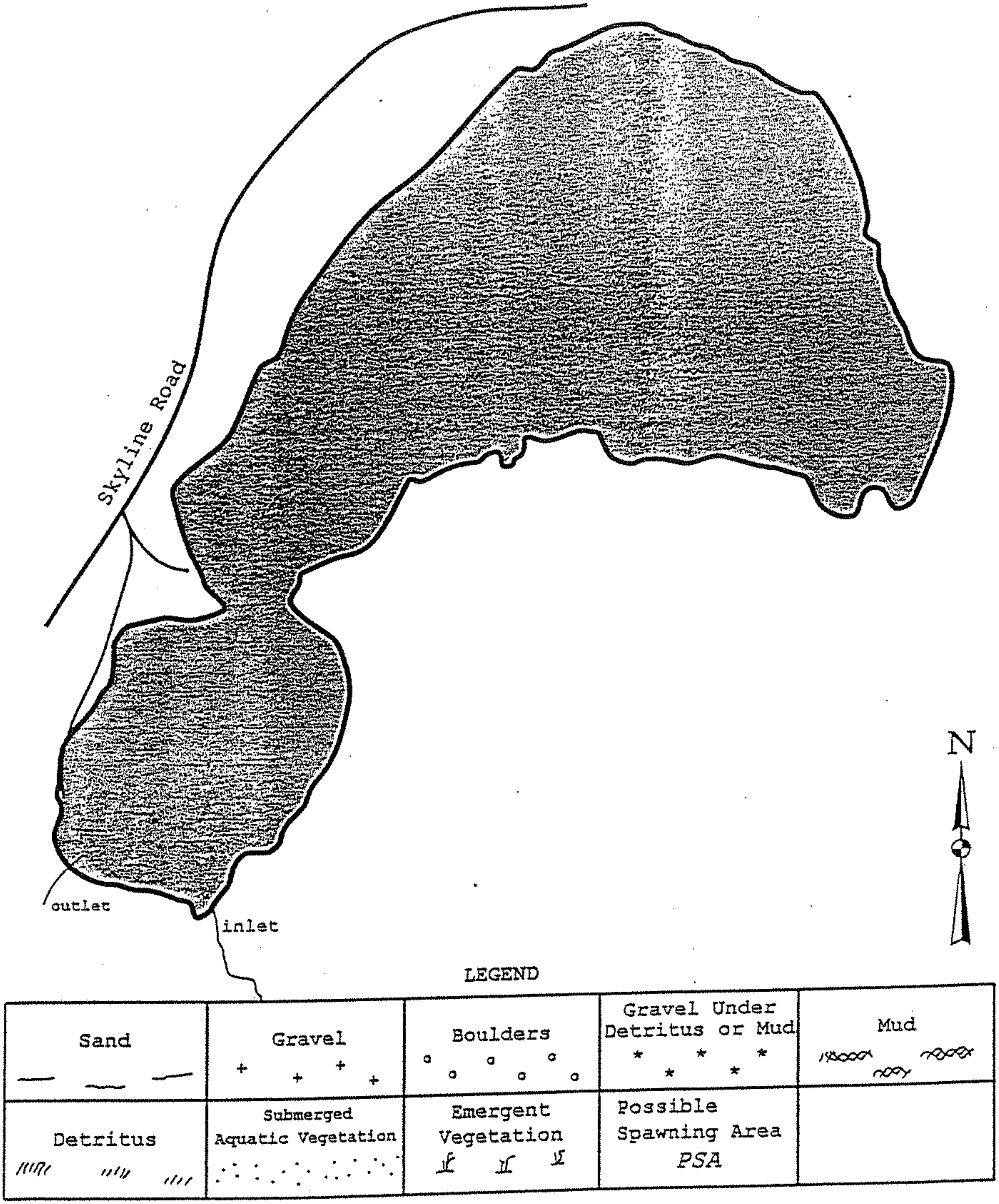
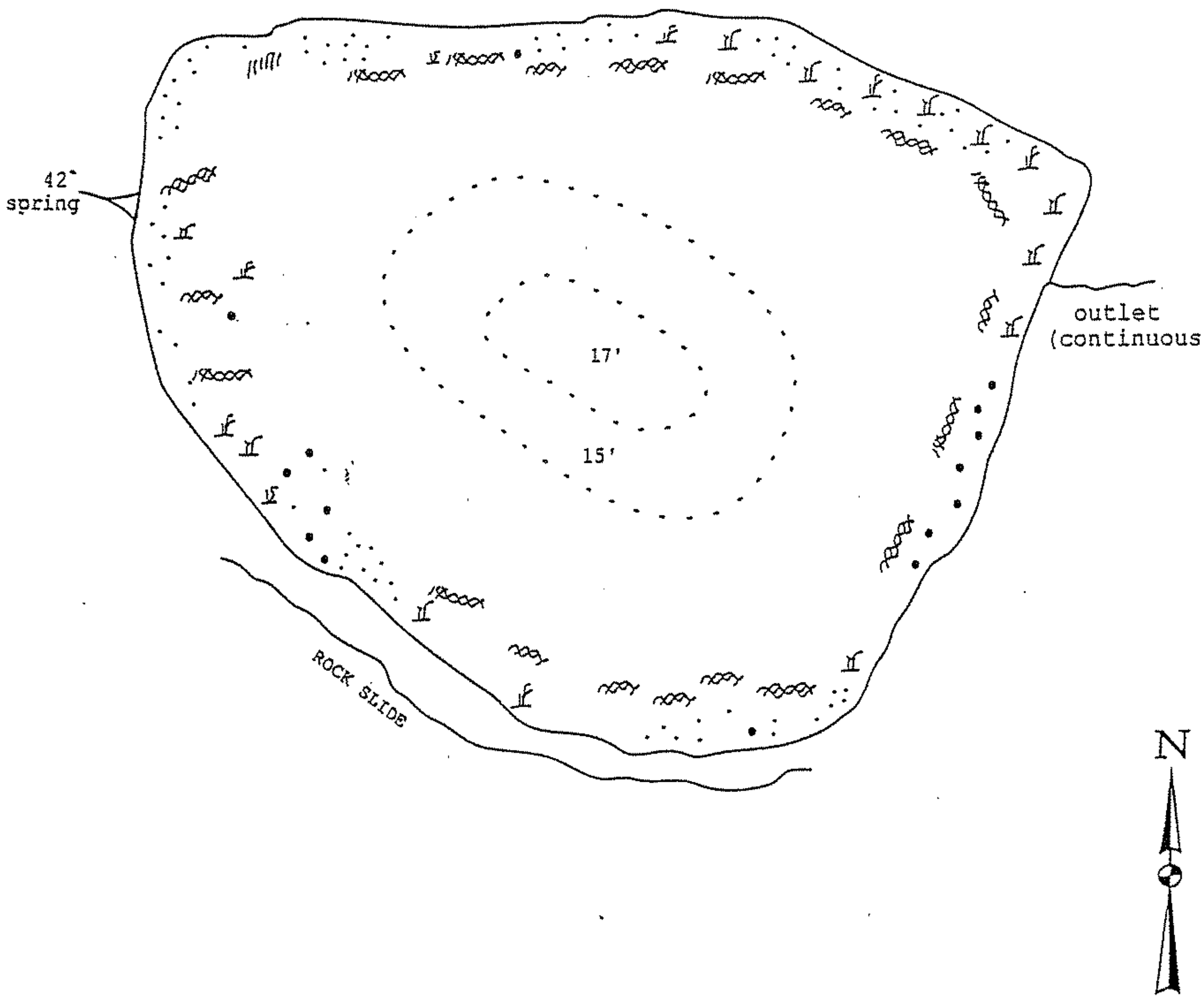


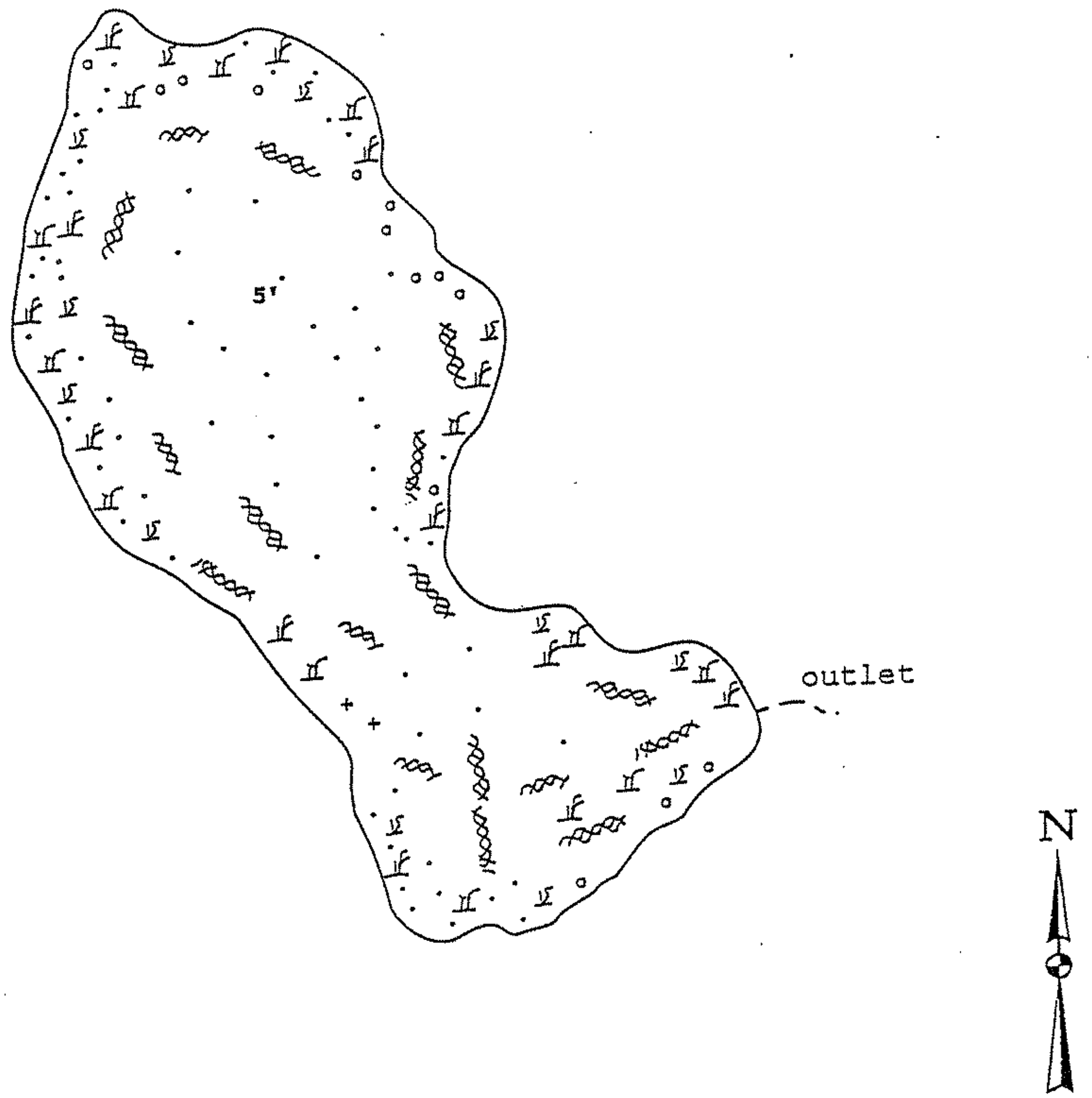
Figure 2.3. Breitenbush Lake. Not to scale



LEGEND

Sand	Gravel	Boulders	Gravel Under Detritus or Mud	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area PSA	

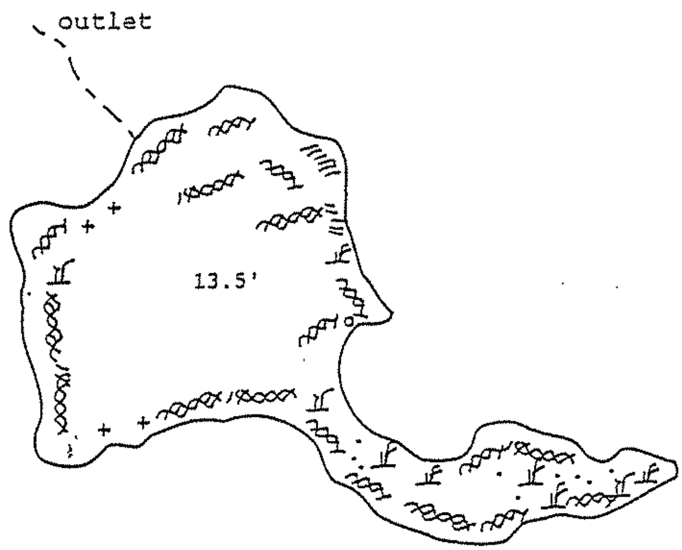
Figure 2.4. Big Boulder Lake. Scale 1:238



LEGEND

Sand	Gravel	Boulders	Gravel Under Detritus or Mud	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area PSA	

Figure 2.5. Little Boulder Lake. Scale 1:238



LEGEND

Sand	Gravel	Boulders	Gravel Under Detritus or Mud	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area PSA	

Figure 2.6. Brook Lake. Scale 1:238

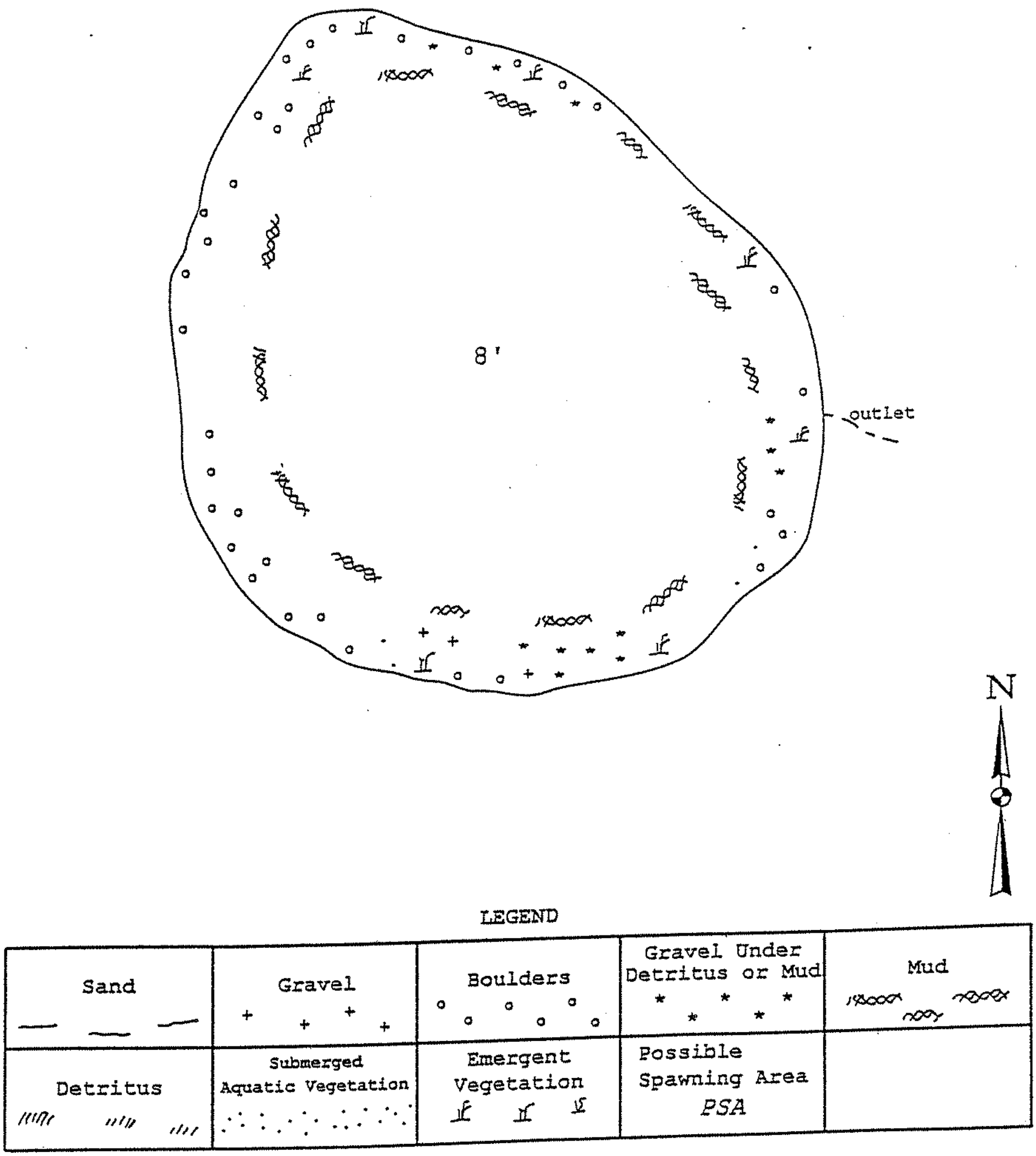
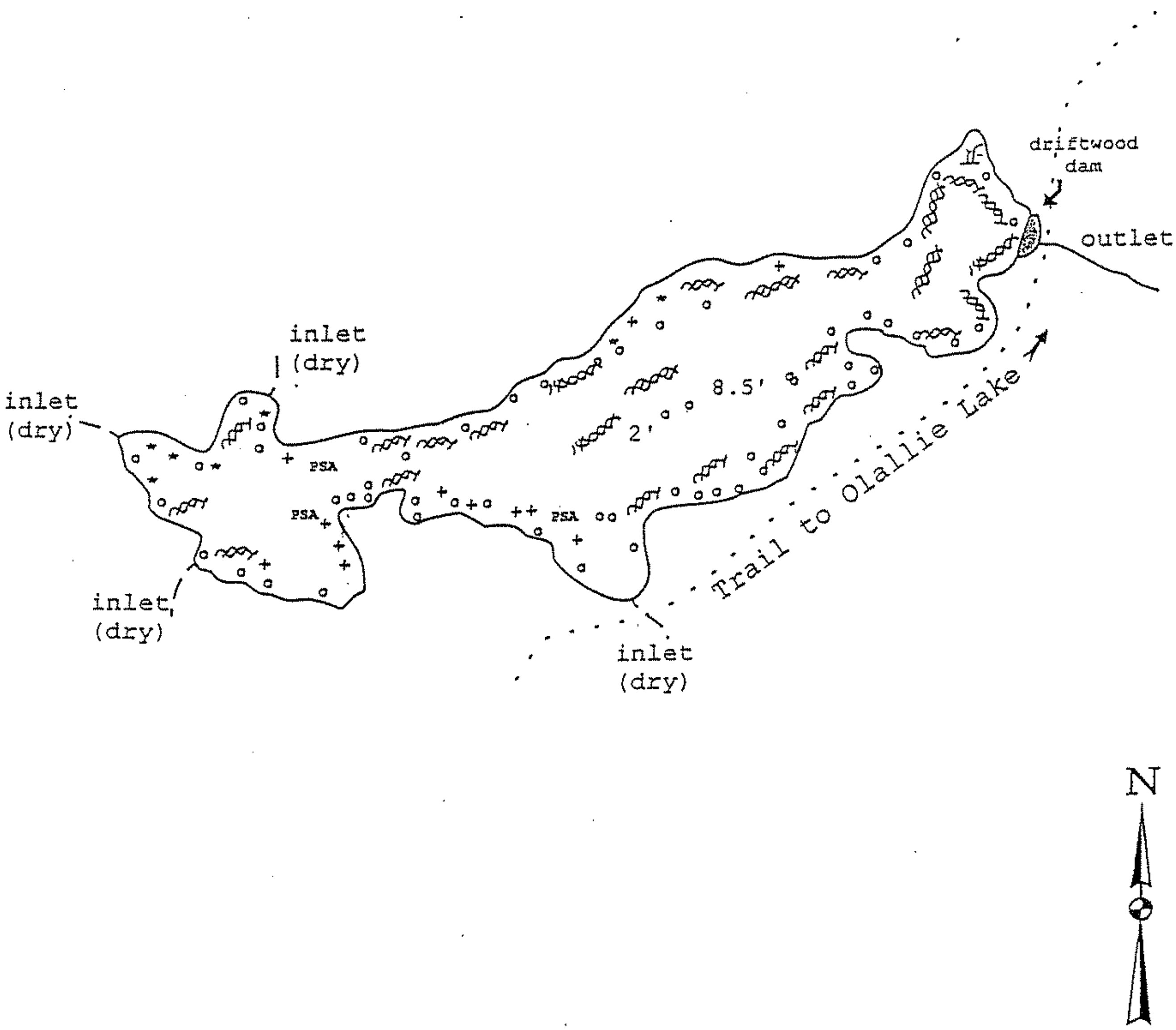


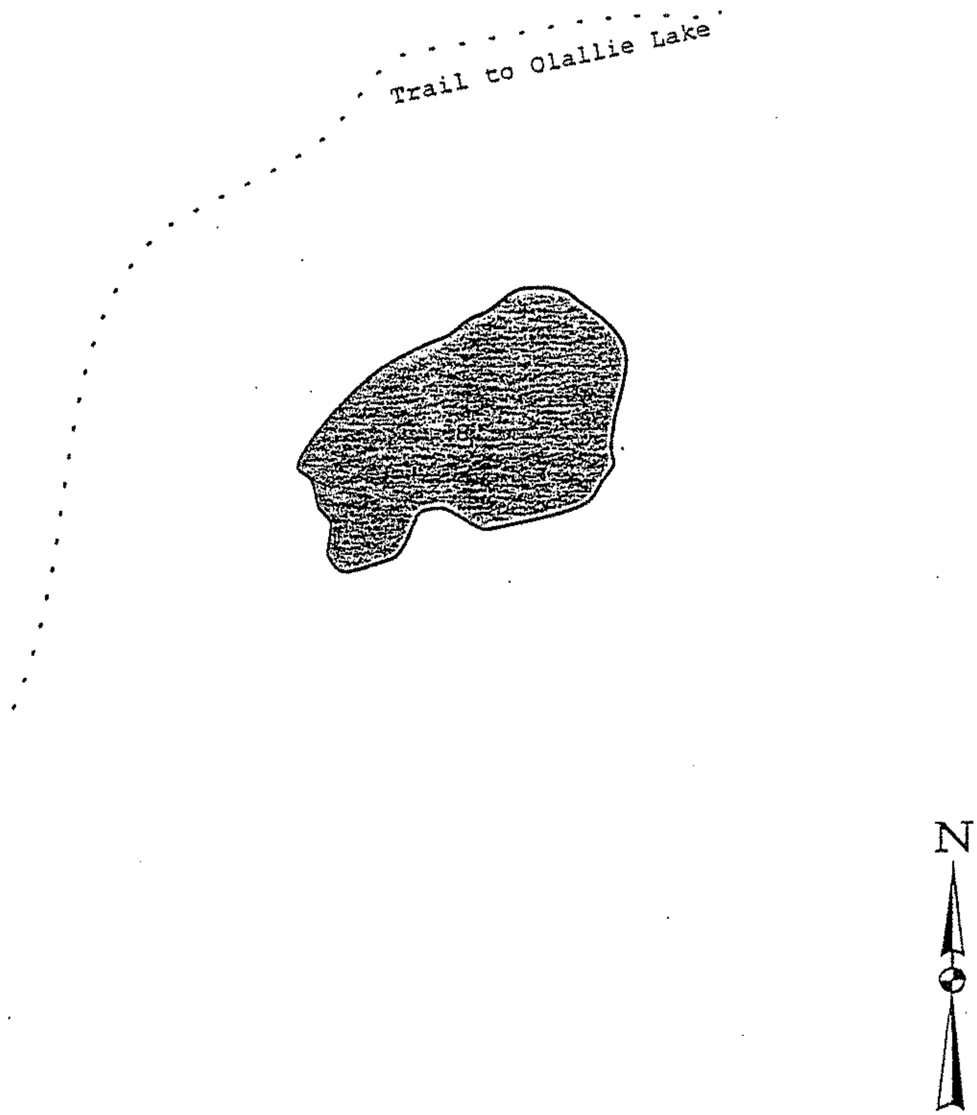
Figure 2.7. Catalpa Lake. Scale 1:238



LEGEND

Sand	Gravel	Boulders	Gravel Under Detritus or Mud	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area *PSA*	

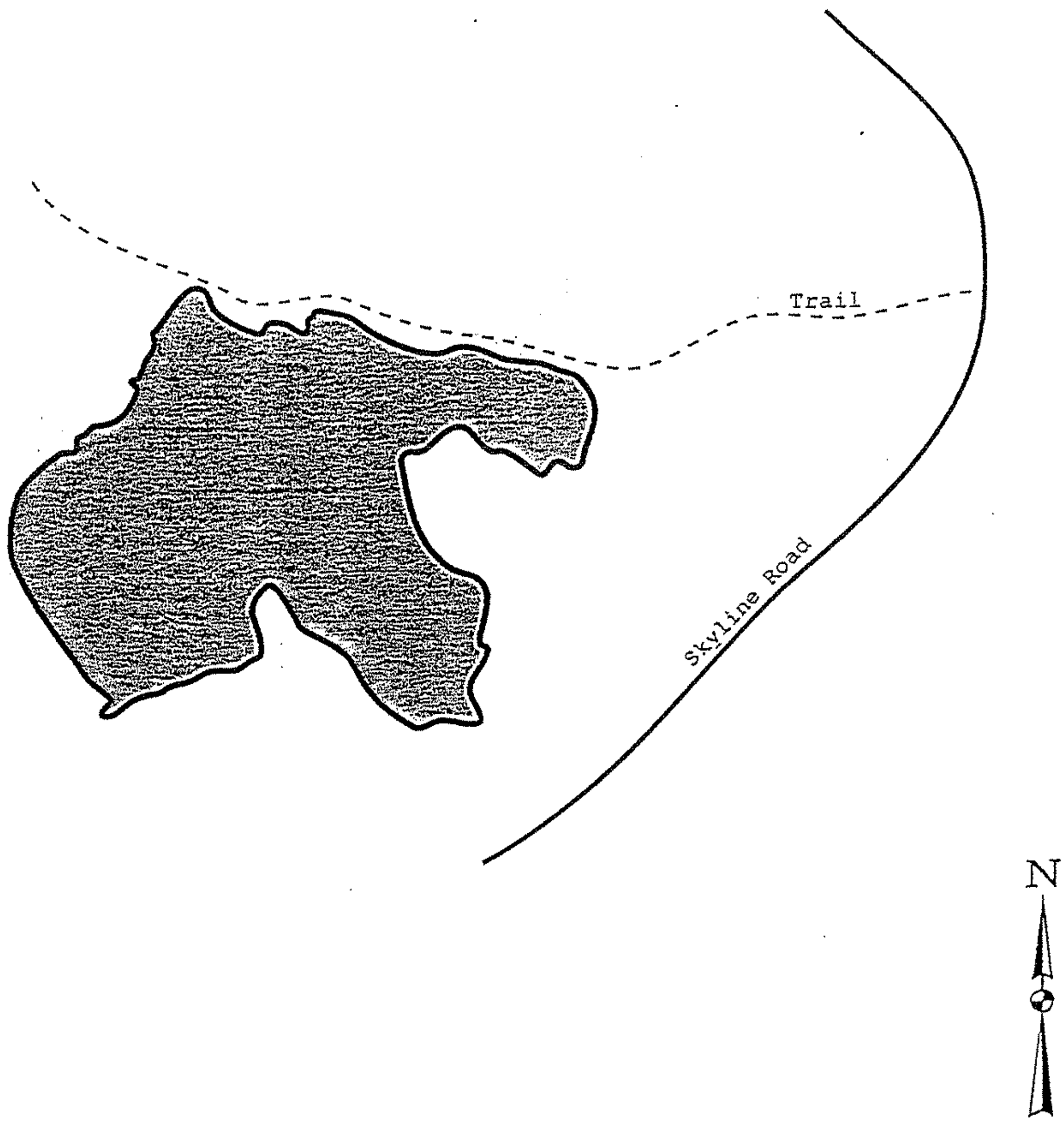
Figure 2.8. Cigar Lake. Scale 1:260



LEGEND

Sand	Gravel	Boulders	Gravel Under Detritus or Mud	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area PSA	

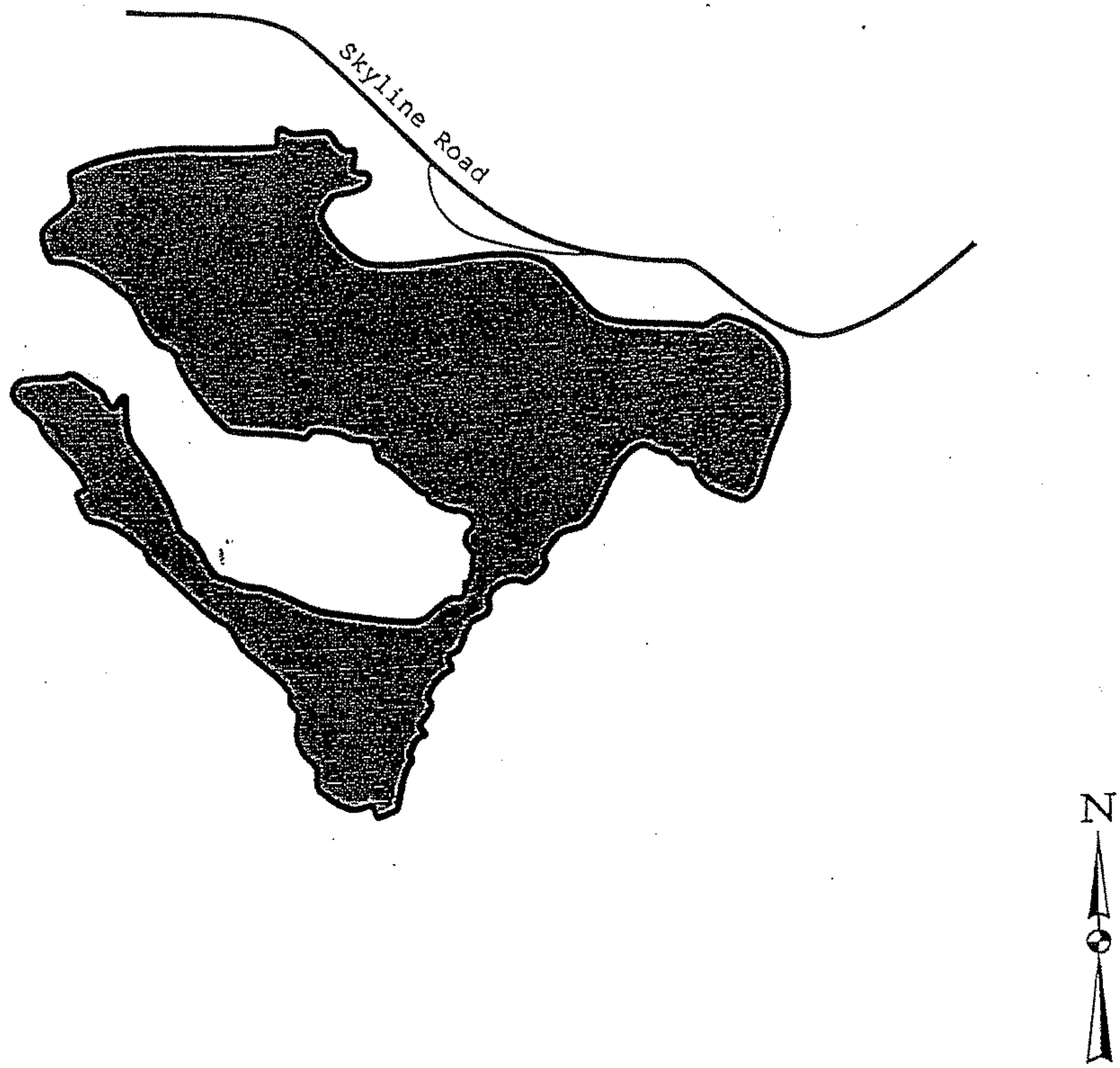
Figure 2.9. Eloise Lake. Not to scale



LEGEND

Sand	Gravel	Boulders	Gravel Under Detritus or Mud	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area PSA	

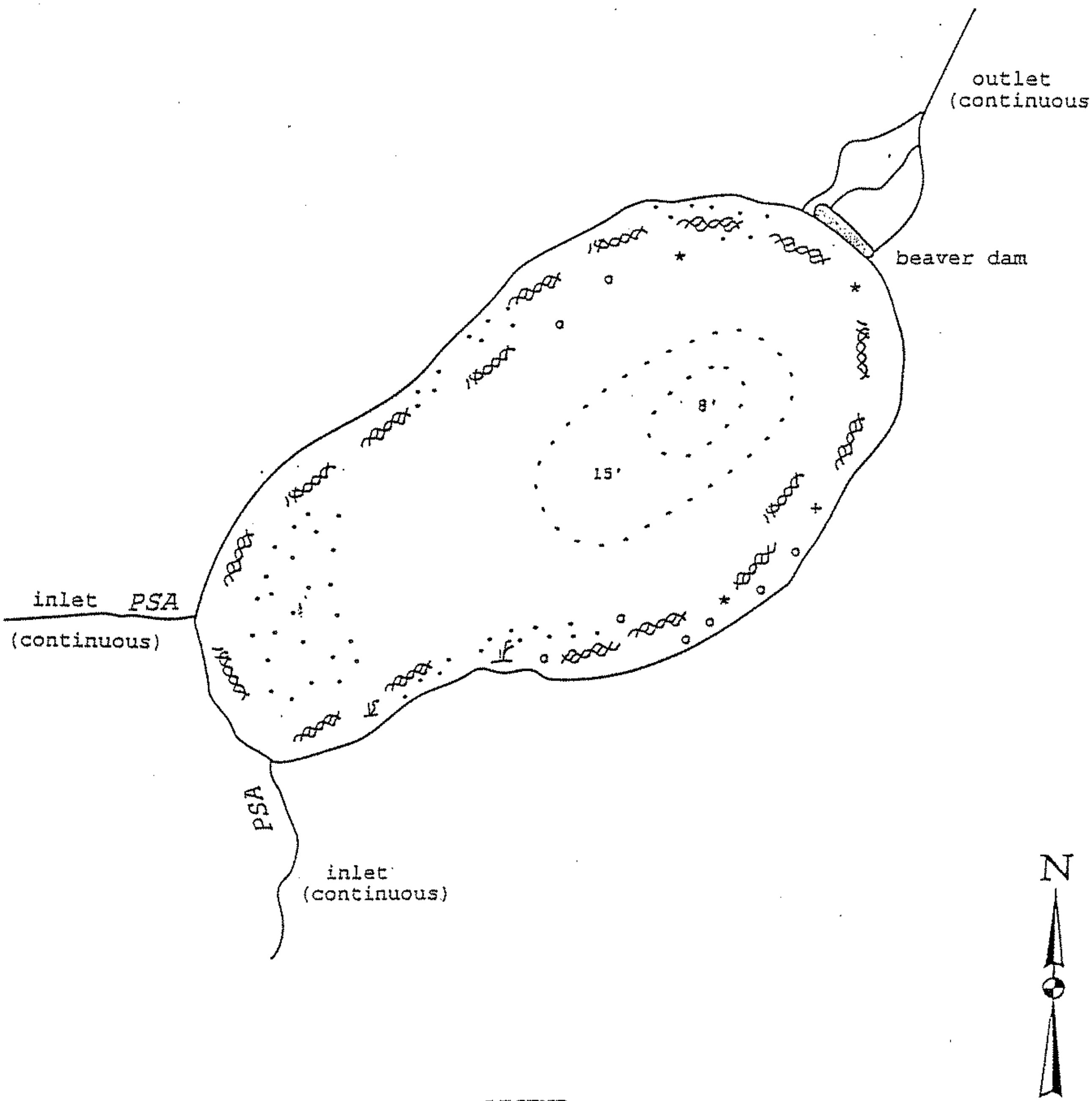
Figure 2.10. Gibson Lake. Not to scale



LEGEND

Sand	Gravel + + + +	Boulders o o o o o o	Gravel Under Detritus or Mud * * * * *	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area *PSA*	

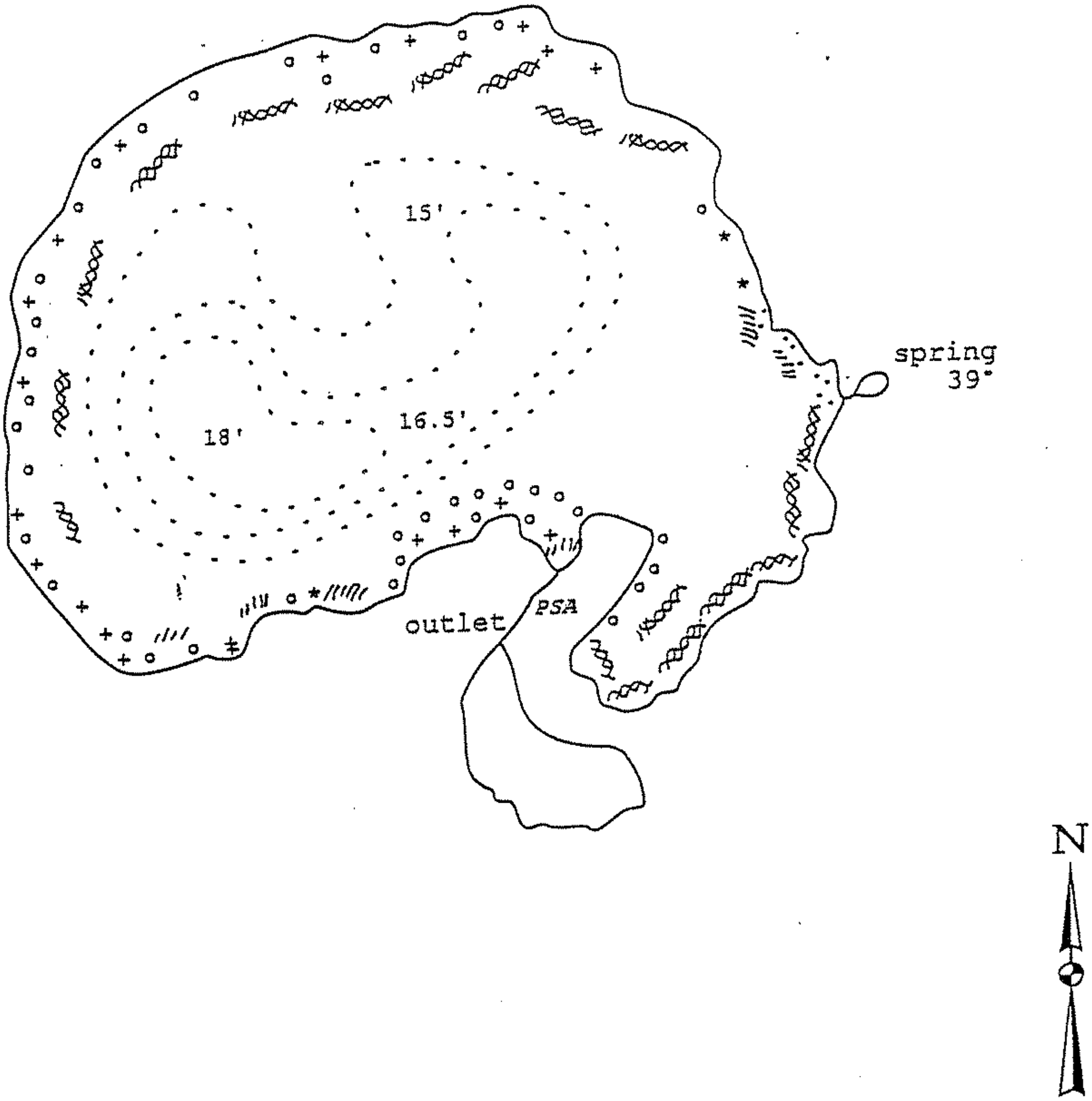
Figure 2.11. Horseshoe Lake. Not to scale



LEGEND

Sand	Gravel + + + +	Boulders o o o o o o	Gravel Under Detritus or Mud * * * * *	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area *PSA*	

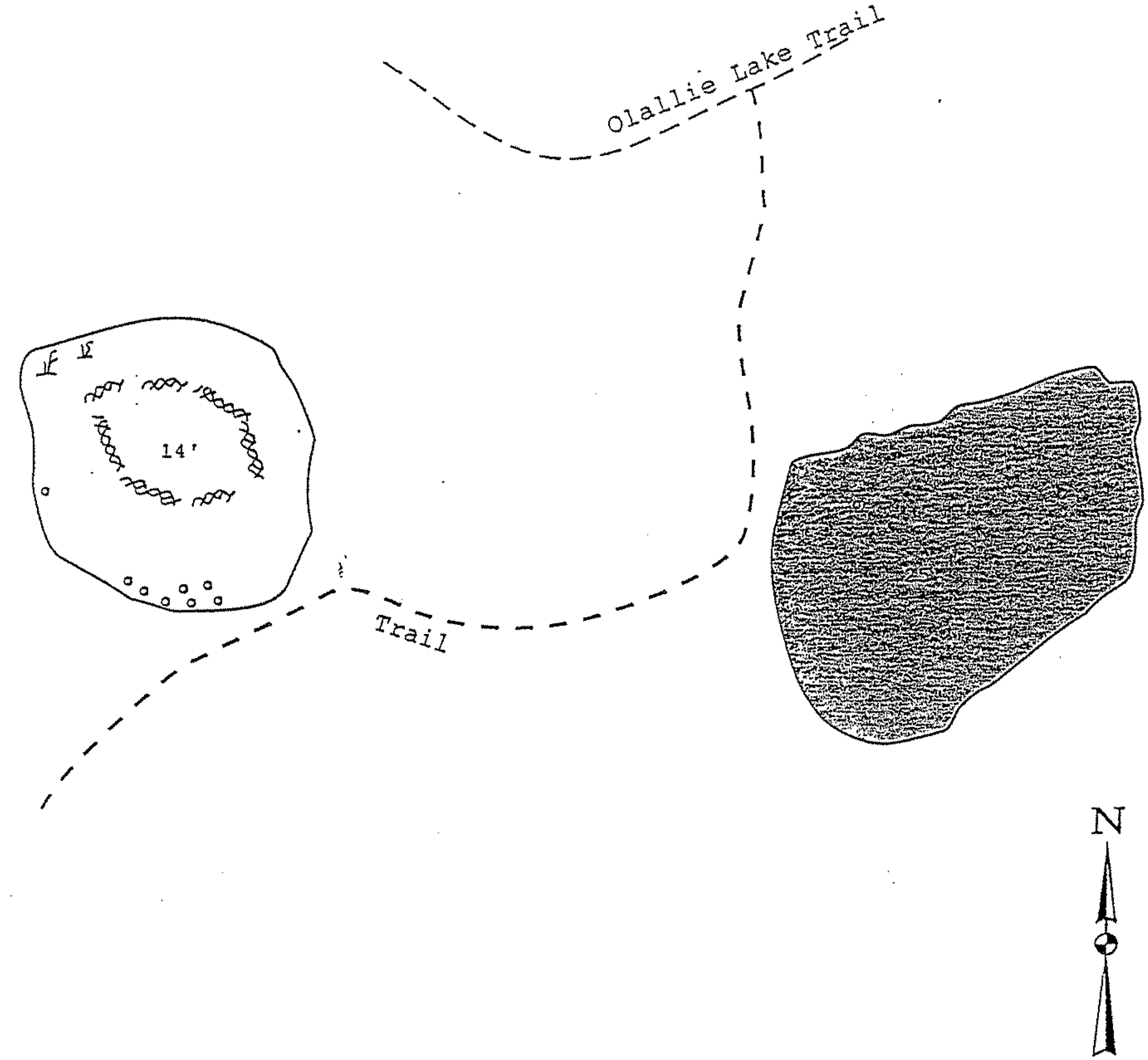
Figure 2.12. Jean Lake. Scale 1:238



LEGEND

Sand	Gravel	Boulders	Gravel Under Detritus or Mud	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area PSA	

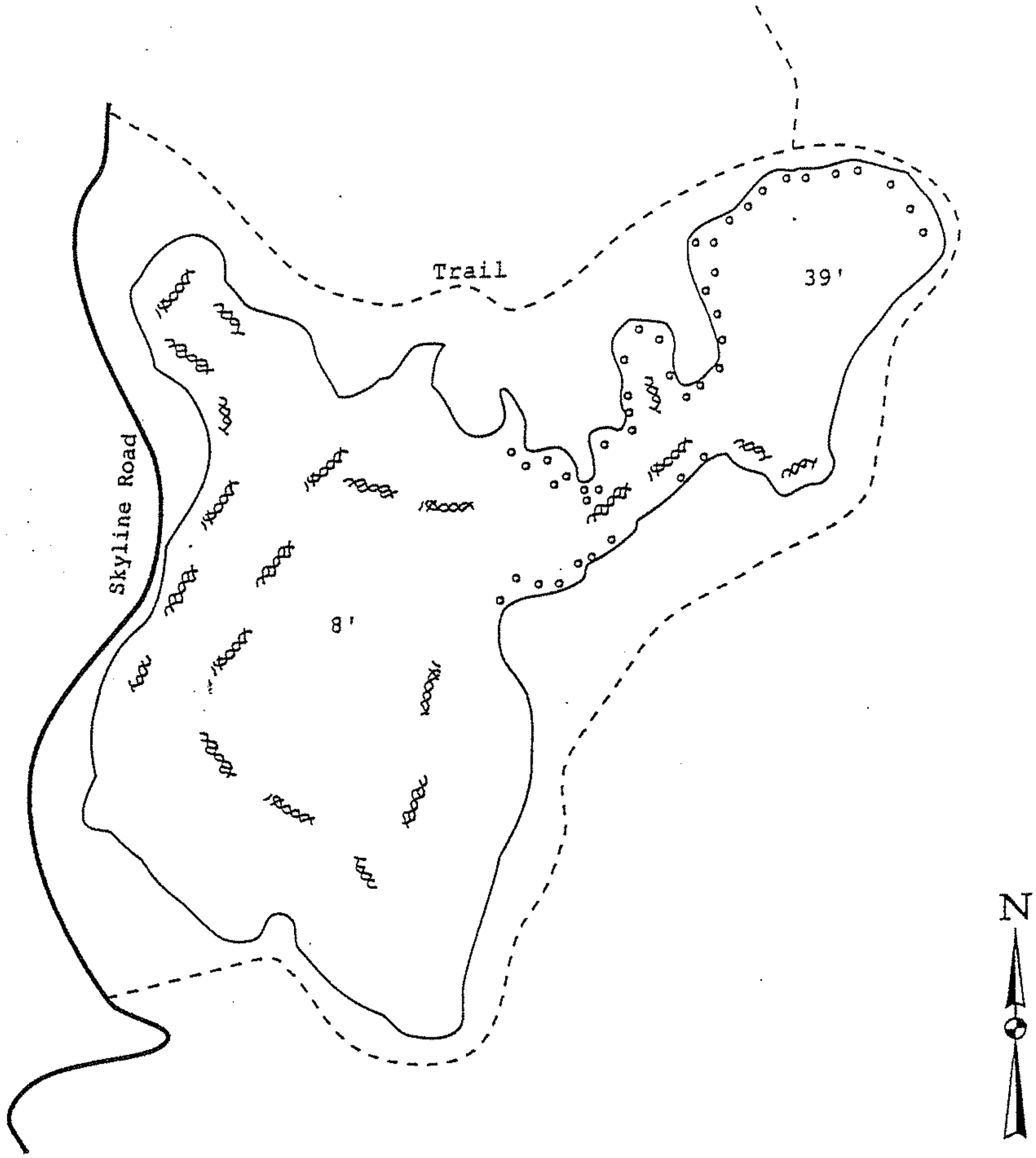
Figure 2.13. Jude Lake. Scale 1:238



LEGEND

Sand	Gravel	Boulders	Gravel Under Detritus or Mud	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area PSA	

Figure 2.14. Mangriff and Nup-Te-Pa Lakes. Not to scale



LEGEND

Sand	Gravel	Boulders	Gravel Under Detritus or Mud	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area PSA	

Figure 2.15. Monon Lake. Not to scale

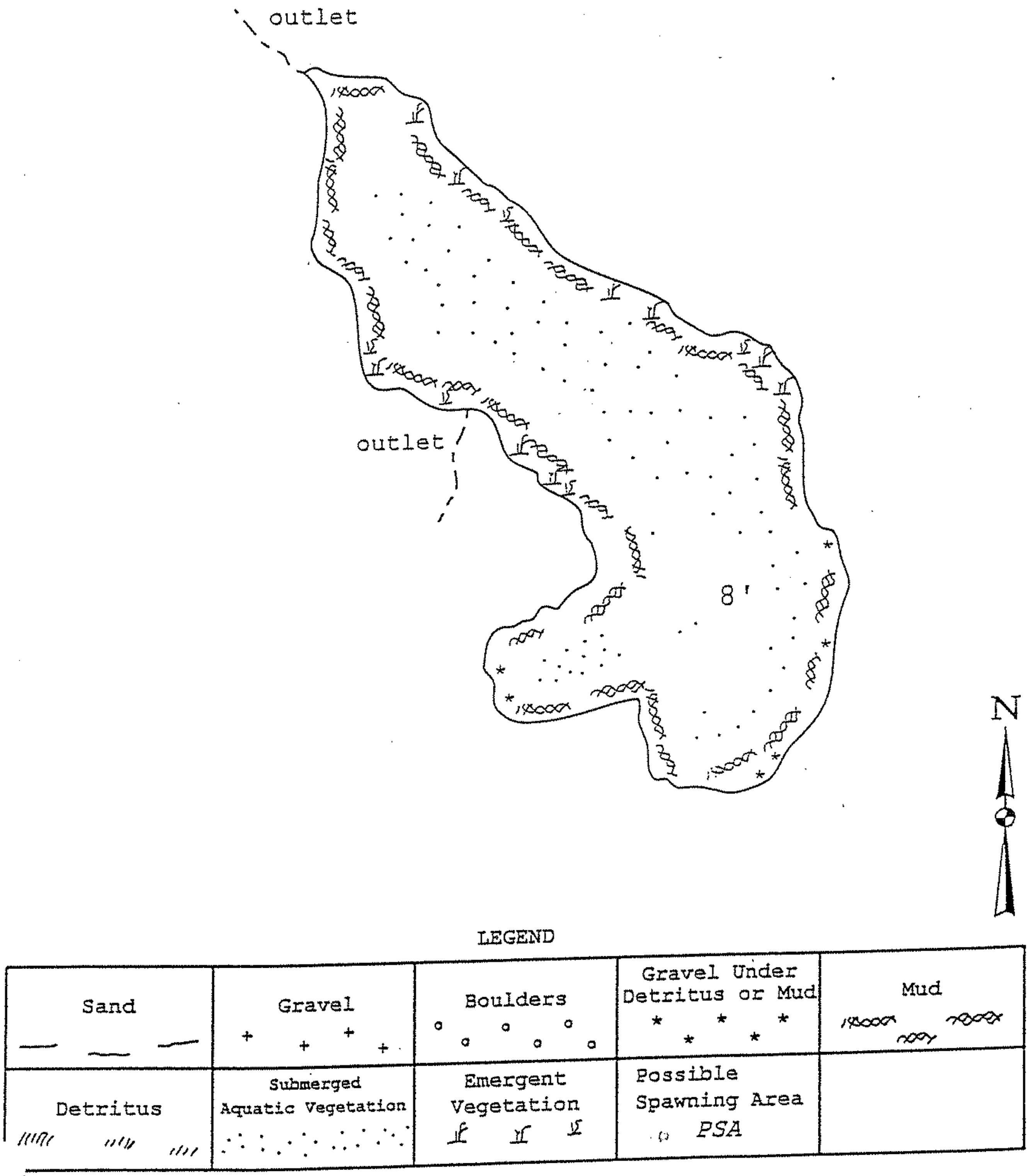


Figure 2.16. Russ Lake. Scale 1:238

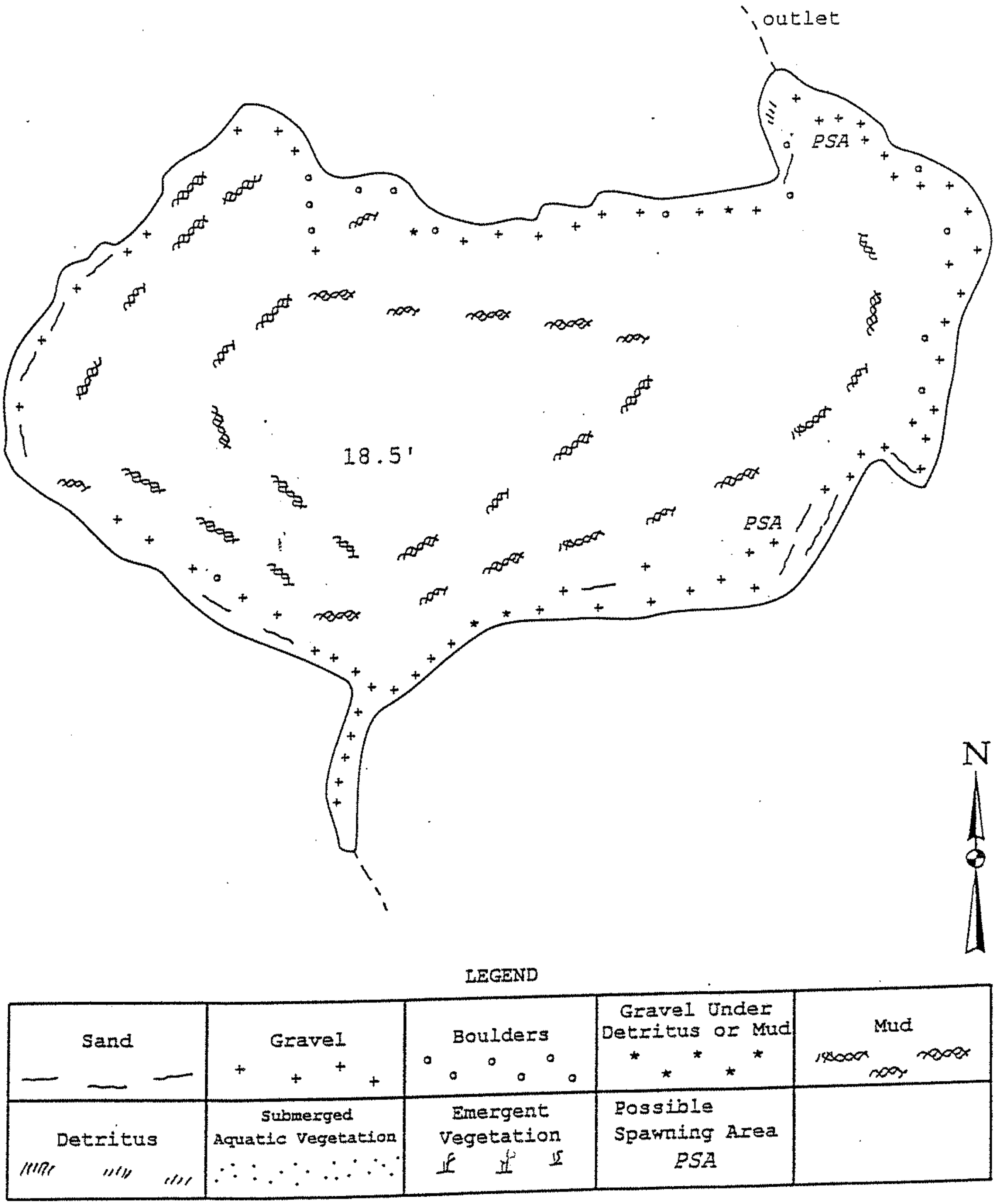
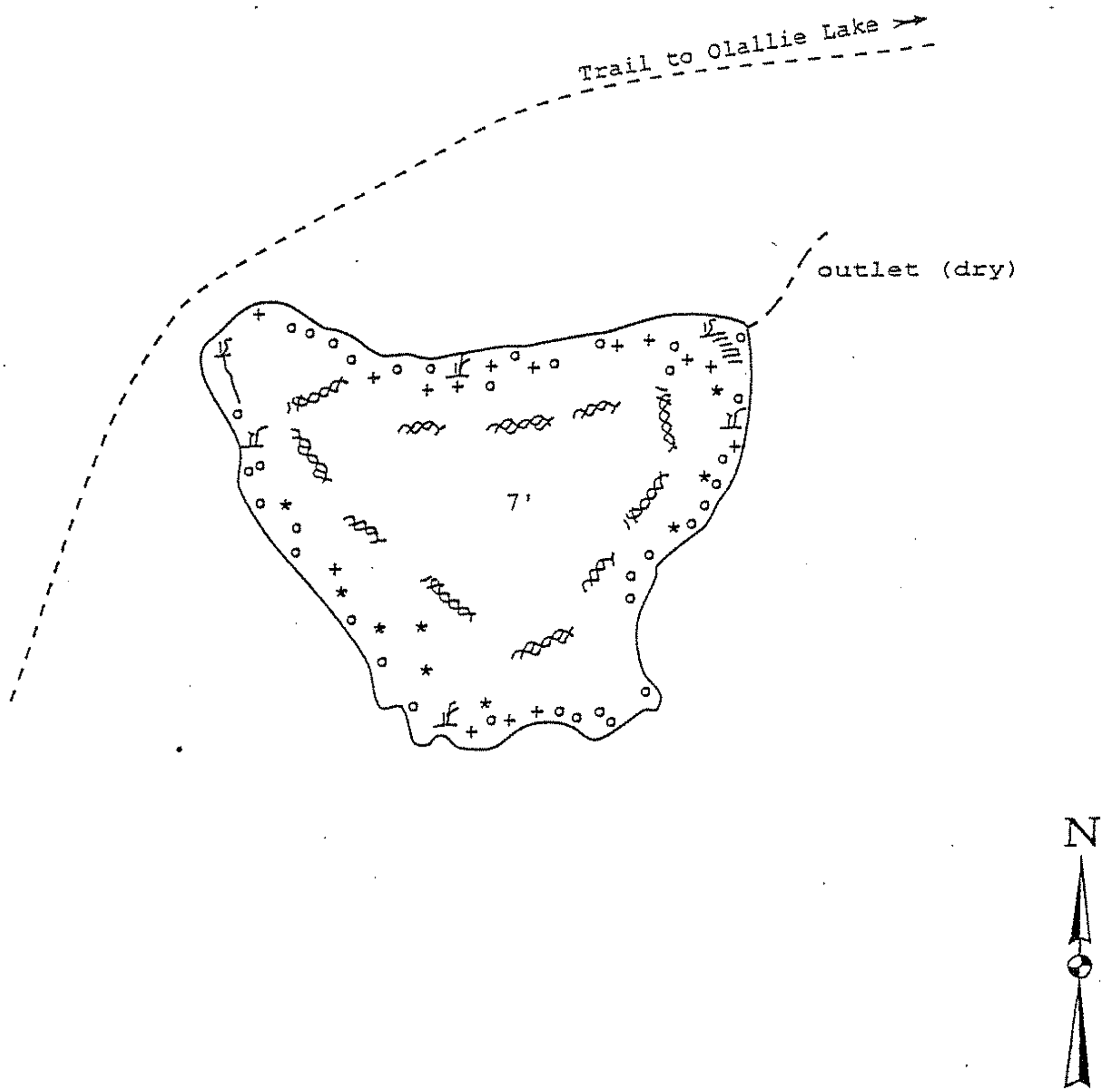


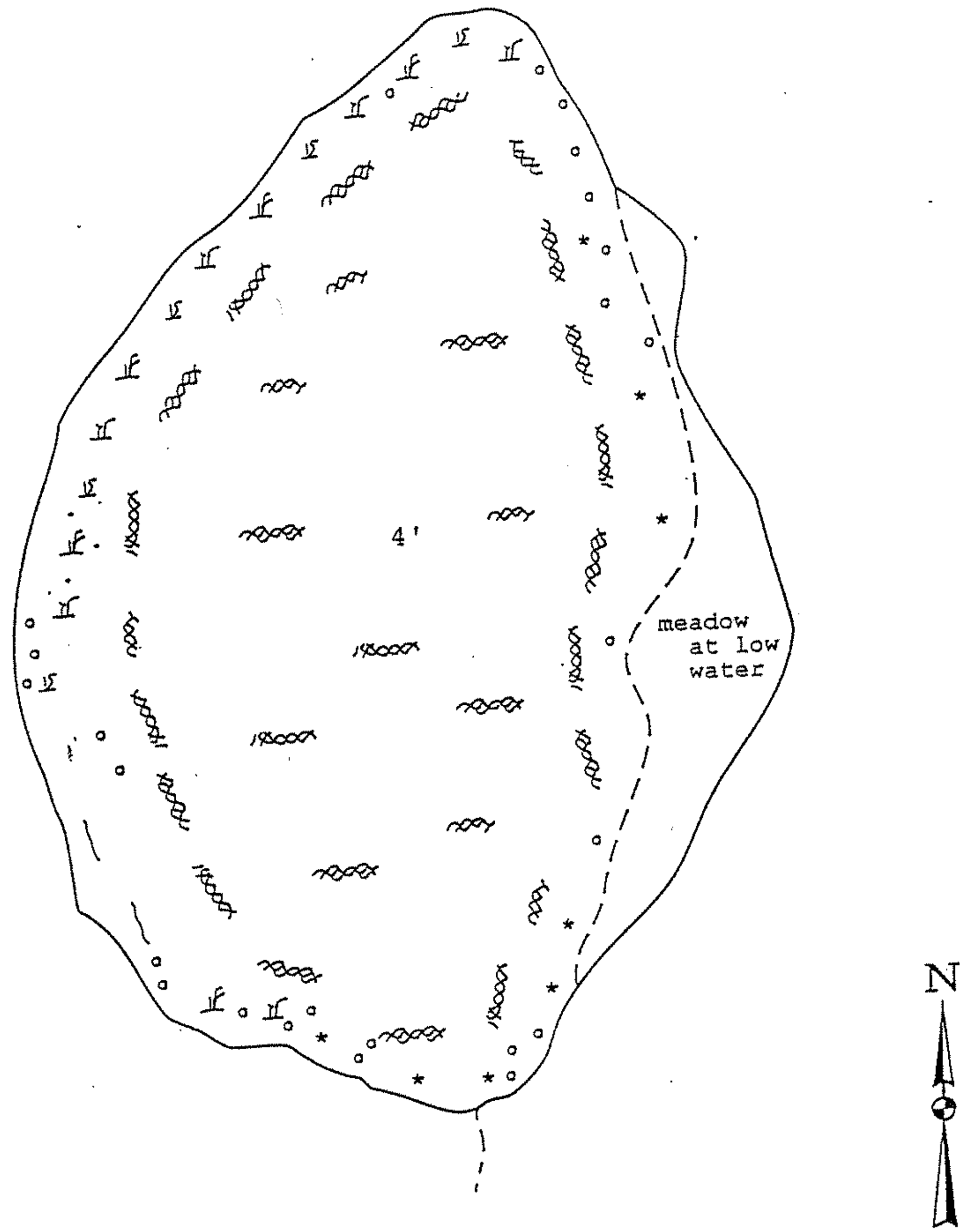
Figure 2.17. Timber Lake. Scale 1:260



LEGEND

Sand	Gravel + + + +	Boulders o o o o o o	Gravel Under Detritus or Mud * * * * *	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area *PSA*	

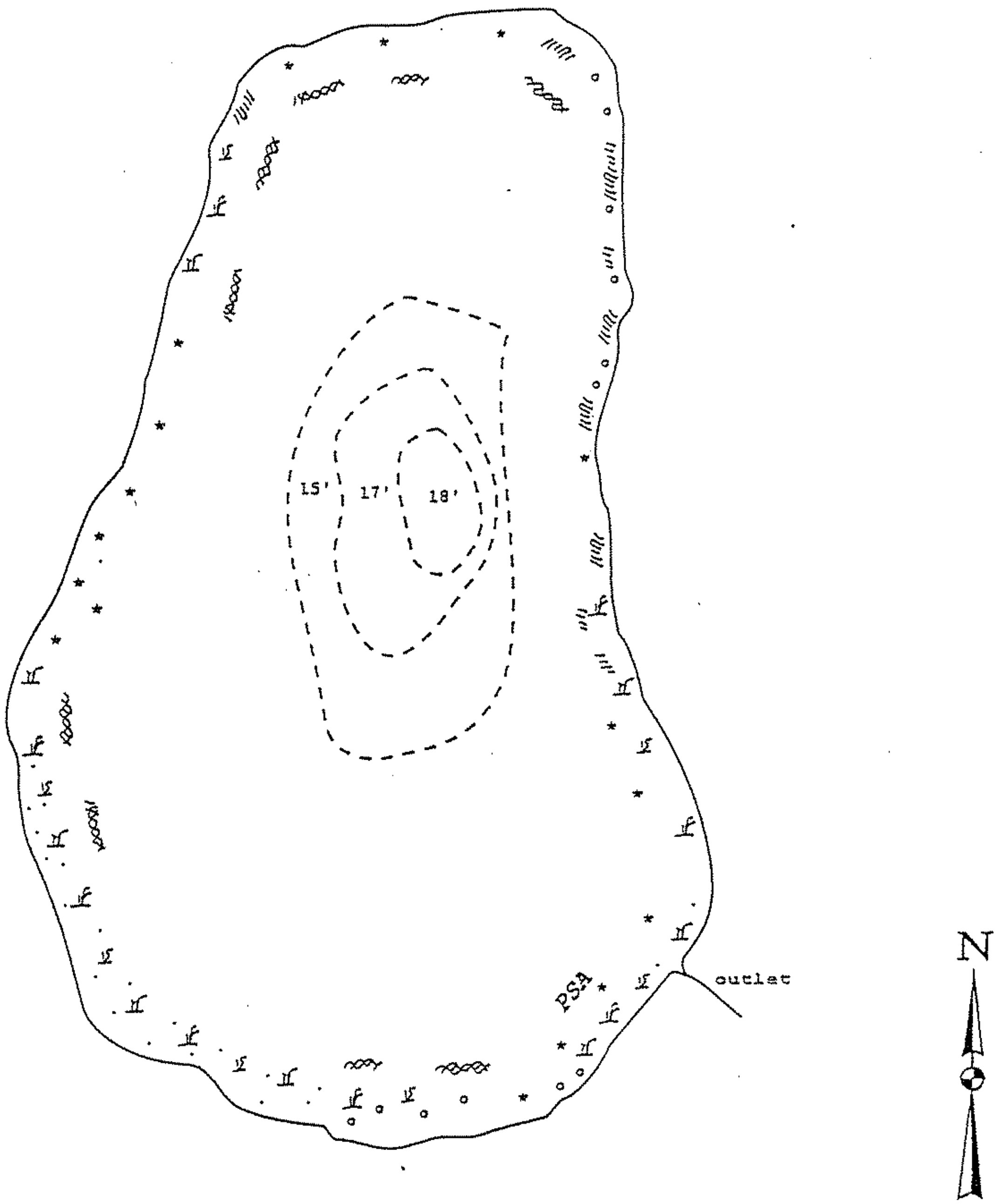
Figure 2.18. Top Lake. Scale 1:238



LEGEND

Sand	Gravel	Boulders	Gravel Under Detritus or Mud	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area *PSA*	

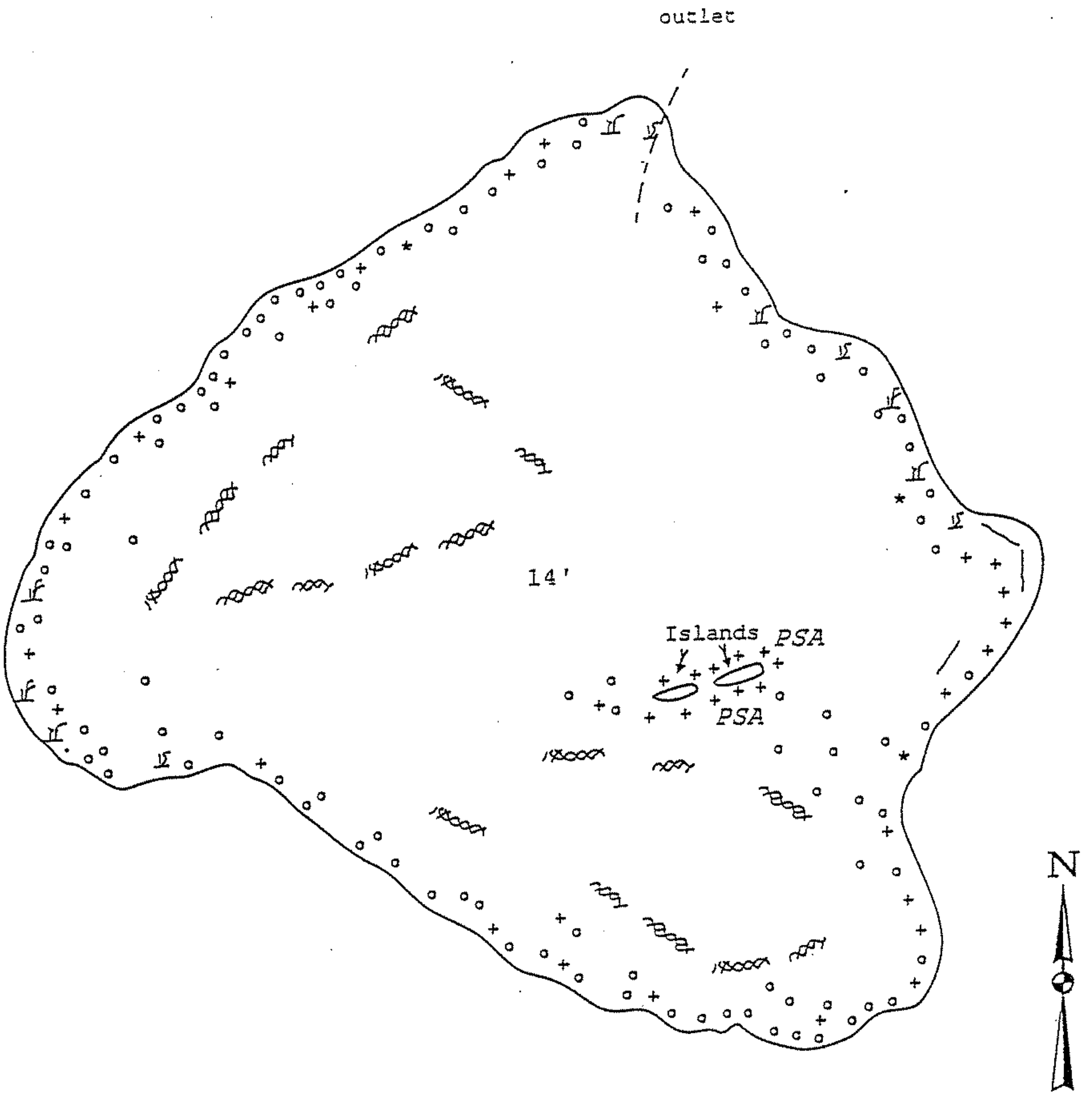
Figure 2.19. Lower Twin Lake. Scale 1:238



LEGEND

Sand	Gravel	Boulders	Gravel Under Detritus or Mud	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area PSA	

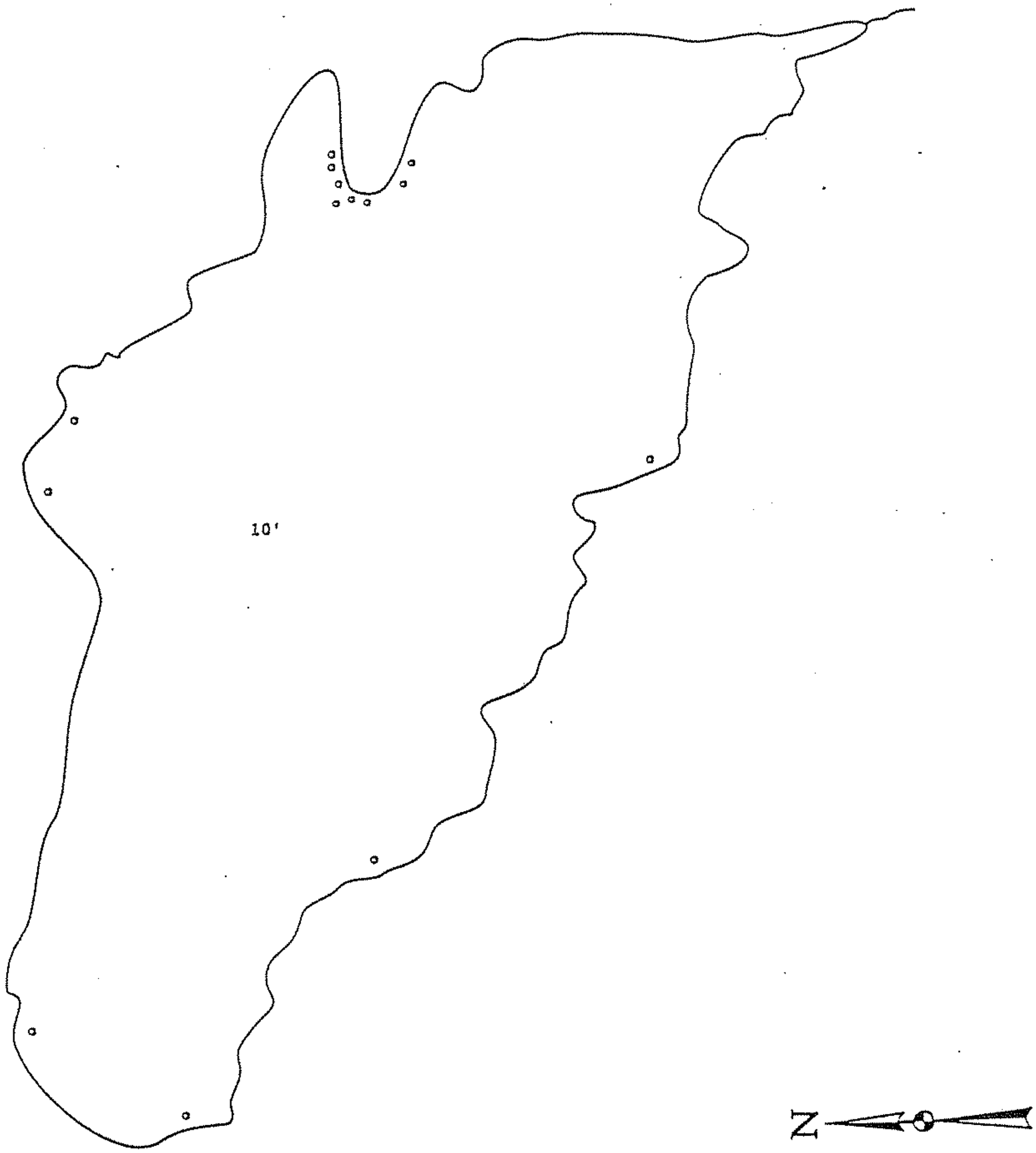
Figure 2.20. Upper Twin Lake. Scale 1:285



LEGEND

Sand	Gravel + + + +	Boulders o o o o o	Gravel Under Detritus or Mud * * * * *	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area *PSA*	

Figure 2.21. Upper Lake. Scale 1:238



LEGEND

Sand	Gravel	Boulders	Gravel Under Detritus or Mud	Mud
Detritus	Submerged Aquatic Vegetation	Emergent Vegetation	Possible Spawning Area *PSA*	

Figure 2.22. View Lake. Not to Scale.

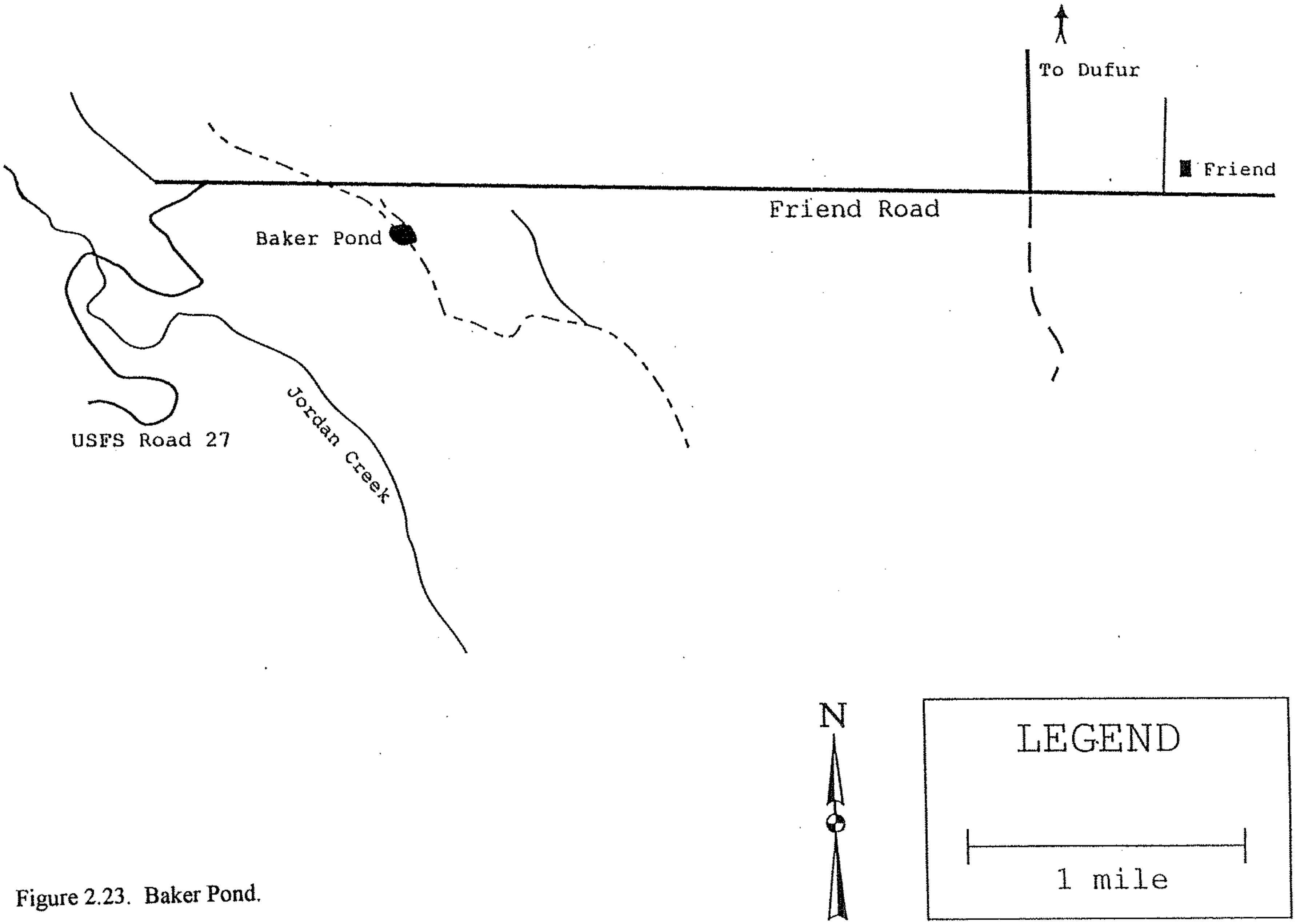


Figure 2.23. Baker Pond.

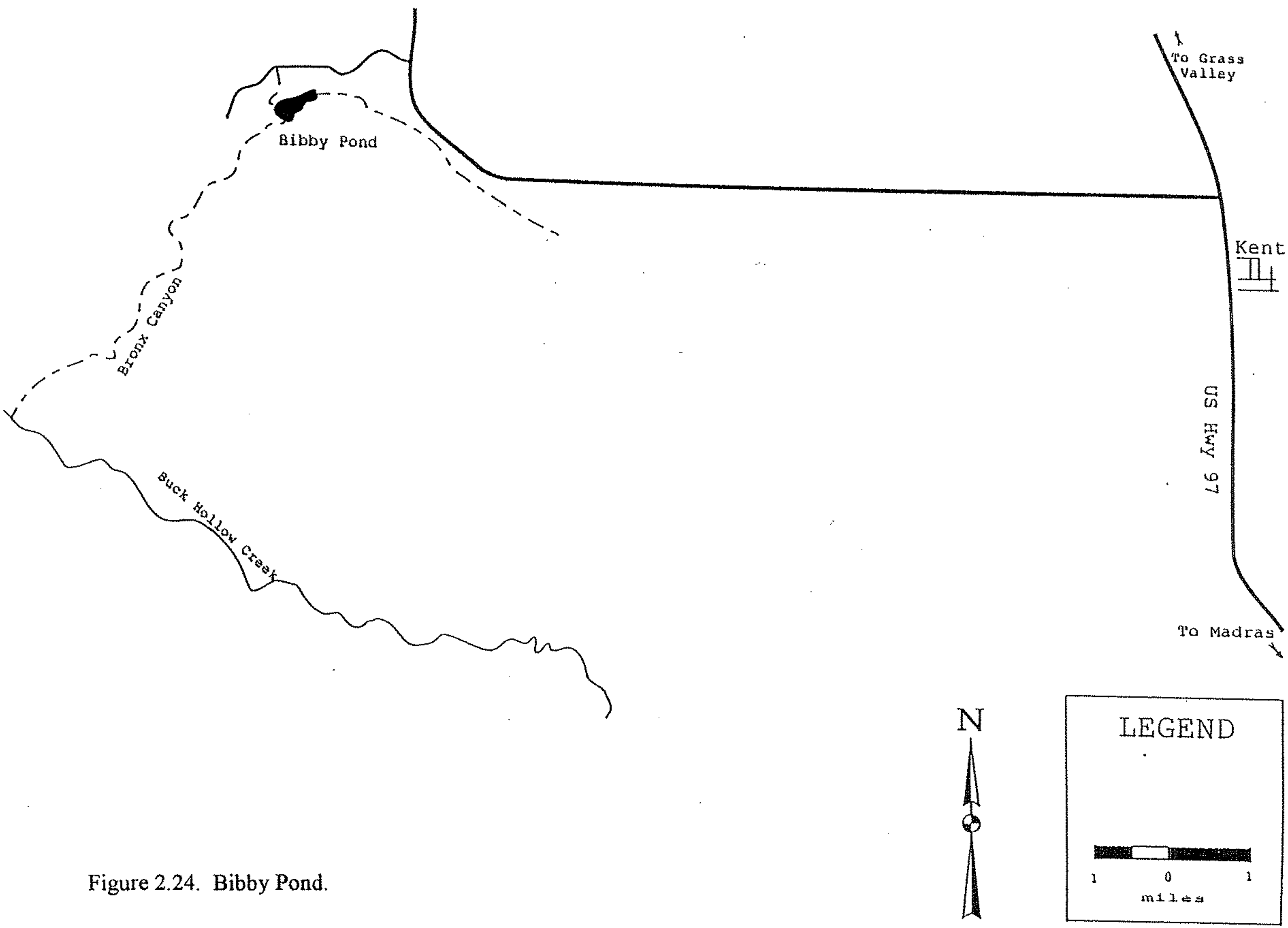


Figure 2.24. Bibby Pond.

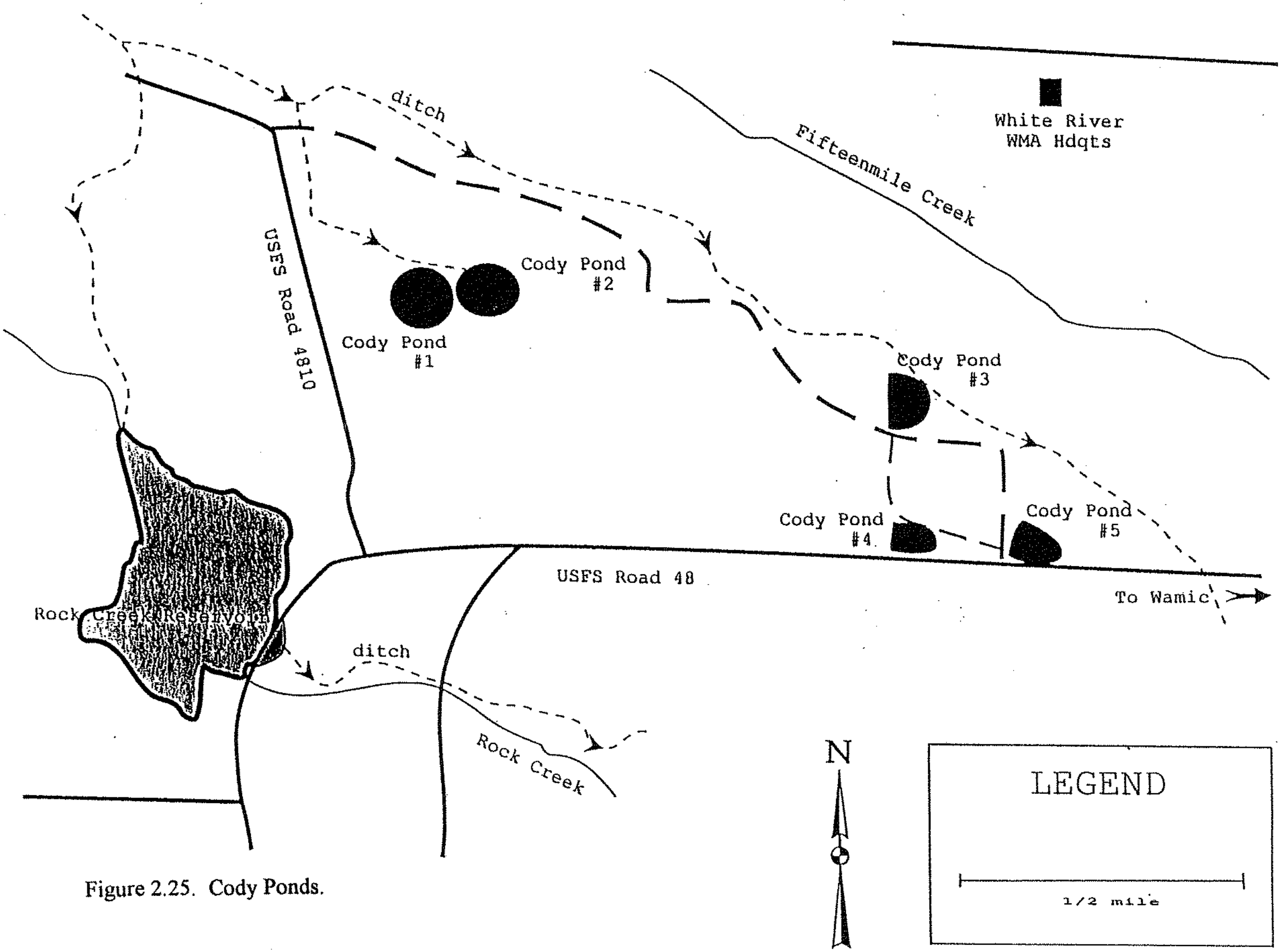


Figure 2.25. Cody Ponds.

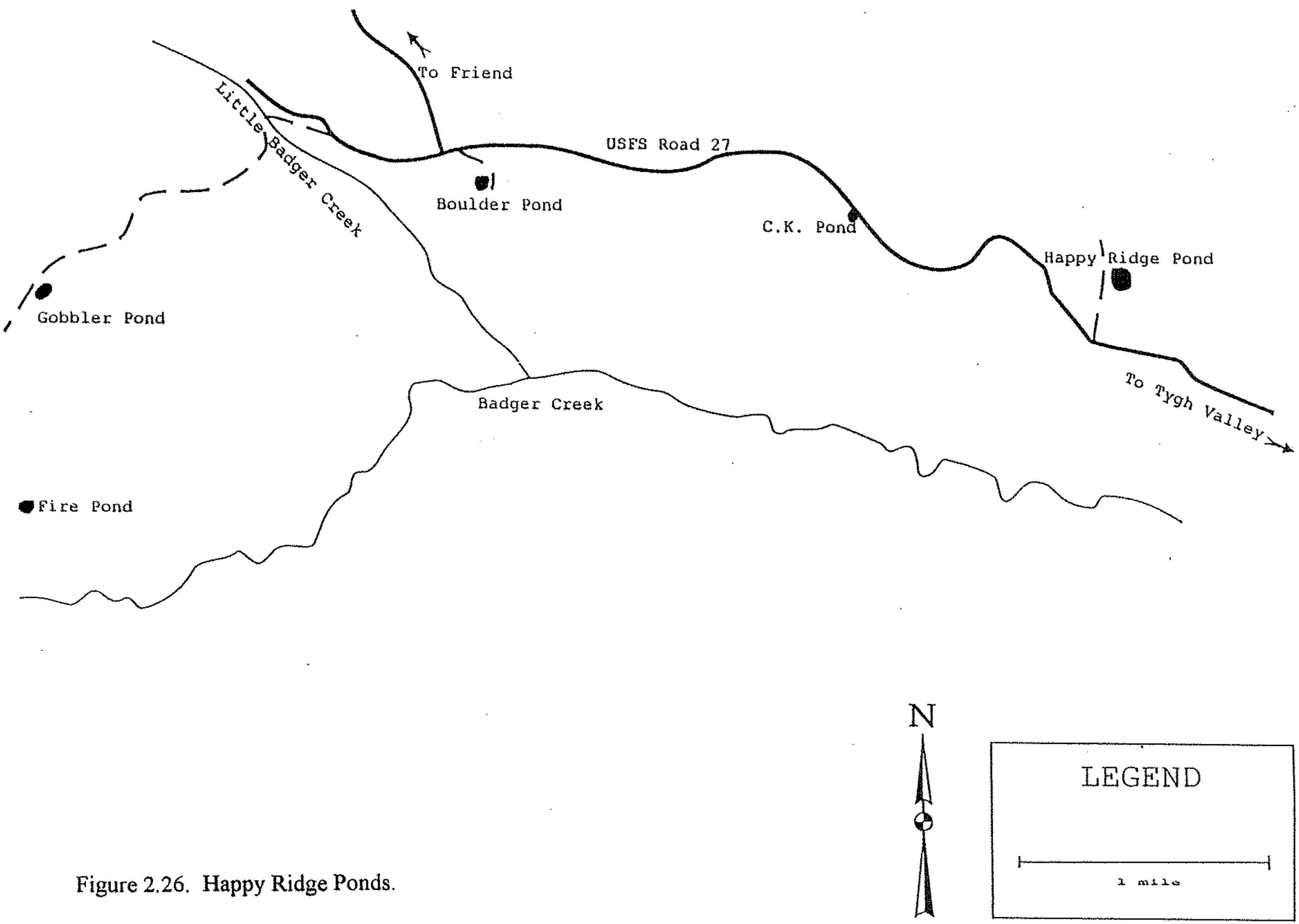


Figure 2.26. Happy Ridge Ponds.

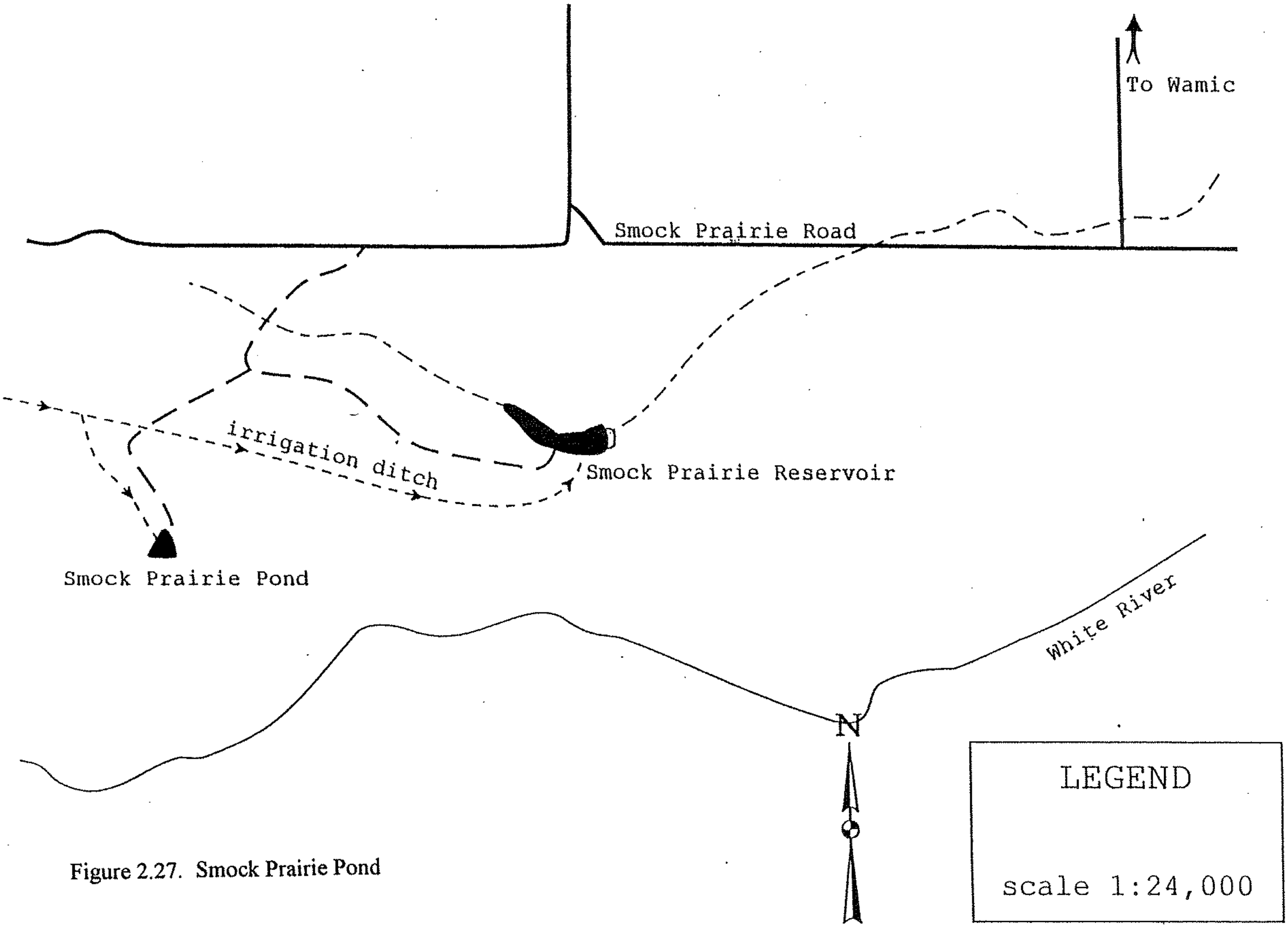


Figure 2.27. Smock Prairie Pond

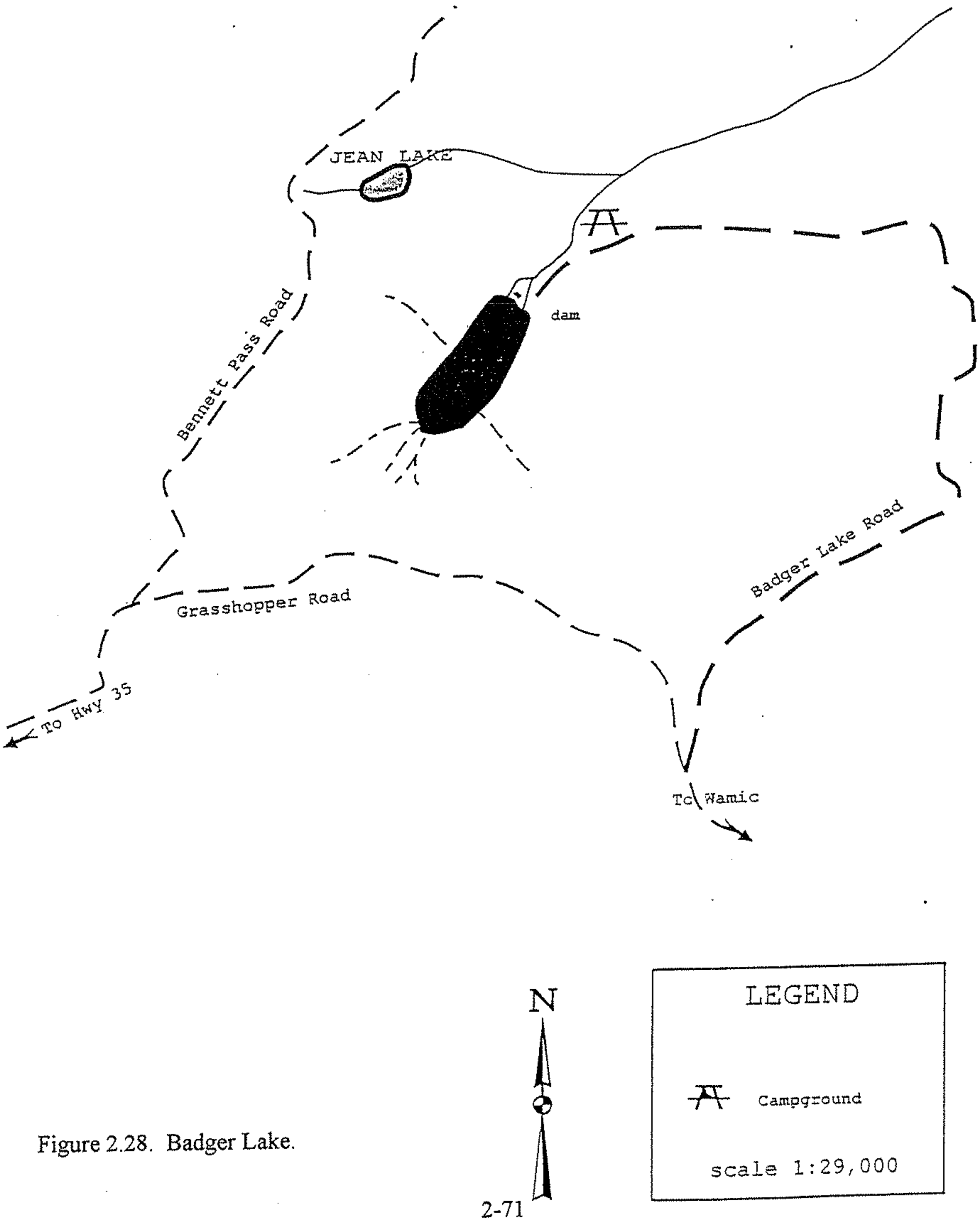


Figure 2.28. Badger Lake.

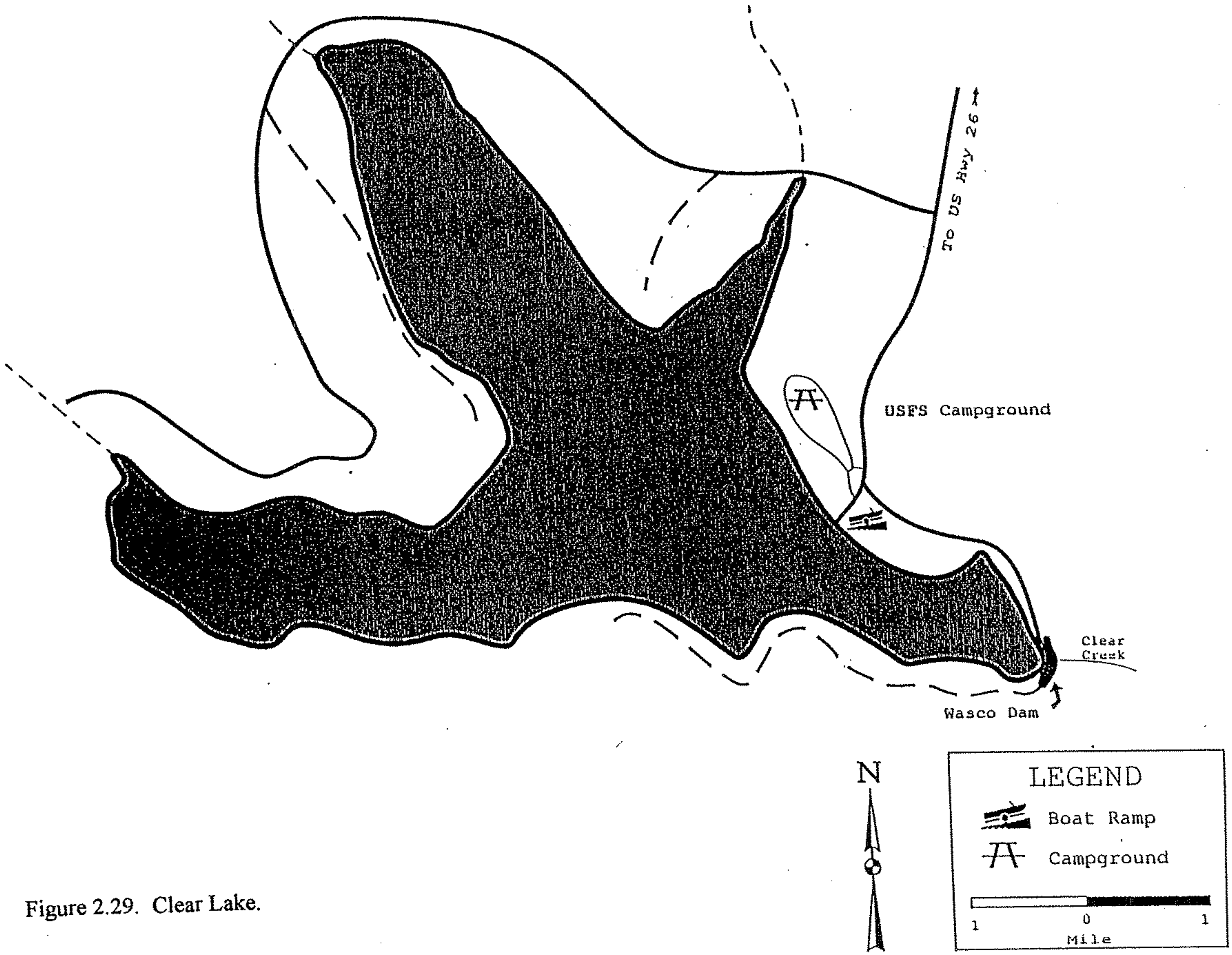


Figure 2.29. Clear Lake.

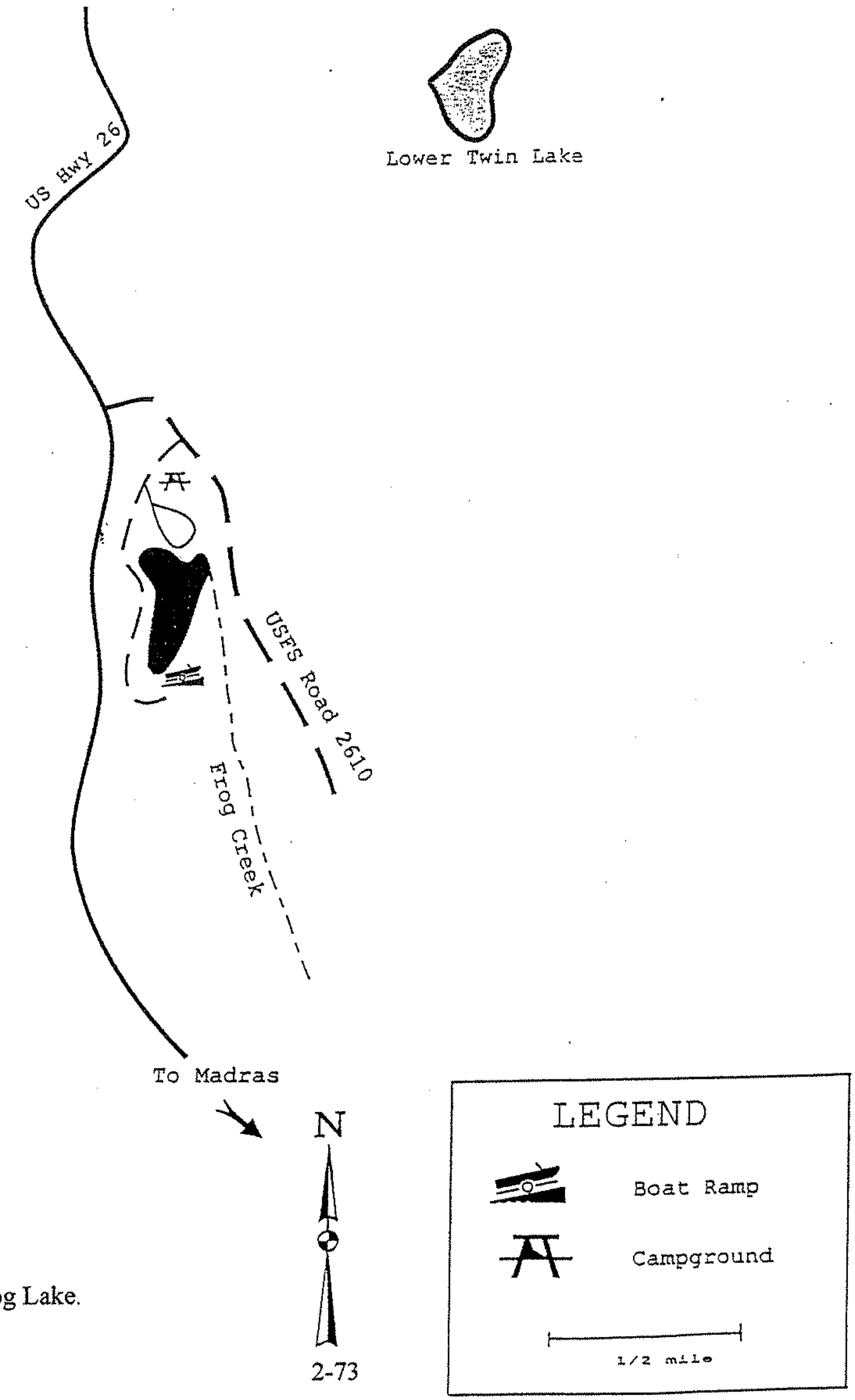


Figure 2.30. Frog Lake.

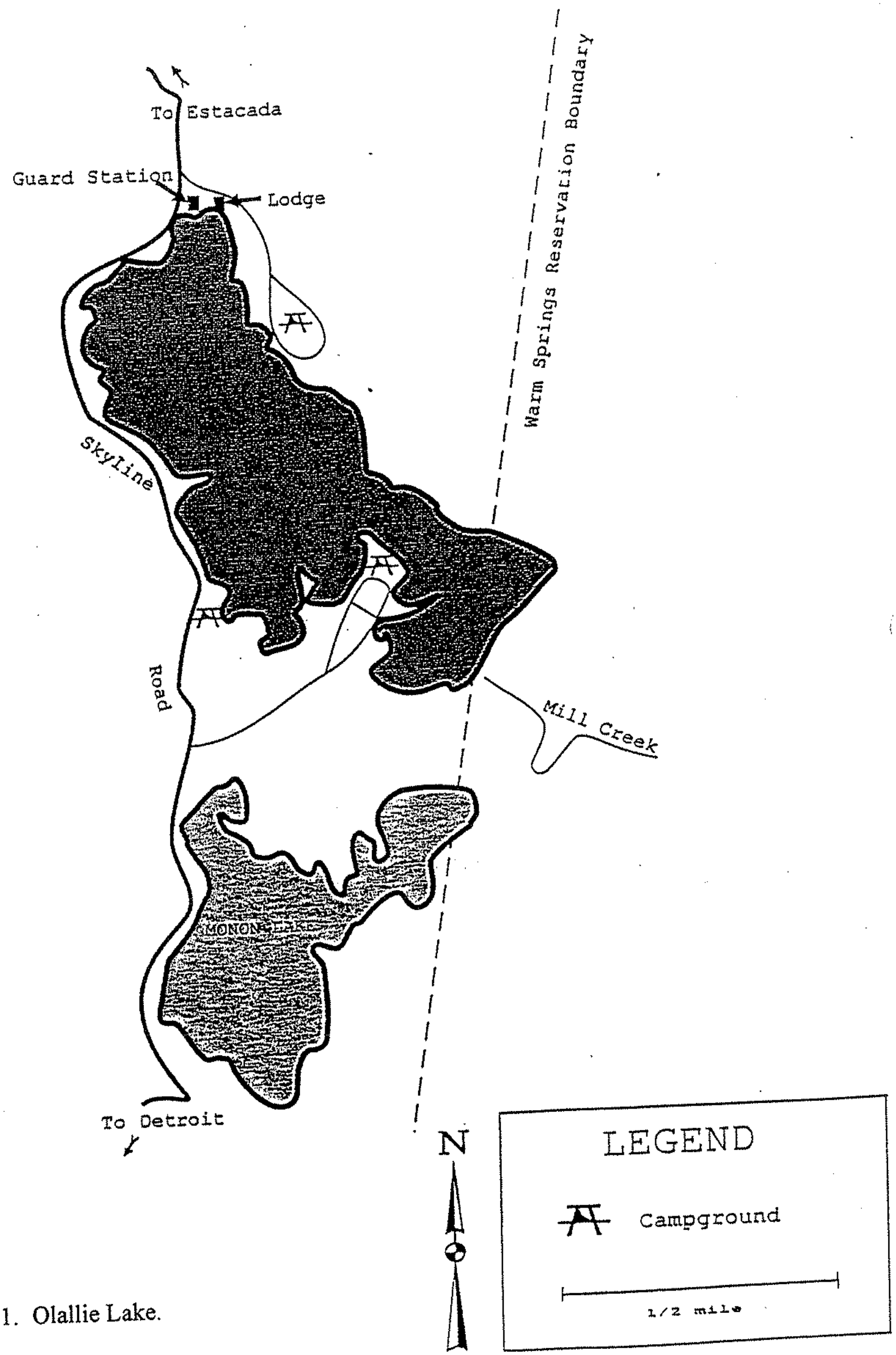


Figure 2.31. Olallie Lake.

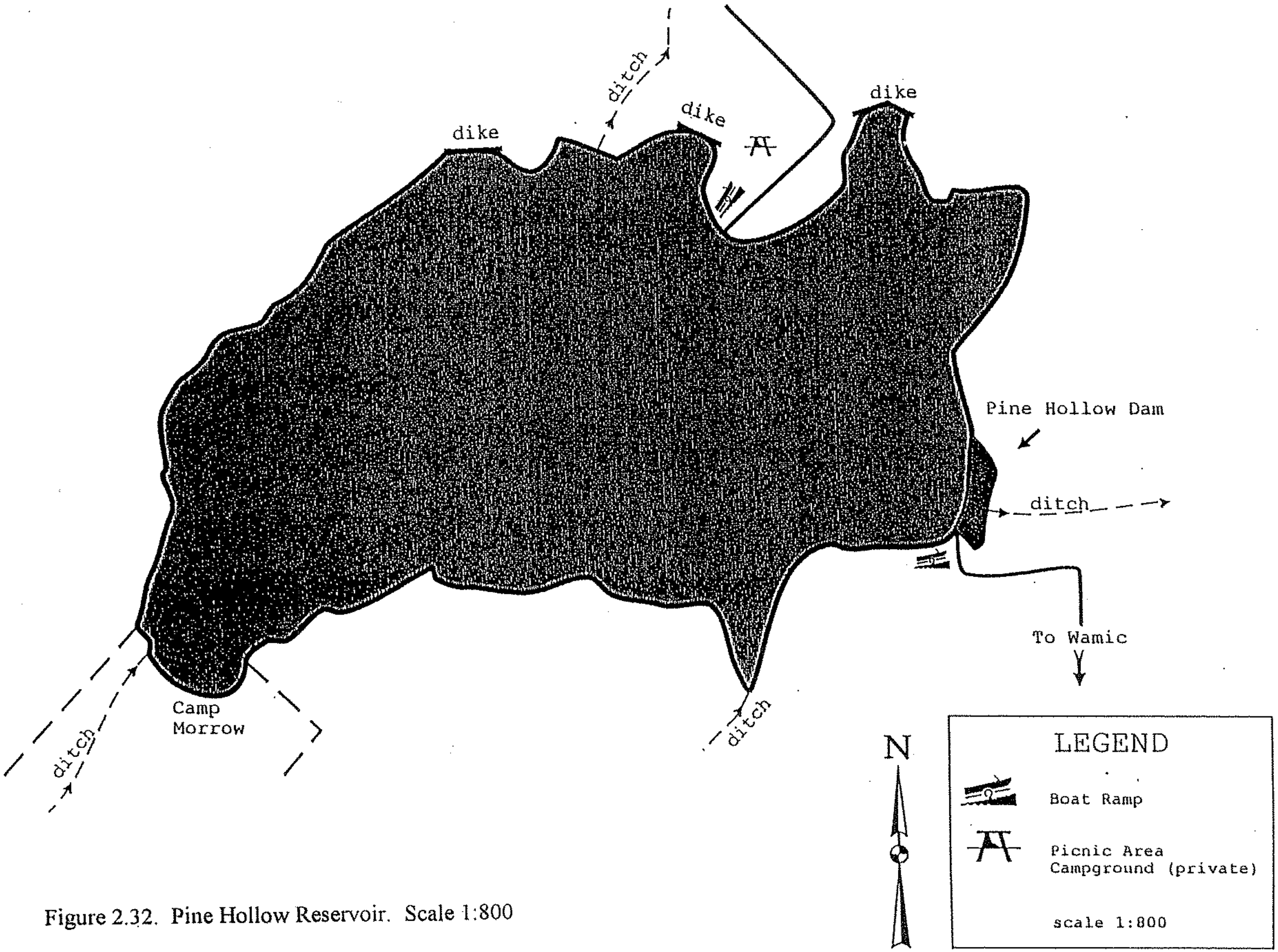


Figure 2.32. Pine Hollow Reservoir. Scale 1:800

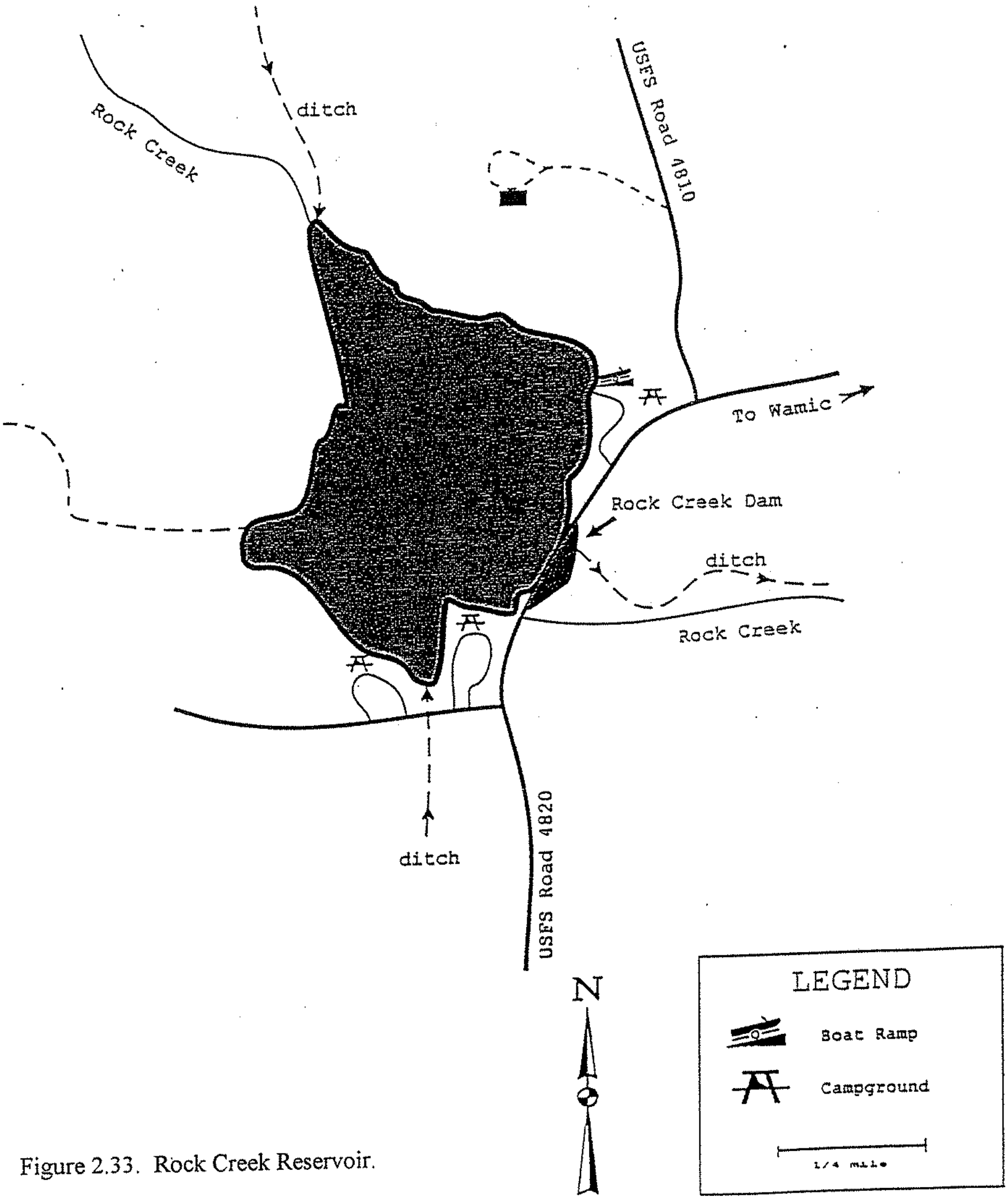


Figure 2.33. Rock Creek Reservoir.

LOWER DESCHUTES RIVER SUBBASIN MANAGEMENT PLAN
SECTION 3. TROUT, WHITEFISH, AND MISCELLANEOUS SPECIES IN FLOWING WATERS

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TROUT, WHITEFISH, AND MISCELLANEOUS SPECIES IN FLOWING WATERS

RAINBOW TROUT

Background and Status

Origin

Rainbow trout, *Oncorhynchus mykiss* (formerly *Salmo gairdneri*), are indigenous to the lower Deschutes River subbasin and they inhabit the lower 100 miles of the Deschutes River. Rainbow trout are also found throughout tributaries of the lower Deschutes River, but are most abundant in the White River system, which is blocked to anadromous fish passage approximately 2 miles from the mouth by impassable waterfalls. Indigenous rainbow trout populations above White River Falls are significantly different from those of the rest of the subbasin. The White River group of rainbow trout exhibit genetic and morphological characteristics that were previously found in populations of rainbow trout inhabiting isolated drainages of the northern Great Basin (Currens et al. 1990). White River rainbow trout may have been isolated from populations in the Deschutes River during the Pleistocene Epoch.

Indigenous populations have been supplemented with hatchery rainbow trout since 1934 in the White River and since the late 1940's in the mainstem lower Deschutes River, in order to meet management objectives of that time. Hatchery supplementation was discontinued in the mainstem lower Deschutes River in 1978, and discontinued after 1993 in White River. Roaring River stock of hatchery rainbow trout were used in both the mainstem lower Deschutes River and in White River. Deschutes River stock of hatchery rainbow trout was stocked into White River above the falls between 1986 and 1991. Cape Cod stock was used there in 1992 and 1993. The Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) have stocked hatchery rainbow trout in both the Warm Springs River and in Shitike Creek but currently stock only the Warm Springs River.

Life History and Population Characteristics

Distribution and Abundance

Abundance of rainbow trout larger than 8 inches has been estimated in specific areas of the lower Deschutes River during the 1970's, 1980's and 1990's. Density of rainbow trout in the lower Deschutes River above Sherars Falls during this time ranged from 640 to 2,560 fish/mile (Tables 3.1 to 3.3). Densities in the 1980's, the time period with the most data, averaged 1,630 fish/mile in the North Junction area (river mile 69.8 to 72.8) and 1,830 fish/mile in the Nena Creek area (river mile 56.5 to 59.5) (Schroeder and Smith 1989). Rainbow trout in the lower Deschutes River are believed to generally be most abundant between Pelton Reregulating Dam and Maupin.

Although statistically sound population estimates for rainbow trout are limited for the reach of the lower Deschutes River downstream from Sherars Falls, rainbow trout are believed to be less abundant below Sherars Falls than above. Several factors may contribute to this decreased abundance. Higher water temperatures may favor other fish species, increasing competition for available resources in the river. Potentially lower quality and quantity of spawning gravel may also contribute to lower rainbow trout populations downstream from the confluence of White River.

Glacial sediments contributed by White River may decrease egg to fry survival and decrease aquatic insect production. The detrimental effect of sediment on fish and invertebrate communities in streams is well documented (Schroeder and Smith 1989).

The abundance of rainbow trout age 1 and older in the White River system upstream from White River Falls was estimated in 1984 (ODFW et al. 1985) to range from 56 to 2,897 fish/mile. The density of rainbow trout greater than 6 inches ranged from 56 fish/mile (Little Badger Creek) to 445 fish/mile (Threemile Creek), whereas density of rainbow trout less than 6 inches ranged from 316 fish/mile (Clear and Frog creeks) to 2,897 fish/mile (Jordan Creek) (Table 3.4). The abundance of rainbow trout in the White River system was greatest in the mainstem and in tributaries of the lower mainstem (downstream from river mile 12).

Estimates of production of wild rainbow trout within the White River system indicate that the mainstem White River produces a higher percentage of legal-sized trout (about 30% were greater than 6 inches long) than other parts of the White River system. Legal-sized trout production (percentage of the total population greater than 6 inches long) of other streams within the basin is lower, from 3% in Little Badger Creek to 18% in Clear Creek (Table 3.4).

Natural Production

Rainbow trout spawn during spring and early summer, with most spawning occurring from April to July, although limited spawning may take place over a much broader period of time. Most suitable trout spawning gravel in the lower Deschutes River is in the area from White River to Pelton Reregulating Dam (Huntington 1985).

Mean age and length of lower Deschutes River rainbow trout at first spawning is 3 or 4 years and 12 to 13 inches. Some males mature at age 2 and about 8-10 inches. Average fecundity of rainbow trout in the lower Deschutes River is 1,300 to 1,500 eggs/female. Spawning rainbow trout compose about half of the population of fish over 10 inches. Approximately 60% of the spawning fish have spawned previously. Some rainbow trout skip one or more years between spawning (Schroeder and Smith 1989).

Tag and recapture studies of rainbow trout indicate very little migration within the lower Deschutes River. About 75% of the tagged rainbow trout greater than 8 inches in length caught 1-5 years after tagging were recaptured within the same three mile study area. Median distance of upstream and downstream migration for tagged fish that did leave the tagging area was about 9 miles and 6 miles, respectively. Most migrants were mature fish and migration appeared to be associated with spawning activity (Schroeder and Smith 1989). Studies done by Oregon Department of Fish and Wildlife (ODFW) Research in 1985 suggest movement of rainbow trout out of the mainstem upper White River into clear water tributaries or into lower White River during periods of heavy glacial siltation. The lower mainstem White River appears to be an important rearing area for indigenous rainbow trout in summer and fall, despite heavy loads of glacial silt that usually occur during this period.

While investigating the survival of hatchery steelhead smolts migrating over White River Falls in 1984, ODFW Research personnel recovered hatchery rainbow trout that had been stocked into the White River system. From this data it is estimated that hatchery rainbow trout stocked into the White River system have a minimum migration rate out of White River of 6% (Schroeder unpublished data). While not directly comparable, a study done at Green Peter Reservoir in the Willamette River system found that the migration rate of hatchery legal-sized rainbow trout varied over a five year period from 10% to 23% (Buchanan unpublished data).

Age Structure and Size

Growth of rainbow trout in the lower Deschutes River is dependent on the stage of maturity and size of the individual. Immature fish grow faster than mature fish. Growth slows after a fish matures as energy is used for development of gonads and regaining body condition after spawning. Growth slows as fish size increases. Average annual growth of rainbow trout at ages 1-6 is 4.4 inches, 4.3 inches, 3.1 inches, 1.7 inches, 1.4 inches, and 0.8 inch, respectively. Data from tagged fish showed that, of the rainbow trout greater than 2 years in age, many were 5 to 7 years old, with a few fish living as long as 10 years (Schroeder and Smith 1989).

Analysis of scales from rainbow trout in the White River system indicated a predominance of age 1 and age 2 fish in the watershed. Analysis of scales of rainbow trout over 12" from lower White River indicated first spawning at age 3 and age 4. Scale analysis suggests that growth continues after maturation, somewhat contrary to what is observed in the lower Deschutes River. Growth rate of rainbow trout in the lower mainstem White River was significantly greater than for rainbow trout elsewhere in White River. Rainbow trout that migrate to lower White River from July to October showed an increase in growth for that period.

Genetics

Currens et al. (1990) examined the genetic characteristics of 22 populations of rainbow trout in the lower Deschutes River subbasin and found three distinct groups based on biochemical similarity. One group consisted of two introduced hatchery populations, the second group consisted of nine populations sampled in White River, and the third group consisted of wild populations in the lower Deschutes River and tributaries other than White River (including indigenous hatchery strains).

Rainbow trout isolated above White River Falls are more similar to isolated populations of rainbow trout in the Fort Rock Basin, in both genetic and morphological characteristics, than they are to lower Deschutes River rainbow trout. These characteristics include fewer pyloric caeca, finer scales, and little or no variation at two specific alleles (Currens et al. 1990). A possible explanation is that the Fort Rock Basin was drained by the Deschutes River until lava flows separated the drainages in the late Pleistocene epoch (Allison 1979). Ancestral rainbow trout probably invaded White River and the Fort Rock Basin when they were connected to the Deschutes River. Subsequent isolation of White River and Fort Rock basins prevented these populations from acquiring genetic traits that evolved in the Deschutes River population during the last glacial period. Therefore, some populations in the White River system may represent remnants of the ancestral population and an evolutionary line originating from a primitive race of rainbow trout.

Based on samples from nine areas in the system, three groups of rainbow trout occupy the White River system. These groups are: (1) Lower White River, Lower Tygh Creek, Gate Creek; (2) Barlow, Little Badger, and Threemile creeks; (3) Upper Tygh, Jordan, and Rock creeks. The rainbow trout within these three groups are more similar to one another than they are to the rainbow trout of the other groups in the basin. A previously unreported allele for rainbow trout is found in the Threemile and Barlow populations.

Observed differences between populations in the White and lower Deschutes rivers are probably not attributable to the influence of hatchery rainbow trout that have been previously stocked in the White River system. However, there is evidence that genetic introgression between indigenous rainbow trout and hatchery populations may have occurred in the lower White River, lower Tygh Creek, Jordan Creek, and Rock Creek (Currens et al. 1990).

Pathology

Lower Deschutes River rainbow trout are resistant to infection by *Ceratomyxa shasta,* a myxosporean parasite that was first detected in the lower Deschutes River immediately below the Pelton Reregulating Dam (river mile 100) in 1965. Its presence has been detected every time tests have been conducted since 1965.

Studies done by ODFW in 1984 indicate that rainbow trout found in the White River system are susceptible to infection by *C. shasta*. A domestic stock of *C. shasta* susceptible rainbow trout was exposed to White River water during the study and showed no evidence of the pathogen, strongly suggesting that *C. shasta* is not present in the White River. Preliminary tests exposing rainbow trout from a *C. shasta* susceptible domestic stock to Warm Springs River water showed no mortality from the pathogen, suggesting that *C. shasta* is also not present in the Warm Springs River (personnel communication with Don Ratliff, PGE Biologist, Madras, Oregon, June 10, 1996). Infectious hematopoietic necrosis (IHNV) was detected in 24% and 28% of the wild rainbow trout spawned at the Pelton trap in 1987 and 1988 respectively. IHNV and infectious pancreatic necrosis virus (IPNV) were not detected in rainbow trout from White River streams when last surveyed in 1983 and 1984.

A considerable amount of research has been done relative to *C. shasta* in the lower Deschutes River, Lake Billy Chinook and Lake Simtustus (Ratliff 1981; Ratliff 1983; Conrad and Decew 1966). One result of these investigations was the discovery that fish killed by ceratomyxosis resulted in an increase in the number of infective spores in the environment (Ratliff 1993). This was found to be especially true if fish killed by ceratomyxosis were in a reservoir upstream from flowing water. As a result of these investigations, only fish stocks resistant to *C. shasta* are currently released in Lake Billy Chinook and Lake Simtustus to decrease the risk of ceratomyxosis in the lower Deschutes River downstream from the reservoirs.

Hatchery Production

Streams, Lakes, and Reservoirs

Approximately 60,000 Roaring River stock legal-sized rainbow trout from Oak Springs and Wizard Falls hatcheries were stocked annually in the lower Deschutes River from the late 1940's to 1978. Trout were stocked near Warm Springs, from Nena Creek to Wapinitia Creek, and from Maupin to Oak Springs. This stock is susceptible to *C. shasta* and thus likely did not survive to spawn in the lower Deschutes River. Stocking was discontinued in 1978 when the Oregon Fish and Wildlife Commission decided that the lower 100 miles of the Deschutes River would be managed exclusively for wild trout. In some years, approximately 500 legal-size hatchery rainbow trout that are susceptible to *C. shasta* have been stocked in the lower Deschutes River at river mile 48 in May for the benefit of handicapped anglers.

Legal-sized hatchery rainbow trout were stocked annually in the Warm Springs River and Shitike Creek by the CTWS but are currently stocked only in the Warm Springs River near Kah-Nee-Ta Resort (Table 3.5). The purpose of this stocking program is for a recreational opportunity at the resort and youth recreation in Warm Springs River. In the past, Warm Springs River and Shitike

Creek were stocked with Cape Cod (Roaring River Hatchery) domestic rainbow trout that were reared at Warm Springs National Fish Hatchery from eggs obtained from Roaring River Hatchery. In recent years, the CTWS have stocked the Warm Springs River with *C. shasta* susceptible hatchery rainbow trout that have been purchased commercially. The contribution of hatchery rainbow trout in these fisheries is monitored by CTWS.

White River, Badger Creek, and the lakes and reservoirs of the White River system were stocked in the past with rainbow trout reared at Oak Springs, Hood River, Wizard Falls, Fall River, Klamath, and Bonneville hatcheries. Deschutes River stock rainbow trout from Oak Springs Hatchery were stocked in the White River system from 1983 until 1991. Deschutes River stock rainbow trout are resistant to *C. shasta* and thus could survive to spawn in the lower Deschutes River. White River and Badger Creek were last stocked in 1993. Former stream stocking locations in the White River system were White River at Farmers Road (river mile 17.5); Tygh Valley Bridge (river mile 6.5); below the Highway 197 bridge (river mile 5.0); and Badger Creek at Bonney Crossing (river mile 7.0). These programs were discontinued due to concerns for potential genetic impacts to the unique indigenous White River redband trout. Currently, only *C. shasta* susceptible hatchery rainbow trout (Cape Cod and Oak Springs stocks) are stocked into lakes and reservoirs of the White River system.

No expansion of the hatchery trout program is planned for the lower Deschutes River subbasin.

Oak Springs Hatchery

The water supply for Oak Springs Hatchery is from springs in the Deschutes River canyon on the east end of Juniper Flat. Wastewater from the Clear Creek Ditch overflows into the hatchery water supply. Efforts are being made to evaluate the impact of this wastewater on the hatchery and to determine actions for protecting the hatchery water supply. Irrigation water for the Clear Creek Ditch is diverted from Clear and Frog creeks.

A proposal to introduce anadromous species into White River upstream from White River Falls has been a component of the Northwest Power Planning Council's Fish and Wildlife Program for many years. The history and future of this proposal are discussed in detail in the Summer Steelhead Section of this plan. Protection of the Oak Springs Hatchery from contamination by IHNV and IPNV is a major consideration in any proposed passage of anadromous fish above White River Falls. Oak Springs Hatchery and resident fish in White River above the falls are free of IHNV and IPNV. Salmon and steelhead that could potentially be introduced into White River above the falls would likely be carriers of IHNV or IPNV. The potential for viral contamination of Oak Springs Hatchery is from surface and ground water connections between the hatchery water supply and the White River watershed.

Angling and Harvest

The lower Deschutes River supports a popular rainbow trout fishery. The character of this fishery has changed over the years as angling regulations have become more restrictive and the stocking of hatchery rainbow trout has been discontinued. Angling regulations and management strategies have changed to protect juvenile steelhead and to potentially increase certain size groups of wild rainbow trout.

In the 1950's through 1960's angling regulations allowed a daily bag limit of 10 trout with a minimum size of 6 inches and no terminal tackle restrictions. During the 1970's regulations on the lower Deschutes River above Sherars Falls gradually became more restrictive until 1979 when the daily bag limit was 2 trout with a minimum size of 12 inches and terminal tackle was restricted to artificial flies and lures (Figure 3.1). Regulations governing the harvest of rainbow trout in the reach from Sherars Falls downstream to the mouth were changed in 1979 for the first time in many years. Until that year, the trout bag limit had remained six trout with a six inch minimum size. After 1979, bag limit and terminal tackle restrictions were the same for the entire lower Deschutes River, with the exception of the Sherars Falls bait reach, which extends from the upstream most railroad trestle (river mile 40) to Sherars Falls (river mile 43). Regulations were changed in 1984 to the current regulations, which allow a daily bag limit of 2 trout with a length restriction of 10 inch minimum and 13 inch maximum, and terminal tackle is restricted to artificial flies and lures with barbless hooks. Bait is still allowed with barbless hooks in the Sherars Falls bait reach (river mile 40-43).

The trout season on the lower Deschutes River is currently open year around from the mouth up to the northern boundary of the CTWS reservation (river mile 69). From river mile 69 upstream to Pelton Reregulating Dam (river mile 100) the trout season is open from the fourth Saturday in April until the end of October (no angling from Pelton Reregulating Dam downstream about 600 feet to the ODFW markers). Regulations on the tributaries allow daily bag limits of 5 trout with a minimum length of 6 inches, and no more than 1 trout over 20 inches. The fishing season does not begin until the fourth Saturday in May on Trout Creek in order to protect migrating juvenile steelhead.

Angling regulations on the portion of the lower Deschutes River bordering the CTWS reservation are set by CTWS. Trout size and bag limits are the same as the State of Oregon regulations and angling is allowed by tribal permit from Dry Creek downstream to the Wasco County/Jefferson County line (near Trout Creek).

There may be both a higher harvest rate of rainbow trout in the Sherars Falls bait section and a higher hooking mortality on trout caught on bait and released. However, since there is no documented target fishery for rainbow trout in the bait section and the bait section is a very small part of the total river, the use of bait in this section is not a constraint in maintaining the currently abundant rainbow trout population in the lower Deschutes River.

Harvest of rainbow trout in the lower Deschutes River was estimated from random and statistical creel surveys in the 1950's, 60's, and 70's when the regulations were liberal and hatchery trout were stocked in the main stem. Estimated harvest of wild rainbow trout from Sherars Falls to Pelton Reregulating Dam ranged from about 22,000 to 133,000 fish during years of creel surveys in the 1950's to the 1970's (Table 3.6). Hatchery fish contributed significantly to the catch of rainbow trout. Anglers harvested approximately 62% of the 61,000 hatchery fish stocked annually (Schroeder and Smith 1989). Historically, most of the trout angling in the lower Deschutes River occurred above Sherars Falls.

Total harvest of rainbow trout from the river mouth to Sherars Falls has not been estimated. Rainbow trout catch and harvest for the period 1 July through 31 October has been estimated by statistically expandable harvest census of anglers surveyed at the river mouth for years 1989 through 1995 (Table 3.7) and at the start of the Macks Canyon Road for years 1989, 1990, 1992, 1993, 1994, and 1995 (Table 3.8). Total catch and harvest of rainbow trout in the reach of river from the mouth upstream to the start of the Macks Canyon Road at river mile 41 for the period 1 July to 31 October can be estimated by summing data from the two sample points on years when sampling was done at both sites (Table 3.9). Estimated catch and harvest of rainbow trout from the mouth upstream to river mile 41 is considerably less than that reported for the Trout Creek area of the lower Deschutes River (Schroeder and Smith 1989). This is likely the result of more restrictive bag limits attracting fewer anglers and a change in angler attitudes regarding retention of wild fish.

It appears that changes in angling regulations and management strategies for rainbow trout in the lower Deschutes River have been followed by decreases in the number of anglers and harvest of rainbow trout. A popular and important largely catch and release fishery for rainbow trout has replaced the historically more consumptive fishery. Expanded harvest survey of rainbow trout anglers in the reach of river downstream from Sherars Falls shows that an estimated 2% to 7% of all rainbow trout landed are kept (ODFW unpublished data).

It is believed that much of the past rainbow trout fishery in the White River system was supported by the stocking of hatchery fish in White River at Tygh Valley and Farmers Crossing and in Badger Creek at Bonney Crossing. Brook trout and indigenous rainbow trout in the remainder of the basin supported a small fishery. Total harvest of hatchery or wild trout in the White River system has not been estimated.

Effect of Angling Regulations

The window or slot regulation currently in place for rainbow trout (two fish per day, 10 inch minimum and 13 inch maximum length) in the lower 100 miles of the lower Deschutes River was enacted to accomplish several objectives. First, it was thought by some anglers that the regulation in place from 1979 to 1984 (two fish per day, 12 inch minimum size and no maximum size) resulted in an unacceptably high harvest of larger trout and that genetic traits for fast growth might be altered if the fast growing, larger fish were removed from the population. The relatively small upper size limit of the slot length limit, 13 inches, was designed to lower the size of trout harvested by anglers and, in theory, stockpile a greater number of larger, older trout in the population that were not available for consumptive harvest by anglers. Second, the lower end of the size limit for the slot regulation, 10 inches, was believed to be large enough to provide substantial protection from harvest to wild summer steelhead smolts, the bulk of which were believed to be less than 10 inches in length. Third, the restrictive limit of two fish was believed to be a low enough bag limit that the trout population as a whole would not be subjected to over harvest.

Schroeder and Smith (1989), in their evaluation of the slot regulation on the lower Deschutes River, reached a number of tentative conclusions relative to the effectiveness of the slot regulation in meeting these objectives. Analysis of trout abundance data in the lower Deschutes River during different regulation schemes showed that changes in the density of rainbow trout appears to be independent of harvest or at least not fully explained by harvest. Schroeder and Smith (1989) found changes in abundance of all trout greater than 19 centimeters (about 7.5 in) as a result of the slot regulation were very difficult to analyze since the entire lower 100 miles of the Deschutes River was placed under the regulation and no control section is available to evaluate changes. Abundance changes that may have resulted from the 12 inch minimum size regulation enacted in 1979, however, were noted using the North Junction study section as a control to compare with the Nena Creek study section (Figure 3.2). Mean density of trout both less than 12 inches and greater than 12 inches was significantly higher at the Nena Creek study section after the 12 inch minimum regulation was enacted (Figure 3.3).

Factors other than the actual 12 inch minimum size limit regulation may be responsible for this difference in abundance. Decreased angler pressure as a result of more restrictive regulation, eliminating releases of hatchery fish in the Nena Creek area, and background environmental effects may be potential factors that explain the increased abundance. Hatchery trout released into the lower Deschutes River were susceptible to the parasite *Ceratomyxa shasta* and likely did not live more than 30 days, limiting the time hatchery fish competed with wild trout for available resources. Hatchery trout were, however, released at about 30 day intervals exposing wild trout to nearly continuous competition from hatchery fish for several months. The net impact of hatchery trout releases and increased angling pressure may have been more serious than earlier thought and may have served to keep wild trout at densities less than those currently estimated.

Interestingly, Schroeder and Smith (1989) showed that the base assumption relative to the need for the slot regulation - that the abundance of trout greater than or equal to 31 centimeters (about 12.2 inches) had declined under the 12 inch minimum regulation during years 1979 to 1983 - was not true. The trend of abundance of fish over 31 centimeters was the same as that for fish under 31 centimeters during that period suggesting that the 12 inch minimum regulation had no effect on abundance of fish of any size and the slot limit was enacted to address a problem that did not exist.

Irrespective of the actual cause of increased or decreased mean abundance of trout in the Nena Creek and North Junction study sections, the density of trout in both sections appears to currently be stable but fluctuating around a mean value and appears to be driven by density dependent and independent mortality factors other than harvest.

The slot limit does not appear to have met the objective of stockpiling more large trout in the population. The average abundance of rainbow trout greater then 41 centimeters (about 16.1 inches) was the same or lower under the slot regulation than under either the 12 inch minimum or more liberal regulations (Schroeder and Smith 1989). Similarly, the mean density of trout greater than 33 centimeters (about 13 inches) showed no significant change or consistent direction of change from the 12 inch minimum regulation to the slot regulation (Figure 3.4).

The concern about harvesting genetically faster growing trout was shown to be unfounded as a basis for harvest regulation in the lower Deschutes River for several reasons (Schroeder and Smith 1989). Harvest of spawning trout in the lower Deschutes River in 1969 under more liberal regulations than the 12 inch minimum or the slot regulations was shown to be approximately 20%, leaving a large number of spawning trout to pass on genetically controlled traits. Favro et al. (1979) suggest that for selective harvest to affect a genetically controlled trait for growth, fast growing fish had to be harvested at a higher rate. A harvest rate of approximately 20%, a much greater harvest rate than measured under more recent and restrictive regulations, of the spawning trout in the lower Deschutes River did not appear to be large enough to do this. The base assumption, that growth rate and body length in fish are traits controlled strongly by genetic factors, is not well supported by research. Parma and Deriso (1990) suggest that growth rate is either not heritable or is passed on genetically at a moderate to low rate and that reduction of growth rate following size selective fishing usually can be explained by alternatives not involving genetic effects. Heath and Roff (1987) showed that growth of fish is affected more by environment and food availability than by genetics. Ancestors of rainbow trout taken from the lower Deschutes River in the 1970's and reared in captivity at Oak Springs Hatchery can reach weights up to 26 pounds, many times those seen in nature (personnel communication April 11, 1996, Randy Robart, Manager, Oregon Department of Fish and Wildlife Oak Springs Hatchery, Maupin, Oregon). This suggests that environment rather than genetic factors control growth and maximum size of lower Deschutes River rainbow trout.

Natural mortality of trout in the lower Deschutes River, particularly associated with spawning, is high (45% to 69%) for fish greater than 31 centimeters (about 12.2 inches). This high natural mortality and not harvest is likely the limiting factor controlling recruitment of trout into size ranges over 41 centimeters (about 16.1 inches). This suggests that unless lower Deschutes River trout change their life history characteristics for high natural mortality and slow growth after maturity, no angling regulation will be successful in stockpiling a large percentage of large fish in the population.

Growth rate, as measured by length increase in tagged trout, generally did not differ significantly in the two study areas after the slot regulation was enacted although scale analysis of growth showed that growth was greater under the window regulation than under the 12 inch minimum length regulation (Schroeder and Smith 1989). These findings are somewhat opposite those made after the 12 inch minimum length regulation was enacted. These findings suggest that growth decreased during the 1970's and 1980's irrespective of regulations in effect during those periods. Growth rate of lower Deschutes River trout has been shown to be very slow following sexual maturity and spawning and that growth rate and maximum size of trout in the lower Deschutes River is probably limited most by environmental factors. Angling regulations likely have little controlling effect on growth rate or attainable maximum size of rainbow trout in the lower Deschutes River.

Available length data for juvenile steelhead migrants in the lower Deschutes River is limited but the current 10 inch minimum length limit of the slot regulation does appear to protect most summer steelhead smolts in the lower Deschutes River from harvest. Less than 2% of age 2 and age 3 juvenile steelhead migrants captured at a weir in Bakeoven Creek in 1970 were greater than 10 inches fork length (Olsen et al 1991). Similarly, less than 1% of all migrants presumed to be steelhead and not resident rainbow (those less than 25 centimeters) sampled by a juvenile trap operated in the Warm Springs River by CTWS from 1990 to 1995 are greater than 10 inches fork length (Figure 3.5) (CTWS unpublished data).

The available data suggest that a minimum length limit of 8 inches would adequately protect summer steelhead juveniles from harvest and would be an acceptable and consistent minimum length limit for trout in the lower Deschutes River. Less than 3% of age 2 and age 3 juvenile steelhead migrants captured at a weir in Bakeoven Creek in 1970 were greater than 8 inches fork length (Olsen et al. 1991). Data from the CTWS Warm Springs River migrant trap for 1990 to 1995 show that 12% of all migrants presumed to be steelhead and not resident rainbow (those less than 25 centimeters) are greater than 8 inches fork length (Figure 3.5) (CTWS unpublished data).

Harvest data for trout are available for the lower Deschutes River downstream from Sherars Falls for 1989, 1990, and 1992 through 1995 for the period July through October. These data show that under the current regulations the majority of angler caught trout are subsequently released. The estimated percent of trout kept downstream from Sherars Falls during this period ranged from 2% to 7% and averages 4% for the period of record. These low harvest rates indicate that most anglers currently do not fish for trout in the lower Deschutes River for consumption, but rather choose to release their catch regardless of existing regulations. This low harvest rate within the slot length size class negates one of the conditions necessary for slot length limits to be effective - a high harvest within the slot to reduce density dependent growth and mortality factors. In effect, the current trout regulation functions very much like a catch and release regulation. The available data suggest that, given the philosophy of the majority of trout anglers currently using the lower Deschutes River, any fairly restrictive harvest regulation would result in a harvest rate similar to that measured under the existing slot regulation.

While data specific to the lower Deschutes River does not exist, hooking mortality very likely equals or exceeds harvest under the existing regulations. Taylor and White (1992), in an analysis of

31 hooking mortality studies, report a mean hooking mortality of 7% for rainbow trout caught on flies and artificial lures.

It is the opinion of some anglers that the use of bait for many years in the lower Deschutes River below Sherars Falls, principally for steelhead, caused a large by-catch of rainbow trout and kept their population below carrying capacity in that area. After bait was banned in 1979, some anglers claimed that rainbow trout numbers in that reach of river increased rapidly in the absence of a larger harvest of trout. Data are not available to support or refute this contention. If rainbow trout densities in this reach of river did, in fact, increase in the absence of higher harvest made possible by bait, then rainbow trout densities have likely stabilized at carrying capacity in the 15 years since restrictive regulations have been adopted and will likely fluctuate around a mean density in future years. The limiting factors controlling rainbow trout densities in this reach of river are likely complex and density independent. Annual natural mortality of rainbow trout below Sherars Falls is probably similar to that reported by Schroeder and Smith (1989) for rainbow trout above Sherars Falls. Natural mortality of rainbow trout greater than 12 inches in the North Junction and Nena Creek study areas ranged from 45% to 69% during the study period.

Management Considerations

Rainbow trout in the lower Deschutes River are a valuable resource and are as important to the recreational fishery in the river as any other salmonid species in the subbasin.

Resident trout in the flowing waters of the lower Deschutes River subbasin are currently managed for wild fish only, with few exceptions.

C. shasta susceptible hatchery rainbow trout are stocked in the lower Warm Springs River by CTWS. This is the only regular release of hatchery reared rainbow trout into flowing waters of the lower Deschutes River subbasin. These fish have been stocked by the CTWS for increased harvest opportunity and under the assumption that if they are not harvested and migrate downstream into the lower Deschutes River they would die of ceratomyxosis before spawning with indigenous Deschutes River rainbow. This is a desirable situation from a genetic standpoint, but it does increase the number of infective spores of *C. shasta* in the lower Deschutes River. Indigenous salmonids in the lower Deschutes appear resistant to ceratomyxosis but not immune to it and elevated infective unit concentrations can increase mortality from the parasite even in resistant stocks (Ratliff 1983).

However, *C. shasta* is not present in the Warm Springs River and hatchery fish that remained there could survive and potentially spawn with indigenous rainbow in the Warm Springs River, many of which are likely lower Deschutes rainbow that migrate into the Warm Springs River to spawn. A somewhat more conservative approach to the use of hatchery rainbow trout in the Warm Springs River may be to use the *C. shasta* resistant Deschutes stock hatchery rainbow there. This stock is resistant to *C. shasta* and would not serve to increase the infective spore stage of the organism in the lower Deschutes River. This stock is more similar genetically to the indigenous lower Deschutes River rainbow than other stocks of hatchery rainbow trout and the potential genetic impacts from interbreeding would be less.

Resident trout support a diversity of angling opportunities in the subbasin. The wild rainbow trout population in the lower 100 miles of the Deschutes River supports a popular recreational fishery. This fishery is primarily a catch and release fishery, with the opportunity to keep two trout 10-13 inches in length per day. The current hatchery trout program operated by CTWS in the Warm Springs River provides a consumptive fishery. The return of hatchery fish to the angler and angler use estimates in Warm Springs River is monitored by CTWS. Tribal members have more liberal gear, bag, and seasonal limitations than do non-tribal members. Opportunities for wild rainbow trout and brook trout angling in small streams are also available in the White River system.

The lower Deschutes River is capable of producing large populations of wild rainbow trout. Densities of rainbow trout greater than 8 inches in the 1980's averaged 1,630 fish/mile in the North Junction area and 1,830 fish/mile in the Nena Creek area of the lower Deschutes River. Rainbow trout in the lower Deschutes River are believed to be most abundant in the reach of river immediately downstream from Pelton Reregulating Dam and least abundant at the mouth of the Deschutes River. This gradient of rainbow trout abundance may be associated with water temperatures (temperatures are coolest near the dam), but is likely caused by a combination of factors.

The Deschutes River subbasin has not only been divided for more than 30 years by the Pelton/Round Butte hydroelectric complex (RM 100), but also by different management strategies. The lower 100 miles, the area within the scope of this plan, is managed for natural production of wild rainbow trout. Lake Simtustus, Lake Billy Chinook, and the upper reaches of the river, and additional reservoirs, are managed for a combination of wild and hatchery rainbow, kokanee, and brown trout.

The concept of providing effective upstream and downstream passage through the Pelton/Round Butte hydroelectric complex is being seriously considered as a component of PGE's relicensing studies. If anadromous fish passage through the hydroelectric project becomes reality, a decision on resident fish passage will have to be made. Rainbow trout are frequently captured at the Pelton trap, the upstream migrant trap at the base of the Pelton Reregulating Dam, and bull trout are occasionally captured there. It is reasonable to assume that these fish are trying to migrate upstream, probably associated with the onset of spawning. Downstream passage of resident species through the hydroelectric project is currently limited to passage through the turbines and occasional spill. One potential method to provide downstream passage of anadromous species through the hydroelectric project would be to trap migrating juveniles in the reservoirs and transport them around the hydroelectric project. Resident fish would undoubtedly be captured during this trapping. If the trap catch was not sorted prior to transportation, some resident introduced species, including smallmouth bass and brown trout, could be transported around the hydroelectric project and released in the lower Deschutes River downstream from the dam complex. A decision on both upstream and downstream passage of resident species will be needed if and when passage is provided through the Pelton/Round Butte hydroelectric complex.

At this time, *C. shasta* resistant hatchery rainbow trout and hatchery origin brown trout are moving out of Lake Simtustus through the turbines and in occasional spill at Pelton Dam and into the Regulating Reservoir. They are then spilled out of the Regulating Reservoir and are escaping into the lower Deschutes River. Actions for addressing this situation are listed under the trout management alternative. If passage for anadromous fish is reestablished through the Pelton/Round Butte hydroelectric complex, decisions will need to be made as to passage of the various resident and introduced species currently in the reservoirs.

Critical Uncertainties

1. The effects of the Pelton/Round Butte Hydroelectric Project on rainbow trout habitat are not understood. Studies funded by PGE are currently underway which greatly enhance our

understanding of these habitats and effects of the hydroelectric project (Zimmerman and Reeves 1996; Grant et al. 1996)

2. The effects of angling regulations on the rainbow trout population in the lower Deschutes River are incompletely understood.
3. The effects of interspecific competition are unknown.
4. Naturally reproducing populations of brook trout present in Clear and Badger lakes and upper White River, Clear, Frog, Boulder, Barlow, Bonney, Mineral, and Buck creeks will not jeopardize the compliance of wild rainbow trout management in the White River system with the Wild Fish Management Policy.

BULL TROUT

Origin, Life History and Population Characteristics

Bull trout, *Salvelinus confluentus,* are indigenous to the subbasin and are found in the lower Deschutes River below Pelton Reregulating Dam, Shitike Creek and the Warm Springs River. A BPA funded biological and habitat inventory to determine suitability of White River above White River Falls for anadromous introduction was completed in 1985 and bull trout were not found in White River upstream from White River Falls (ODFW et al. 1985). Anecdotal information suggests that, historically, distribution of bull trout in the Deschutes River subbasin was likely wider than it is today.

More than one bull trout population or subpopulations likely occupied the Deschutes River basin and there was probably interchange between these subpopulations. A variety of factors including construction of Crane Prairie (1922) and Wickiup (1947) dams and introduction of brook trout likely contributed to the extinction of upriver subpopulations in the 1950's. Construction of Pelton (1956) and Round Butte (1964) dams and termination of fish passage around these structures in 1968 greatly restricted or eliminated migration of upriver groups of bull trout into the lower Deschutes River. Fluvial subpopulations in Shitike Creek and the Warm Springs River did and likely still do contribute bull trout into the lower Deschutes River.

Bull trout have not been documented in the lower Deschutes River downstream from Sherars Falls (river mile 43). The Sherars Falls adult salmon and steelhead trap, located in the fish ladder at Sherars Falls, has never captured a bull trout in 5 years of operation from mid-April through October or in 14 years of operation from mid-June through October. Small anadromous individuals (jack salmon) and resident rainbow trout are routinely captured at this facility and bull trout would be vulnerable to capture. It is possible that bull trout can negotiate Sherars Falls during high spring flows and likely did prior to construction of the fish ladder in the 1920' or 1930's.

Drift boat mounted electrofishing surveys have been conducted sporadically for spring chinook, summer steelhead, and rainbow trout downstream from Sherars Falls since the early 1970's and no bull trout have been sampled in this reach by electrofishing. Additionally, harvest estimates of summer steelhead and spring chinook utilizing creel census have been conducted downstream from Sherars Falls at a variety of locations annually since 1970. No bull trout have ever been sampled in any of these surveys.

Quantitative estimates in the form of population estimates or relative abundance indices for any life stage of bull trout in the mainstem lower Deschutes River are not available. Bull trout have been captured in the mainstem lower Deschutes River upstream from Sherars Falls during rainbow trout population estimate work but at numbers lower than those needed to make statistically sound population estimates (Table 3.10). Bull trout abundance in the subbasin is likely low.

Anecdotal information suggests that bull trout in the lower Deschutes River subbasin were more abundant historically than at present. A fish trap was used to pass upstream migrating salmonids over Pelton Reregulating Dam prior to 1968. Workers at that facility recall annually passing up to several hundred large bull trout there for a number of years indicating that bull trout were much more abundant historically (Ratliff et al. 1996).

It is not known if a resident population exists in the lower Deschutes River or if fish observed there are members of fluvial populations. Completion of Round Butte Dam in 1964 and the subsequent abandonment of downstream fish passage facilities in 1968 effectively isolated bull trout subpopulations in the Metolius from those in the lower Deschutes River subbasin.

The Warm Springs River and Shitike Creek populations of bull trout are thought to be fluvial but may contain a resident component as well. The fluvial components of these populations spawn and rear in headwater reaches or smaller streams tributary to the Warm Springs River and Shitike Creek. Juvenile and sub-adult individuals migrate to the mainstem lower Deschutes River to rear for a period of years. An upstream spawning migration into the smaller tributaries takes place with the onset of maturity. The only known suitable spawning sites in the subbasin are contained in the Warm Springs River and Shitike Creek.

No bull trout tagged during rainbow trout population estimate work have been recaptured at trap facilities or by anglers; therefore, quantitative data on frequency, rate, and direction of movement is lacking for subbasin populations. Qualitatively, however, movement is known to occur within the subbasin. It is believed that the fluvial component of the Warm Springs River and Shitike Creek populations migrate downstream into the lower Deschutes River to rear. Juvenile and sub-adult bull trout are periodically captured in very small numbers in the Humphrey trap in the Warm Springs River (Table 3.11). Very small numbers of large, presumably adult, bull trout are captured at the barrier dam and associated fish trap at Warm Springs National Fish Hatchery (river mile 11.0) (Table 3.12). Bull trout captured at this site were not counted prior to 1990 and were killed rather than passed upstream. It is assumed that this movement is associated with a spawning migration.

Low numbers of bull trout have been captured at the Pelton trap in recent history (Table 3.13). These fish were not enumerated prior to late 1991 (personal communication February 25, 1994, Bill Nyara, Manager, Oregon Department of Fish and Wildlife Round Butte Hatchery, Madras, Oregon). Bull trout captured at the Pelton trap are not marked in any way and it is possible that repeat captures are double counted.

Bull trout populations were monitored at the Upper Crossing site on Shitike Creek (river mile 10.0) from 1986 to 1990 by CTWS (Fritsch and Hillman 1995). This site is thought to be the downstream limit of bull trout rearing in Shitike Creek. Though bull trout made up a small fraction of the total salmonid population in the Upper Crossing site, their density and biomass fluctuated little above a horizontal trend. In contrast, their mean weights decreased significantly (Figure 3.6). Mean weight was found to correlate directly with backwater area, which decreased during the period of study (Fritsch and Hillman 1995).

Personnel from CTWS perform bull trout redd counts on selected reaches of the Warm Springs River and Shitike Creek from 1984 to present (Table 3.14). These data indicate a general downward trend in abundance.

Historically, liberal bag limits and a lack of terminal tackle restrictions likely resulted in greater harvest and higher exploitation rates on bull trout in the mainstem lower Deschutes River than in recent times. It is possible that small target fisheries for bull trout existed and that harvest affected population levels. More recent harvest information indicates that sport harvest of bull trout has been low and is likely not a major factor in current population status (Table 3.15). Harvest of bull trout on the CTWS reservation is unknown.

Size and bag limit regulations on the lower Deschutes River have likely precluded a target bull trout fishery and limited exploitation rates to very low levels. The taking of bull trout was banned by rule in the mainstem lower Deschutes River starting in 1994.

Management Considerations

Bull trout are currently listed on the Oregon Sensitive Species List (OAR 635-100-040) as Critical. Additionally, bull trout are a candidate for protection under the federal Endangered Species Act.

The limited quantitative measures of bull trout numbers in the basin suggest a small population size. Small populations risk extinction through excessive rates of inbreeding and chronic or catastrophic natural processes. It is unknown if lower Deschutes River subbasin bull trout populations are large enough to escape these risks.

It is difficult to speculate on potential habitat degradation issues that may have contributed to reductions in bull trout populations in the subbasin. Water withdrawals from the mainstem lower Deschutes River, Shitike Creek and the Warm Springs River have been minimal. The Deschutes River is thought to have historically had a very stable flow regime. The potential effects of logging, road construction, and intensive livestock grazing in the lower Deschutes River subbasin could have and may well continue to impact bull trout habitats.

The Pelton/Round Butte hydroelectric complex eliminated upstream passage of bull trout in the Deschutes River subbasin. Downstream passage is limited to passage through the turbines and occasional spill through the spillways and occasional spill. This complex constitutes a total upstream passage barrier and is the major factor currently dividing the metapopulation in the basin. The importance of migration and genetic interchange between subpopulations within the metapopulation is difficult to assess but there likely was movement of bull trout between populations within the subbasin. If fish passage is reestablished as part of the FERC relicensing process of the Pelton/Round butte hydroelectric complex, these populations within the Deschutes River metapopulation will again be allowed to mix.

Sherars Falls was likely not a complete passage barrier to bull trout migration prior to ladder construction in the 1920's or 1930's. Upstream passage conditions were undoubtedly variable from year to year depending on flow, but passage was likely possible most years.

Hybridization with brook trout is a concern for the Warm Springs River and Shitike Creek population(s). Hybridization has not been documented in the lower Deschutes River subbasin but brook trout are present in high lakes in both systems and the potential does exist. Competition between juvenile brook trout and bull trout for available resources may exist where both are present even if hybridization does not occur. Additionally, competition with brown trout that escape down-stream from Lake Simtustus is a concern in the upper reach of the lower Deschutes River and possibly Shitike Creek. Better information on the distribution of both brook trout and bull trout is needed in the Warm Springs River and Shitike Creek. If additional information suggests a potential for hybridization between the two species, it is possible some artificial barriers could be build to better isolate them and decrease potential problems.

Regulations currently and historically in effect in the lower Deschutes River subbasin governing trout and steelhead angling have likely precluded major bull trout harvest. Regulations enacted in 1994 prohibit the taking of bull trout in the lower Deschutes River subbasin and should afford them complete protection. Increased angler awareness of the plight of the bull trout may help to lessen the potential for illegal harvest.

Critical Uncertainties

1. The distribution and abundance of bull trout in the lower Deschutes River subbasin is unknown.
2. Causes of an apparent decline in bull trout numbers in the subbasin are unknown.
3. Totally eliminating upstream passage and significantly reducing downstream passage of bull trout at the Pelton/Round Butte hydroelectric complex has divided the Deschutes River bull trout metapopulation into subpopulations. The result of this division is poorly understood.
4. It is not known if bull trout/brook trout hybridization is occurring in the lower Deschutes River subbasin.

MOUNTAIN WHITEFISH

Origin, Life History, and Population Characteristics

Mountain whitefish, *Prosopium williamsoni*, are found in the lower Deschutes River, Warm Springs River, White River and Shitike Creek. Mountain whitefish are indigenous to the subbasin.

The abundance of mountain whitefish was estimated to be 5,000 fish/mile in the lower Deschutes River from the Warm Springs River to Trout Creek in 1975 (Schroeder and Smith 1989). Abundance has not been estimated in the Warm Springs River or Shitike Creek, but overall abundance appears to be low, with some seasonal variation. Whitefish have been captured by CTWS in July and August in Shitike Creek during sampling for juvenile spring chinook salmon. Whitefish are captured during spring and fall in the juvenile migrant trap in the Warm Springs River near its confluence with the Deschutes River.

Whitefish have gained more popularity as a game fish for recreational angler in recent years. Whitefish are harvested in the lower Deschutes River and Warm Springs River during the late winter and early spring by CTWS members for subsistence purposes. Whitefish are harvested by dip netting from scaffolds or stream bank during turbid water conditions.

Mountain whitefish are indigenous to White River, but their distribution is limited to the lower reach of the river. They have been sampled from the falls upstream to river mile 6 but were not found in any of the tributaries. Abundance was estimated to be 100 whitefish/mile in the 4.5 mile section of river immediately upstream from White River Falls (ODFW et al. 1985). The fork length of whitefish sampled in lower White River ranged from 6 to 13 inches. There is no information on the age of these fish. There is probably some incidental harvest of whitefish by trout fishermen in the White River, but it is likely not a target species. ODFW and CTWS wish to maintain the existing population of mountain whitefish in White River.

The time of whitefish spawning in the subbasin has not been documented, but elsewhere whitefish spawn from October to December in riffles. Sexual maturity occurs at three to four years of age. Fecundity may range from 2,995 to 9,400 eggs with the eggs hatching in about one month at 48° F (Wydoski and Whitney 1979).

Mountain whitefish generally reside in riffles and are primarily adapted as bottom feeders. Their diet consists primarily of aquatic insects, but also includes crayfish, freshwater shrimp, leeches, fish eggs and occasionally small fish (Wydoski and Whitney 1979). Analysis of stomach contents of whitefish in the lower Deschutes River showed that about 72% of the food composition consisted of immature forms of aquatic insects (Schroeder and Smith 1989).

Management Considerations

Whitefish are believed to be the most abundant sport fish in the mainstem lower Deschutes River and are under-utilized as a sport species. This population could support a substantial fishery and provide additional angling diversity. Mountain whitefish may be an important prey species for bull trout in the lower Deschutes River.

The population of whitefish in the White River above the falls is limited to the mainstem White River in the area of Tygh Valley. It is possible that the population of mountain whitefish in White River above White River Falls is genetically unique. Maintaining the population of mountain whitefish in White River is a management concern.

Critical Uncertainties

1. It is unknown if the mountain whitefish in the White River above White River Falls are genetically similar to the mountain whitefish in the mainstem lower Deschutes River, or if they represent a genetically unique population.
2. Based on the limited distribution of mountain whitefish in White River above White River Falls it is unknown if mountain whitefish are indigenous to White River above White River Falls.
3. The impact of increased production of anadromous salmonids on whitefish populations in the lower Deschutes River subbasin is not known.

BROOK TROUT

Origin, Life History, and Population Characteristics

Brook trout, *Salvelinus fontinalis*, are not indigenous to Oregon waters. The earliest recorded introduction into the lower Deschutes River subbasin was in 1934, when they were released into Clear Lake and Badger Creek. Brook trout were subsequently stocked into many of the high lakes in the subbasin, including high lakes in the Olallie Lake basin. These lakes are at the upper end of Mill Creek, a tributary to the Warm Springs River. Brook trout are also present in Harvey Lake, the headwaters of Shitike Creek. Both the Warm Springs River and Shitike Creek flow through the CTWS reservation. The Cascade Mountain Lakes section and Lakes and Reservoirs section of this plan contains details on brook trout populations in individual high lakes. Brook trout have moved out of some high lakes over time and established populations in some of the upper tributaries of the White River system, Shitike Creek, and the Warm Springs River.

Distribution and Abundance

Stream dwelling brook trout in the lower Deschutes River subbasin are believed to be most abundant in upper White River, Clear, Frog, and Boulder creeks. Brook trout are also found in Barlow, Bonney, Mineral, and Buck creeks. Brook trout are found in Mill Creek in the Warm Springs River system and in upper Shitike Creek. Brook trout are not known to occur below the 2,500 foot elevation contour in the White River Basin (ODFW et al. 1985).

Estimates of brook trout abundance in the White River system were made by ODFW in 1985 (ODFW et al. 1985). It was estimated that there were 26,842 stream dwelling brook trout of all age classes present in the White River subbasin at that time. Of the brook trout sampled, 90% were found in Clear and Frog creeks.

Age Structure and Size

No age data is available for brook trout in the subbasin.

Brook trout that were sampled in the White River subbasin were small; 95% were less than 6 inches in length. Electro-shocking data indicated that 2 to 4 inches was the dominant size class sampled (ODFW et al. 1985).

Brook trout continue to be stocked into high lakes that either have no outlet or that discharge into other closed basins.

Both angler use levels and harvest of brook trout in the subbasin are unknown. Lakes and streams that contain brook trout in the subbasin that are managed by ODFW are open to angling from the fourth Saturday in April to the end of October.

Management Considerations

Brook trout have invaded the upper White River system by moving out of lakes where they were originally stocked and into White River tributaries. The abundance of rainbow trout is thought to be reduced in Clear Creek by competition with brook trout for available food and space. Rainbow trout appear to have been displaced from Frog Creek by brook trout above river mile 0.4.

There are naturally reproducing populations of brook trout in both Clear and Badger lakes. Natural reproduction also occurs in upper White River, Clear, Frog, Boulder, Barlow, Bonney, Mineral, Buck, and Mill and Shitike creeks on the CTWS reservation. It would be difficult to remove these naturally reproducing populations of brook trout. Future brook trout stocking into lakes that have outflow streams and have never been stocked with brook trout will be evaluated for competition and genetic impacts to other fishes, as well as for potential impacts to sensitive non-game wildlife resources.

Critical Uncertainties

1. The distribution of brook trout in the White River system is unknown.
2. It is unknown if brook trout hybridization with bull trout has taken place in the Warm Springs River system and Shitike Creek.
3. The impact of established stream dwelling brook trout populations on indigenous fishes and wildlife is unknown.

BROWN TROUT

Origin, Life History and Population Characteristics

Brown trout, *Salmo trutta*, are not indigenous to Oregon waters. There are, however, established populations of brown trout present in a variety of waters of the state. For example, populations of brown trout are established in the Deschutes River above the Pelton/Round Butte hydroelectric project. The development of irrigation impoundments in the upper Deschutes River in the 1940's resulted in lower and warmer summer flows downstream from the impoundments. This flow regime was most pronounced in the Deschutes River upstream from its confluence with the Crooked and Metolius rivers. These conditions apparently favored introduced brown trout and their numbers and range increased through time.

Anecdotal information suggests that brown trout were present in the lower Deschutes River in the vicinity of the Pelton/Round Butte hydroelectric complex prior to its construction but their abundance decreased following project construction. It is possible that changes in the water temperature regime caused by the hydroelectric complex flow releases were responsible for declines in brown trout abundance and distribution.

Management Considerations

Brown trout were stocked annually in Lake Simtustus from 1987 to 1996 (Table 3.16). These releases were made to provide a featured fish for the fishery in Lake Simtustus and to help control nongame species there. Portland General Electric, the current operator of the Pelton/Round Butte hydroelectric complex, has a clause in their Federal Energy Regulatory Commission license to control nongame fish in the project reservoirs if requested by the fisheries agencies. Brown trout were chosen for biological control because they can become piscivorous and tolerate warmer water than other salmonids. Immediately prior to these releases, brown trout were virtually non-existent in Lake Simtustus, the Pelton Reregulation Reservoir, or the lower Deschutes River below the Pelton Reregulation Reservoir. Only three brown trout were captured in annual gill net inventories in Lake Simtustus during the years 1969-75.

Brown trout that were stocked from 1987 to 1996 in Lake Simtustus are known to move out of Lake Simtustus through the turbines and into the Reregulation Reservoir upstream from Pelton Reregulating Dam. They are also known to move out of the Reregulation Reservoir and into the lower Deschutes River either through the turbines or in spill over the Pelton Reregulating Dam. Limited sampling done in the Reregulation Reservoir in 1991 and 1992 by ODFW biologists showed that brown trout were the most abundant salmonid species sampled in that reservoir (Table 3.17).

The number of brown trout captured at the Round Butte Hatchery adult salmon and steelhead trap located at the base of the Pelton Reregulating Dam (the Pelton trap) has increased since the first capture in 1990 (Table 3.18). Brown trout made up 7%, 8%, 11% and 4% of all trout captured at the Pelton trap from 1992 through 1995, respectively. Additionally, 10 brown trout carcasses have been found in the lower Deschutes River from the Pelton Reregulating Dam downstream to river mile 92 from 1990 to 1995 during fall chinook salmon carcass recovery for mark-recapture population estimates. The current abundance of brown trout in the lower Deschutes River is unknown.

The management direction described in the Trout and Whitefish section of this plan calls for managing the mainstem lower Deschutes River for natural production of native wild rainbow trout and other indigenous fish species. Brown trout that pass from Lake Simtustus into the lower Deschutes River may jeopardize the management of indigenous fish species in the lower Deschutes River. A decision to stop the release of brown trout in Lake Simtustus after 1996 was made in 1995 since brown trout did not appear to be accomplishing the desired nongame fish control objectives and were known to leave the reservoir environment and take up residence in the lower Deschutes River.

Critical Uncertainties

1. It is unknown if brown trout escaping from Lake Simtustus have established a reproducing population in the lower Deschutes River.
2. How brown trout would interact with indigenous species in the lower Deschutes River is uncertain.

MANAGEMENT DIRECTION

Trout and Mountain Whitefish

Objectives and actions contained in the management direction will be used to set district work plans that form the basis for monitoring and evaluation programs. Completion of actions listed under an objective contribute to the meeting of that objective. Many actions cannot be accomplished under current levels of funding. If funding continues to be limited, ODFW will pursue completion of actions according to priorities as funds become available.

Policies

Policy 1. *Wild rainbow and bull trout, whitefish and introduced brook trout shall be managed for natural production consistent with the Featured Species and Waters alternative of Oregon's Trout Plan (ODFW 1987). No hatchery trout or whitefish shall be stocked in flowing waters of the lower Deschutes River subbasin.*

Objective 1. Maintain the genetic diversity, adaptiveness, and abundance of the wild indigenous rainbow trout, bull trout, and mountain whitefish in the lower Deschutes River and in the tributaries of the lower Deschutes River.

Assumptions and Rationale

1. The CTWS manage their fisheries consistent with conservation of indigenous species. The CTWS are co-managers in meeting subbasin management plan objectives and will be involved in fish management activities in the lower Deschutes River subbasin at all levels. All action items will be conducted in cooperation with CTWS as co-managers of the resource.
2. Indigenous Deschutes River rainbow trout are one of the few populations of resident rainbow trout that occur sympatrically with steelhead. This and other life history characteristics may be attributable to the genetic diversity of the population.
3. White River rainbow trout have genetic and morphological characteristics that are found elsewhere only in isolated populations of rainbow trout of the northern Great Basin.
4. Indigenous White River rainbow trout have been identified as inland redband trout and are classified as a sensitive species in Oregon and have been listed as a candidate species for listing under the federal Endangered Species Act.
5. The isolated population of mountain whitefish in White River above White River Falls may also have unique genetic and morphological characteristics.
6. Prohibiting the harvest of bull trout will adequately protect this species from harvest impacts in the lower Deschutes River.
7. Trends in bull trout populations in the mainstem lower Deschutes River can be monitored with the proposed resident fish sampling strategies there.
8. Special angling regulations may be needed to protect stock fitness, life history characteristics, and population health of wild rainbow trout, bull trout and mountain whitefish in the lower Deschutes River subbasin.

9. Releases of hatchery reared salmonids into Lake Simtustus will not impact indigenous species in the lower Deschutes River downstream from the Reregulating Dam.
10. The movement of trout not indigenous to the lower Deschutes River into the river below Pelton Reregulating Dam could result in competition with and predation on indigenous species.
11. The movement of *C. shasta* resistant hatchery rainbow trout into the lower Deschutes River from Lake Simtustus and the Warm Springs River could pose a genetic risk to the indigenous rainbow trout population downstream.
12. The movement of hatchery trout from upstream of the Pelton Reregulating Dam can be prevented through physical changes in the dams or cessation of hatchery releases upstream.
13. Electrofishing is an appropriate sampling method to determine status, abundance, distribution, and age class structure of rainbow trout.
14. Monitoring the distribution and abundance of hatchery trout in the lower Deschutes River immediately below the Pelton Reregulating Dam (RM 97 to 100) is limited by water conditions, the presence of adult salmon and steelhead, and the timing of spawning of salmon, steelhead and trout in the study reach.

Actions

Action 1.1. Monitor the distribution and abundance of rainbow trout and mountain whitefish in the mainstem lower Deschutes River and tributaries.

Action 1.2. Monitor the distribution and abundance of rainbow trout and mountain whitefish in White River above White River Falls.

Action 1.3. Collect genetic data on rainbow trout, bull trout and mountain whitefish in the lower Deschutes River subbasin and tributaries, including White River and areas made accessible by providing fish passage through the Pelton/Round Butte hydroelectric complex.

Action 1.4. Identify what number of hatchery reared salmonids emigrating from Lake Simtustus into the lower Deschutes River pose unacceptable ecological and/or genetic risk to indigenous fishes downstream.

Action 1.5. Monitor the distribution and abundance of hatchery reared salmonids moving out of upstream impoundments and into the lower Deschutes River.

Action 1.6. Evaluate the impacts hatchery reared salmonids in Lake Simtustus have on downstream trout resources and develop management strategies for Lake Simtustus which minimize ecological and genetic risks to lower Deschutes River fishes.

Action 1.7. Cooperate with the CTWS to collect additional information on bull trout and brook trout distribution and abundance in the Warm Springs River and Shitike Creek.

Action 1.8. Cooperate with CTWS to establish hatchery rainbow use guidelines for the Warm Springs River and determine the level of hatchery rainbow trout movement out of the Warm Springs River.

Action 1.9. Monitor bull trout abundance and distribution. Determine location and condition of bull trout spawning and rearing areas. Monitor bull trout life history and juvenile movements from tributaries into the lower Deschutes River.

Objective 2. Provide the opportunity for consumptive harvest of wild trout in the lower Deschutes River subbasin.

Assumptions and Rationale

1. The lower Deschutes River is one of the most productive and popular wild trout streams in Oregon.
2. Anglers are interested in managing this section of the lower Deschutes River for optimum numbers and catch rates of wild trout.
3. Consumptive harvest would not reduce potential catch rates below the optimum possible.
4. The use of artificial flies and lures with barbless hooks will minimize hooking mortality to acceptable levels.
5. The use of bait in the three mile reach below Sherars Falls for anglers targeting salmon and steelhead is acceptable under this objective.

Actions

Action 2.1. Continue to provide regulations that will allow consumptive harvest of wild trout in the lower Deschutes River and White River.

Action 2.2. Protect juvenile summer steelhead from consumptive harvest in lower Deschutes River tributaries such as Bakeoven, Buck Hollow, and Trout creeks through restrictive angling regulation.

Action 2.3. Monitor angler effort and catch rates of wild trout in index reaches.

Objective 3. Maintain a population of rainbow trout of 1,500 to 2,500 fish per mile larger than 8 inches in length in the lower Deschutes River from Pelton Reregulating Dam to Sherars Falls. Maintain a population of rainbow trout of 750 to 1,000 fish per mile larger than 8 inches in length in the lower Deschutes River below Sherars Falls.

Assumptions and Rationale

1. Past research has shown that a population of 1,500 to 2,500 rainbow trout per mile larger than 8 inches in length occurs in the Nena Creek study area under existing regulations.
2. A population of 1,500 to 2,500 rainbow trout greater than 8 inches in length per mile supports a quality sport fishery on the lower Deschutes River from Pelton Reregulating Dam to Sherars Falls.
3. Preliminary research indicates that maintaining a population density of 750 to 1,000 rainbow trout larger then 8 inches in length is feasible in the Jones Canyon study section. This estimate is based on two years of data collection and may not be representative of long term densities.
4. A population of 750 to 1,000 rainbow trout greater than 8 inches in length per mile supports a quality sport fishery on the lower Deschutes River downstream from Sherars Falls.

5. The rainbow trout densities in the Nena Creek study section and in a study section upstream from White Horse Rapids are representative of the rainbow trout population in the lower Deschutes River from Pelton Reregulating Dam to Sherars Falls.
6. The rainbow trout densities in the Jones Canyon reach is indicative of the rainbow trout population in the lower Deschutes River below Sherars Falls.

Actions

Action 3.1. Monitor population abundance, age and length structure through electrofishing of rainbow trout in the lower Deschutes River at the Nena Creek study section and in a study section upstream from White Horse Rapids. These sites will serve as index areas of population status in the river above Sherars Falls.

Action 3.2. Monitor population abundance, age and length structure through electrofishing sampling of rainbow trout in the Jones Canyon reach of the lower Deschutes River. This sample site will serve as an index area of population status in the lower Deschutes River below Sherars Falls.

Action 3.3. Sample annually for a minimum of 4 years, then evaluate sampling frequency and sampling sites for future monitoring efforts.

Action 3.4. Monitor the time of migration and degree of residualization for any increase in smolt releases at Pelton ladder. Also monitor the distribution and abundance of hatchery reared salmonids that are migrating into the lower river from upstream impoundments.

Action 3.5. If population levels are less than the objective for three consecutive years either above or below Sherars Falls, ODFW will attempt to determine causative factors and will consider modifying appropriate management strategies (such as angling regulations) to meet this objective.

Objective 4. Maintain a population size distribution in the lower Deschutes River such that 30% of the population (fish >8 inches in length) is larger than 12 inches in length, as measured at the Jones study section, the Nena Creek study section and in a study section upstream from White Horse Rapids.

Assumptions and Rationale

1. During the 1980's, the percentage of the population of rainbow trout larger than 8 inches that were over 12 inches averaged 23% and was as high as 34% one year.
2. The trout population size structure will be monitored in the lower Deschutes River at the, Nena Creek study section, in a study section upstream from White Horse Rapids, and in the Jones Canyon study section.
3. The population size structure of rainbow trout at the Nena Creek study section and in a study section upstream from White Horse Rapids is representative of the population size structure of rainbow trout in the Warm Springs to Sherars Falls area of the lower Deschutes River.
4. The population size structure of rainbow trout at the Jones Canyon area is representative of the population size structure of rainbow trout in the lower Deschutes River below Sherars Falls.

Actions

Action 4.1. Determine population size structure while monitoring rainbow trout abundance in the Nena Creek study section, in a study section upstream from White Horse Rapids, and in the Jones Canyon study section of the lower Deschutes River.

Action 4.2. If 30% of the rainbow trout population (fish >8 inches in length) are not 12 inches in length or larger for three consecutive years in the Nena Creek or Jones Canyon areas of the lower Deschutes River, the Department will attempt to determine causative factors and will consider modifying appropriate management strategies (such as angling regulations) to meet this objective.

OTHER FISHES

Pacific Lamprey

Pacific lamprey, *Lampetra tridentatus*, are indigenous to the subbasin and are found in the subbasin in the lower Deschutes River, Shitike Creek, Beaver Creek, and the Warm Springs River. Pacific lamprey are indigenous to the subbasin.

Pacific lamprey are anadromous. The juveniles rear in freshwater and migrate to the ocean to mature before returning as adults to freshwater to spawn.

Abundance of Pacific lamprey in the subbasin has not been estimated, but appears to be low. Pacific lamprey abundance throughout the Columbia River basin has decreased significantly in recent years. Ammocoetes (larvae) and juveniles were captured annually in July and August in Shitike and Beaver creeks during sampling for juvenile spring chinook salmon in 1986 to 1989. Lamprey are also captured during spring and fall in the juvenile migrant traps in the Warm Springs River and Shitike Creek. Adult Pacific lamprey probably enter the subbasin from June to September one year prior to spawning. The time of lamprey spawning in the subbasin has not been documented, but elsewhere spawning occurs in June and July. Adults die after spawning. Eggs hatch within 2-3 weeks. The ammocoetes burrow into the mud downstream from the nest and may spend up to six years in the mud burrows. When body transformation from the juvenile to adult stage is complete, they migrate downstream from March to July to enter the ocean (Wydoski and Whitney 1979).

Suckers

Two species of suckers, bridgelip sucker, *Catostomus columbianus*, and largescale sucker, *Catostomus macrocheilus*, are indigenous to the lower Deschutes River and many of its tributaries. Suckers are not found in the White River system above White River Falls.

The abundance of suckers was estimated to be 8,400 suckers/ mile in the Warm Springs to Trout Creek area of the lower Deschutes River in 1975 (Schroeder and Smith 1989). Abundance has not been estimated in any of the tributaries. Suckers are captured during spring and fall in the juvenile migrant trap in the Warm Springs River near its confluence with the lower Deschutes River.

Time of sucker spawning in the subbasin has been incompletely documented, but large numbers of presumably spawning suckers are seen each year in Bakeoven and Buck Hollow creeks in March and April. Spawning occurs usually in sandy or gravelly areas of streams and fecundity may be as high as 20,000 eggs per female. Eggs typically hatch about 2 weeks after deposition (Scott and Crossman 1973).

Suckers prefer riffles and are primarily bottom feeders. Their diet consists primarily of plant material, with invertebrate consumption being greatest in the winter when plant material is scarce (Schroeder and Smith 1989).

Chiselmouth

Chiselmouth, *Acrocheilus alutaceus*, are indigenous to the lower Deschutes River and some of its tributaries including Warm Springs River, and Bakeoven, Buck Hollow, Shitike, and Trout creeks. Chiselmouth are not found in the White River system above White River Falls.

The abundance of chiselmouth in the subbasin has not been estimated, but appears to be low. Chiselmouth are captured during spring and fall in the juvenile migrant trap in the Warm Springs River near its confluence with the lower Deschutes River.

The time of chiselmouth spawning in the subbasin has not been documented, but elsewhere spawning occurs in late June and early July, when water temperatures exceed 62.5° F. Fecundity is approximately 6,200 eggs (Wydoski and Whitney 1979).

Chiselmouth feed primarily by scraping their chisel-like lower jaw along rocks, ingesting filamentous green algae and diatoms. Younger chiselmouth have been found to feed largely on surface insects (Wydoski and Whitney 1979).

Dace and Sculpin

Several species of dace (*Rhinichthys* sp.) and sculpin (*Cottus* sp.) are indigenous to the lower Deschutes River and many of its tributaries, including White River above White River Falls, the Warm Springs River and Shitike Creek.

Little is known relative to abundance or specific life history characteristics of these fishes in the subbasin. Although specific information has not been gathered, there is speculation that populations of these fishes in White River above White River Falls may be genetically or morphologically unique, given the period of evolutionary isolation from other populations in the subbasin.

Northern Squawfish

Northern squawfish (*Ptychocheilus oregonensis)*, also referred to as the bigmouth minnow, are indigenous to the subbasin and are found in the mainstem lower Deschutes and Warm Springs rivers, Trout and Shitike creeks, and may make spawning migrations into other tributaries.

Abundance of squawfish in the lower Deschutes River is unknown but they are sampled during rainbow trout electrofishing work throughout the lower 100 miles of the lower Deschutes River. As many as several thousand adults have been observed in lower Trout Creek in May and June, apparently on a spawning migration.

Squawfish food habits have received considerable attention recently throughout the Columbia River basin. Young squawfish feed principally on insects but as they grow larger, fish become a more important dietary item. Large adult squawfish feed heavily on other fishes and occasionally crayfish (Scott and Crossman 1973). Food habits of squawfish in the lower Deschutes River have been incompletely documented but they undoubtedly eat juvenile indigenous fishes. Results of northern squawfish predation on the abundance of other species in the lower Deschutes River is unknown.

Redside Shiners

Redside shiner, *Richardsonius balteatus,* are indigenous to the lower Deschutes River subbasin. They are found in the mainstem, Bakeoven, Buck Hollow, Shitike, and Trout creeks and the Warm Springs River.

The abundance of redside shiners in the lower Deschutes River subbasin is unknown but are periodically captured by electrofishing in the mainstem lower Deschutes River and in downstream migrant traps in the Warm Springs River and Shitike Creek.

The time of spawning of redside shiners in the subbasin has not been documented, elsewhere spawning takes place from May to later July and is apparently triggered by 50° F water temperature (Scott and Crossman 1973).

Redside shiner food habits have not been documented in the lower Deschutes River subbasin. Scott and Crossman (1973) report that adult redside shiners are mainly insectivorous and consume both adult and immature forms of aquatic and terrestrial insects but will eat mollusks, fish eggs and small fishes.

Angling and Harvest

Little information is available on the harvest of mountain whitefish, suckers, squawfish, and chiselmouth in the subbasin. Recreational and tribal harvest of these species is believed to be low. Squawfish are captured incidentally while angling for rainbow trout and summer steelhead throughout the lower Deschutes River. They will readily take artificial flies, particularly during the salmon fly hatch. Lamprey and mountain whitefish are of more importance to members of the CTWS than are suckers and chiselmouth. Whitefish can be easily caught on hook and line while fishing for rainbow trout but are targeted by recreational anglers at a low rate.

Angling regulations in the lower Deschutes River subbasin for these species are consistent with statewide regulations. Mountain whitefish are a game fish and have no catch or length limits. Lampreys, suckers, chiselmouths and squawfish are considered non-game fish and have no catch or length limits.

Lamprey are an important traditional food source for members of the CTWS and are harvested annually from June through August in the fish ladder and surrounding area at Sherars Falls. Harvest techniques include hand, dip nets, and, most commonly, hooking. Limited observations of tribal fishers at Sherars Falls suggest a harvest of about 1,000 lamprey per year. Lampreys are consumed fresh, and are also preserved by drying for use throughout the year. Lamprey are particularly valued by tribal elders.

Chiselmouth are important for tribal subsistence purposes. Historically, chiselmouth were harvested primarily in Buck Hollow, Bakeoven and Trout creeks. Time of harvest was associated with the seasonal movement of the chiselmouths into these tributaries in the late winter and early spring. Chiselmouth are harvested by dip netting from the stream bank.

Management Considerations

Whitefish, lamprey, suckers, and chiselmouth and other indigenous species are culturally significant fishes to members of CTWS, not only in contemporary culture, but also in traditional and historical aspects. Lamprey and whitefish, though not as important as salmon and other primary food sources, have played an important role in the seasonal subsistence treks of the tribes. Chiselmouth is another species of tribal importance. These fish are also an important and poorly understood part of the aquatic ecosystem.

The significance of these species is evident by the numerous locations named in oral history for the procurement and processing of these fishes. Further evidence of the significance of lamprey and suckers in traditional tribal cultures is manifested in the role they play in legends and creation mythology.

Since the establishment of the CTWS reservation, lamprey and whitefish procurement has continued to be important in subsistence activities and in maintaining traditional cultures.

Unfortunately, environmental degradation and loss of spawning and rearing habitat throughout the Columbia River system has reduced the abundance of lamprey to low levels.

Protection and enhancement of the lamprey is very important to the CTWS.

MANAGEMENT DIRECTION

The management of all indigenous freshwater and marine fish, including these fish, is subject to the Wild Fish Management Policy (WFMP). The intent of this direction is to preserve populations of indigenous fishes through periodically monitoring their population abundance and distribution, and through maintenance of critical habitats.

Policies

Policy 1. *Manage all indigenous species of fish in the lower Deschutes River and its tributaries to sustain the tribal cultural and subsistence needs, while providing the structural, functional and biological requirements to insure ecosystem viability.*

Objective 1. Protect populations of all indigenous species of fish in the lower Deschutes River subbasin.

Assumptions and Rationale

1. The CTWS manage their fisheries consistent with conservation of indigenous species. The CTWS are co-managers in meeting subbasin management plan objectives and will be involved in fish management activities in the lower Deschutes River subbasin at all levels. All action items will be conducted in cooperation with CTWS as co-managers of the resource.
2. A variety of indigenous species of fish are present in the lower Deschutes River and are important from an ecological or landscape perspective, as well as important to tribal fishers and recreational anglers.
3. Periodic population monitoring will serve as an indicator of species health and adaptiveness.

Actions

Action 1.1. Maintain or enhance fish habitat in the subbasin through implementation of actions identified in the habitat protection and anadromous fish sections of this subbasin plan.

Action 1.2. Develop population monitoring strategies for indigenous fish species in the lower Deschutes River subbasin.

Action 1.3. Educate anglers as to the ecological value of these species and encourage them to release non-salmonid species unharmed.

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SECTION 3. TROUT, WHITEFISH, AND MISCELLANEOUS SPECIES IN FLOWING WATERS

FIGURES AND TABLES

Table 3.1. Rainbow trout density (fish/mile) at the Nena Creek study section, by year.

Year	Size Group 8-10"	10-12"	> 12"	Total
1973	a/	184	a/	—
1974	858	267	89	1,214
1975	1,311	167	56	1,534
1979	267	201	171	639
1981	911	596	338	1,845
1982	971	997	592	2,560
1983	927	1,005	486	2,418
1984	755	721	172	1,648
1985	a/	782	130	912b/
1986	409	555	489	1,453
1987	261	472	312	1,045
1988	567	651	491	1,709
1995	465	457	212	1,134

a/ No estimate because of insufficient recaptures.
b/ Total estimate for trout > 10" only.

Table 3.2. Rainbow trout density (fish/mile) at the North Junction study section, by year.

Year	Size Group 8-10"	10-12"	> 12"	Total
1972	295	354	282	931
1973	164	1,138	462	1,764
1974	555	481	568	1,604
1975	1,179	723	533	2,435
1981	423	393	333	1,149
1983	343	857	853	2,053
1984	253	507	683	1,443
1985	a/	303	462	765 b/
1986	559	357	1,224	2,140
1987	211	541	638	1,390
1988	a/	757	962	1,719
1995	335	822	497	1,654

a/ No estimate because of insufficient recaptures.
b/ Total estimate for trout > 10" only.

Table 3.3. Rainbow trout density (fish/mile) in four areas of the Deschutes River.

Location/ Year	Size Group 8-10"	10-12"	> 12"	Total
Warm Springs Bridge-Trout Creek				
1972	375	456	742	1,573
1973	a/	684	733	1,417b/
1974	739	261	530	1,530
1975	741	478	367	1,586
Above Warm Springs River				
1978	407	720	1,050	2,177
1979	536	374	784	1,694
1996	275	519	323	1,117
Whiskey Dick				
1971	200	712	911	1,823
1972	401	733	1,040	2,174
1973	a/	741	686	1,427b/
1974	786	377	559	1,722
1978	412	473	1,240	2,125
1979	377	345	572	1,294
Below Sherars Falls				
Beavertail-Macks Canyon				
1971	--	--	--	31
Pine Tree-Macks Canyon				
1972	--	--	--	55
Jones Canyon-Rattlesnake C.				
1986	140	163	217	520
1996	378	592	145	1,115

a/ No estimate because of insufficient recaptures.
b/ Total estimate for trout > 10" only.

Table 3.4. Rainbow trout population estimates and density (fish/mile) in the White River system 1984. a/

Stream	Length (mile)	≤6 inches	Density (fish/mi)	<6 inches	Density (fish/mi)	%>6 inches
White River	41.0	11,413	278	27,979	682	29
Tygh Creek						
below falls	12.6	2,055	163	30,421	2,414	6
above falls	5.4 b/	396 b/	73	7,261 b/	1,344	5
Jordan Creek						
below falls	0.9	300	333	2,607	2,897	10
above falls	12.8	3,237	253	24,773	1,935	12
Badger Creek						
below falls	18.9	5,320	281	42,374	2,242	11
above falls	3.1	1,289	416	2,807	905	31
Little Badger Cr.	5.7 b/	320 b/	56	11,645 b/	2,043	3
Threemile Creek	10.0 b/	4,447 b/	445	25,510 b/	2,551	15
Rock Creek						
below reservoir	3.3 b/	381 b/	115	5,997 b/	1,811	6
above reservoir	6.0	763	127	14,487	2,414	5
Gate-South Fork	10.2 b/	584 b/	57	4,210 b/	397	12
Boulder-Forest c/	12.6	1,827	145	10,966	870	14
Clear-Frog c/,d/	16.4	1,145	70	5,183	316	18
Barlow Creek c/	6.4	68	108	5,599	875	11
Mineral c/-Iron-Bonney c/ -Buck c/	8.7	498 e/	57	3,901	448	11
Total						
below barriers	146.7	28,979	196	176,372	1,202	
above barriers	27.3	5,685	208	49,328	1,807	

a/ Population estimates expanded for stream by site-specific measurements of abundance.
b/ Adjusted stream length and abundance to account for stream sections with no summer flow or without resident populations.
c/ Brook trout present in the stream.
d/ Frog Creek had no rainbow trout above 4.6 miles.
e/ All in Iron Creek. Rainbow trout population estimatesa/ and density (fish/mile) in the White River system 1984 (from ODFW et al. 1985).

Table 3.5. Number of legal-sized (7-10") hatchery rainbow trout stocked periodically in streams in the lower Deschutes River subbasin.

Date	Stream	Number	Location
April-May	Shitike Creek	1,000	Warm Springs a/
April-Sep	Warm Springs R.	15,0000	Kah-Nee-Ta a/

a/ Not always stocked annually.

Table 3.6. Estimated harvest of rainbow trout in the Deschutes River from Sherars Falls to Pelton Reregulating Dam, 1952, 1969, and 1973.

Year	Wild	Hatchery	Total
1952	50,866	-- a/	50,866
1969 b/	132,846	36,928	169,774
1973	21,884	38,253	60,137

a/ No estimate.
b/ Estimates based on 1968 sampling in Maupin area (RM 59 to 43) and 1969 sampling from Warm Springs (RM 97) to Locked Gate (RM 59).

Table 3.7. Estimated angler catch of rainbow trout. Data from the Heritage Landing site (mouth west bank, river mile 0) site for the period July 1 to October 31, by year.

Year	Anglers	Hours	Kept	Rainbow Trout Released	Rainbow Trout Total
1989	234	1,398	65	1,319	1,384
1990	95	1,079	21	470	491
1991	214	1,690	33	1,359	1,392
1992	188	1,578	13	1,453	1,466
1993	392	3,071	34	1,453	1,487
1994	355	2,207	13	1,055	1,068
1995	354	1,790	6	1,142	1,148

Table 3.8. Estimated angler catch of rainbow trout. Data from the Macks Canyon Road site for the period July 1 to October 31, by year.

Year	Anglers	Hours	Kept	Rainbow Trout Released	Rainbow Trout Total
1989	2,198	10,601	515	6,909	7,424
1990	1,941	9,180	443	6,037	6,480
1991			no sample		
1992	1,246	7,188	153	3,160	3,313
1993	1,772	8,781	98	3,887	3,985
1994	2,268	10,456	151	6,538	6,690
1995	2,985	15,225	172	7,189	7,361

Table 3.9. Estimated angler catch of rainbow trout from the lower Deschutes River, river mile 0 to river mile 41, for the period July 1 to October 31, by year.

Year	Anglers	Hours	Kept	Rainbow Trout Released	Rainbow Trout Total
1989	2,432	11,999	580	8,228	8,808
1990	2,036	10,259	464	6,507	6,771
1991		incomplete data			
1992	1,434	8,766	156	4,613	4,769
1993	2,164	11,852	132	5,340	5,472
1994	2,623	12,663	164	7,593	7,758
1995	3,339	17,015	178	8,331	8,509

Table 3.10. Length data (cm) of bull trout captured by electro-fishing in the Deschutes River, by year.

Year	Mean	Range	Sample Size	Standard deviation	Sum of lengths
NENA CREEK					
1974	28.0	14.8-41.2	2	18.7	56.0
1975	28.0	15.0-51.1	3	20.1	83.9
1979	—	31.6	1	—	31.6
1981	42.7	34.0-51.6	4	9.4	171.0
1982	39.3	36.5-42.1	2	4.0	78.6
1983	33.5	—	2	0	67.0
1984	—	38.0	1	—	38.0
1985	—	36.0	1	—	36.0
1986	32.6	29.7-34.8	4	2.4	130.4
1987	31.6	29.0-32.9	7	1.5	221.1
1988	38.8	31.6-46.0	4	7.3	155.4
1995	32.0	15.5-42.9	5	11.2	160.1
NORTH JUNCTION					
1972	29.6	19.8-54.7	4	16.8	118.6
1973	24.8	15.2-37.9	5	10.7	124.2
1974	34.6	12.9-49.7	11	10.6	380.6
1975	30.6	13.6-46.2	14	12.0	428.2
1981	29.2	15.7-53.3	4	17.6	117.0
1983	44.0	35.5-55.5	2	12.0	88.0
1984	47.4	37.9-58.0	2	13.5	94.9
1985	35.9	30.5-40.6	4	5.1	143.7
1986	43.3	34.0-57.5	9	7.3	389.5
1987	40.3	31.9-49.5	10	7.5	403.4
1988	39.7	27.0-51.5	6	9.7	238.3
1995	33.1	17.3-46.5	8	16.2	264.7
TROUT CREEK - WHISKEY DICK					
1972	27.9	21.8-38.5	3	9.2	83.6
1973	24.3	17.5-31.3	5	6.3	121.5
1974	37.5	33.3-46.8	6	5.8	225.3
1978 a/	1.4	16.0-38.7	8	6.9	251.4
1979 a/	31.3	14.6-46.4	18	7.1	563.7
WARM SPRINGS - TROUT CREEK a/					
1972	31.6	17.2-56.6	18	12.8	568.2
1973	48.0	—	2	0	96.0
1974	32.3	15.0-52.0	26	11.8	840.5
1975	26.1	12.8-51.5	27	11.2	705.5

a/ Above and below the mouth of the Warm Springs River.

Table 3.11. Number of bull trout captured in a Humphrey Trap, Warm Springs River, by year.

Year	Date	Number	Fork Length (mm)	Weight (g)
1984	05/25	1	127	--
1985		0		
1986	05/20	1	240	--
1986	12/08	1	220	112 g
1986	12/12	1	255	185 g
1986	12/12	1	274	219 g
1987	10/16	1	175	--
1988	11/09	1	285	290 g
1989	03/29	1	148	--
1990	10/19	1	571	--
1991		0		
1992		0		
1993		0		
1994	06/28	1	188	--
1994	10/19	1	282	224 g
1995		0		

Table 3.12. Number of bull trout captured at the Warm Springs National Hatchery upstream migrant trap, by year.

Year	Bull Trout	Lengths
1991	2	48 cm, 60 cm
1992	0	--
1993	1	42 cm
1994	2	42 cm, 42 cm
1995	5	2 @ 42 cm, 2@ 44 cm One no length

Table 3.13. Number of bull trout captured in the Pelton trap, by year.

Year	Date Captured	Number Captured
1992		0
1993	06/28	1
1993	07/02	1
1993	07/13	1
1993	07/26	2
1994	08/02	1
1994	08/31	1
1995		0

Table 3.14. Bull trout redd counts by index areas in the Warm Springs River and Shitike Creek, by year.

Index Area	KM	84	85	86	87	88	89	90	91	92	93	94	95
Shitike Creek													
Peter's Pasture	1.1	5	2	3	3	12	12	9	6	6	5	2	1
Powerline to Upper Crossing	3.2	--	--	--	--	--	--	6	1	--	3	4	1
Upper Crossing to Bennett Place	4.5	--	--	--	--	--	--	--	1	0	0	--	--
Warm Springs River													
Buchgrass to Schoolie	6.4	--	--	--	--	--	--	15	12	9	8	5	26

Table 3.15. Bull trout catch in five locations of the lower Deschutes River in various years from 1969-83. a/

Area/Year	Anglers	Hours	Bull Trout	Rainbow Trout (wild b/)
Trout Creek				
1969	8,177	28,681	6	3,219
1972	2,773	8,263	14	1,063
1973	3,582	11,432	25	1,613
1974	6,306	16,085	12	2,095
South Junction				
1969	5,423	19,880	2	3,106
1972	2,396	8,735	7	1,115
1973	2,503	9,951	33	999
1974	3,338	10,224	71	1,289
Maupin c/				
1972	2,000	6,624	6	2,186 d/
1973	3,966	14,664	8	1,932 d/
Warm Springs Bridge				
1973	38,739	53,374	263	2,680 d/
Dry Creek				
1973	82	300	1	109
1978	390	1,167	3	174
1979	502	1,383	3	194
1980	284	781	3	87
1981	157	536	7	86
1983	62	237	1	21

a/ Statistical creel except where noted
b/ ≥ 12 inches except where noted
c/ Not statistical creel
d/ ≥ 6 inches

Table 3.16. Number of brown trout stocked into Lake Simtustus, by year.

Year	Month	Species	Number	Fish/LB	Mark
1987	May	Brown	3,700	3.0	AD
1988	May	Brown	2,008	3.0	AD
1989	April	Brown	18,000	3.0	LV
1990	April	Brown	24,625	2.8	RV
1991	May	Brown	20,418	2.3	AD
1992	A,M,J	Brown	20,960	2.0	RM
1993	May	Brown	19,457	2.0	LM
1994	M,J	Brown	19,819	2.0	LV
1995	M,J	Brown	18,927	1.4	RV
1996	1/ M,J	Brown	20,000	2.0	AD

1/ Number and size approximate.

Table 3.17. Number, mark, method, and year of capture of fish sampled in the Pelton Reregulating Reservoir, by year.

Year	Method	Species	Mark	Number
1991	Gillnet	Brown Trout	LV	10
1991	"	Brown Trout	AD	2
1991	"	Brown Trout	RV	3
1991	"	Rainbow Trout	none	1
1991	"	Rainbow Trout	RV	1
1991	"	Rainbow Trout	DD	6
1992	Gillnet	Brown Trout	LV	5
1992	"	Brown Trout	AD	9
1992	"	Brown Trout	RV	1
1992	"	Brown Trout	DD	1
1992	"	Rainbow Trout	none	1
1992	"	Whitefish	none	9
1992	"	Coursescale		
1992	"	Sucker	none	4
1992	"	Squawfish	none	7
1992	"	Bridgelip		
1992	"	Sucker	none	1
1992	Angling	Brown Trout	LV	4
1992	"	Brown Trout	AD	9
1992	"	Brown Trout	RV	2
1992	"	Brown Trout	DD	2
1992	"	Rainbow Trout	none	4
1992	"	Rainbow Trout	LV	3
1992	"	Rainbow Trout	RV	7
1992	"	Whitefish	none	2

Table 3.18. Capture of brown trout at the Pelton Trap, by year.

Year	Marked	Unmarked	Total
1990	3	0	3
1991	18	2	20
1992	24	2	26
1993	30	3	33
1994	25	2	27
1995	10	2	12

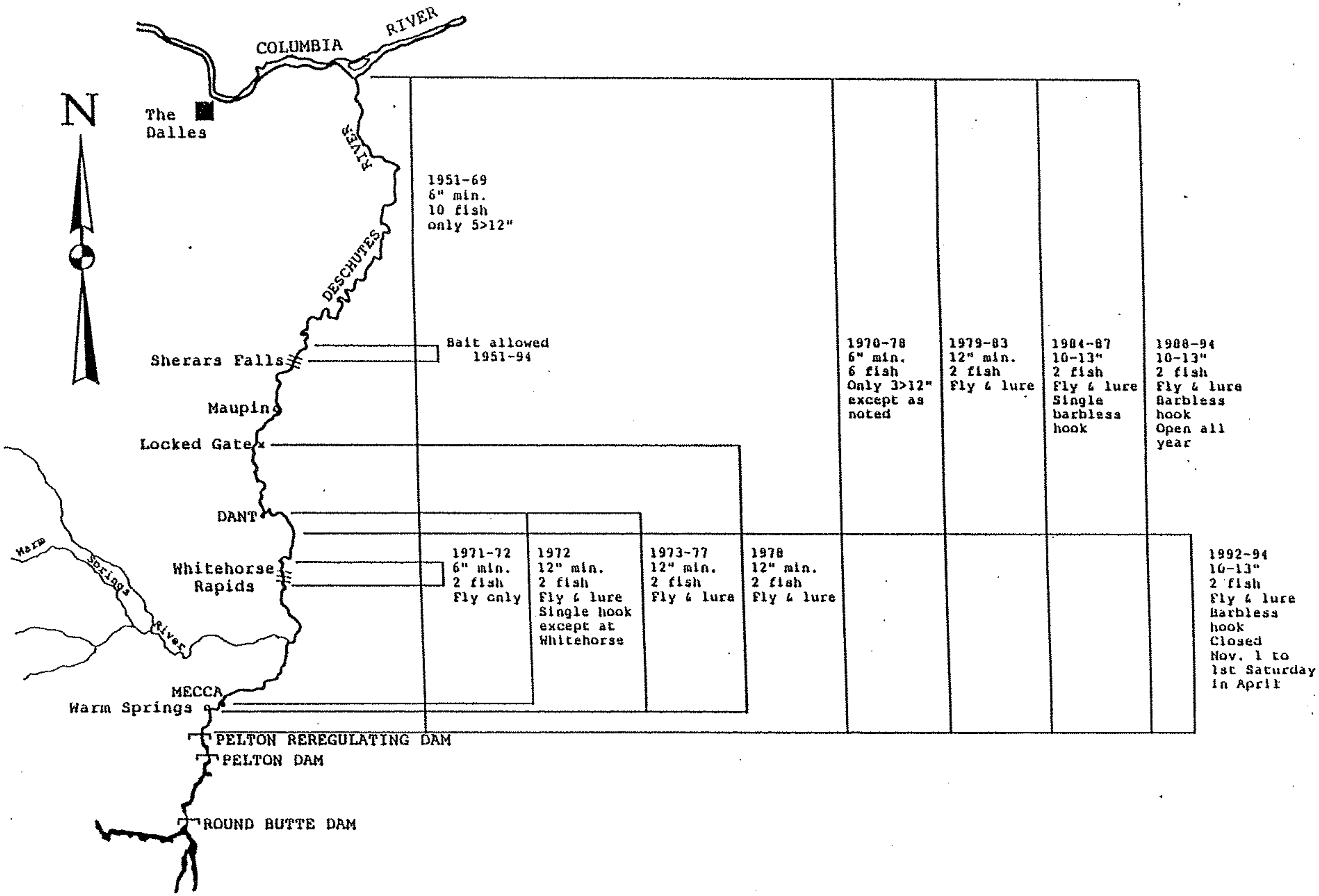
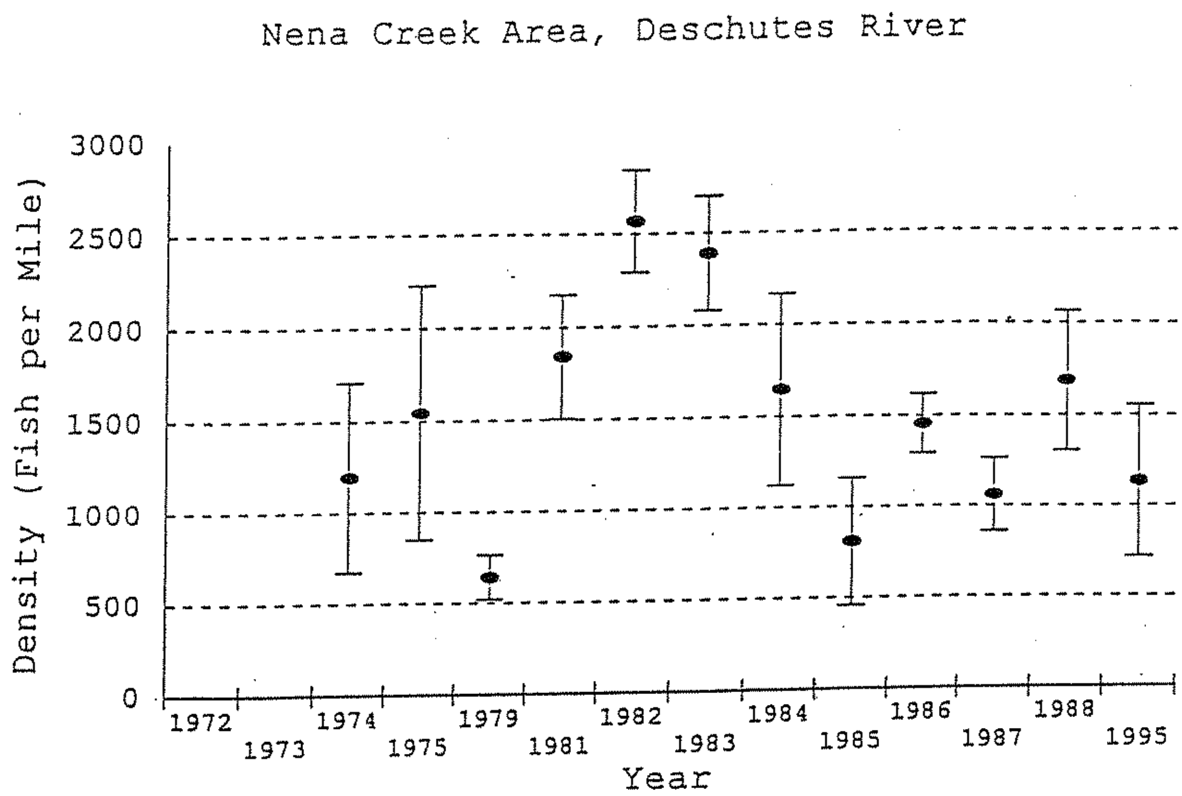


Figure 3.1. Angling regulations for rainbow trout in the Deschutes River below Pelton Reregulating Dam, 1951-1994.



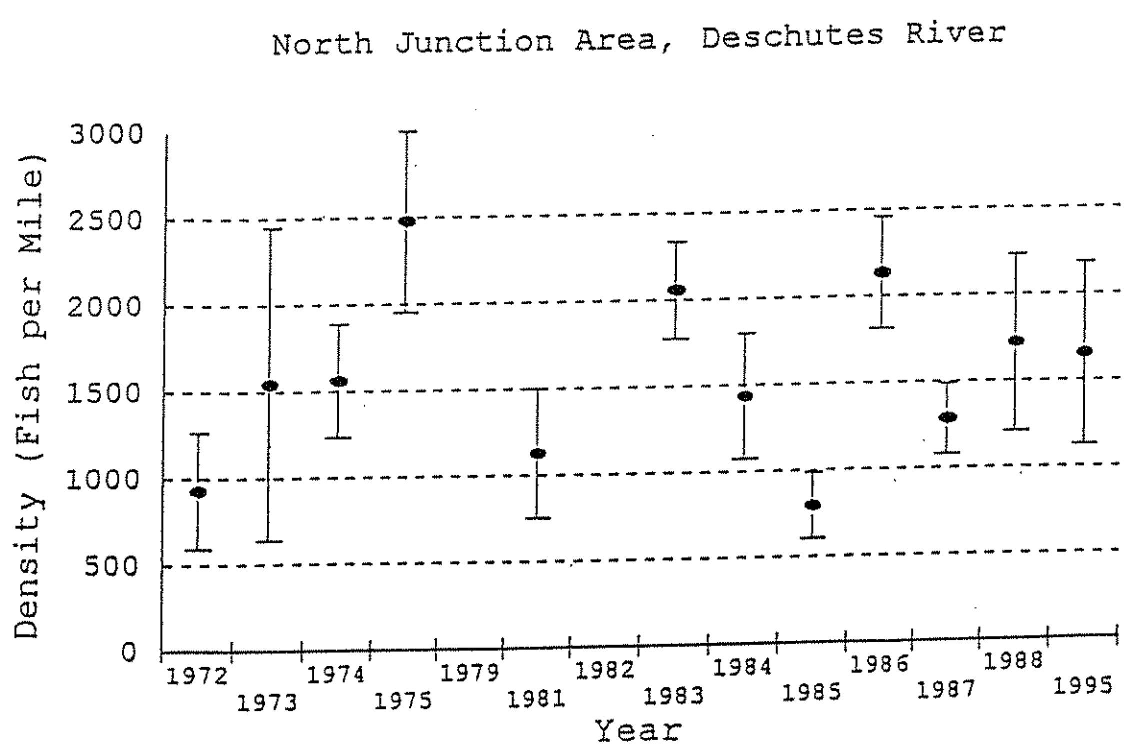


Figure 3.2. Estimated density and 95% confidence interval of rainbow trout greater than 19.0 cm fork length in two sections of the Deschutes River, by year.

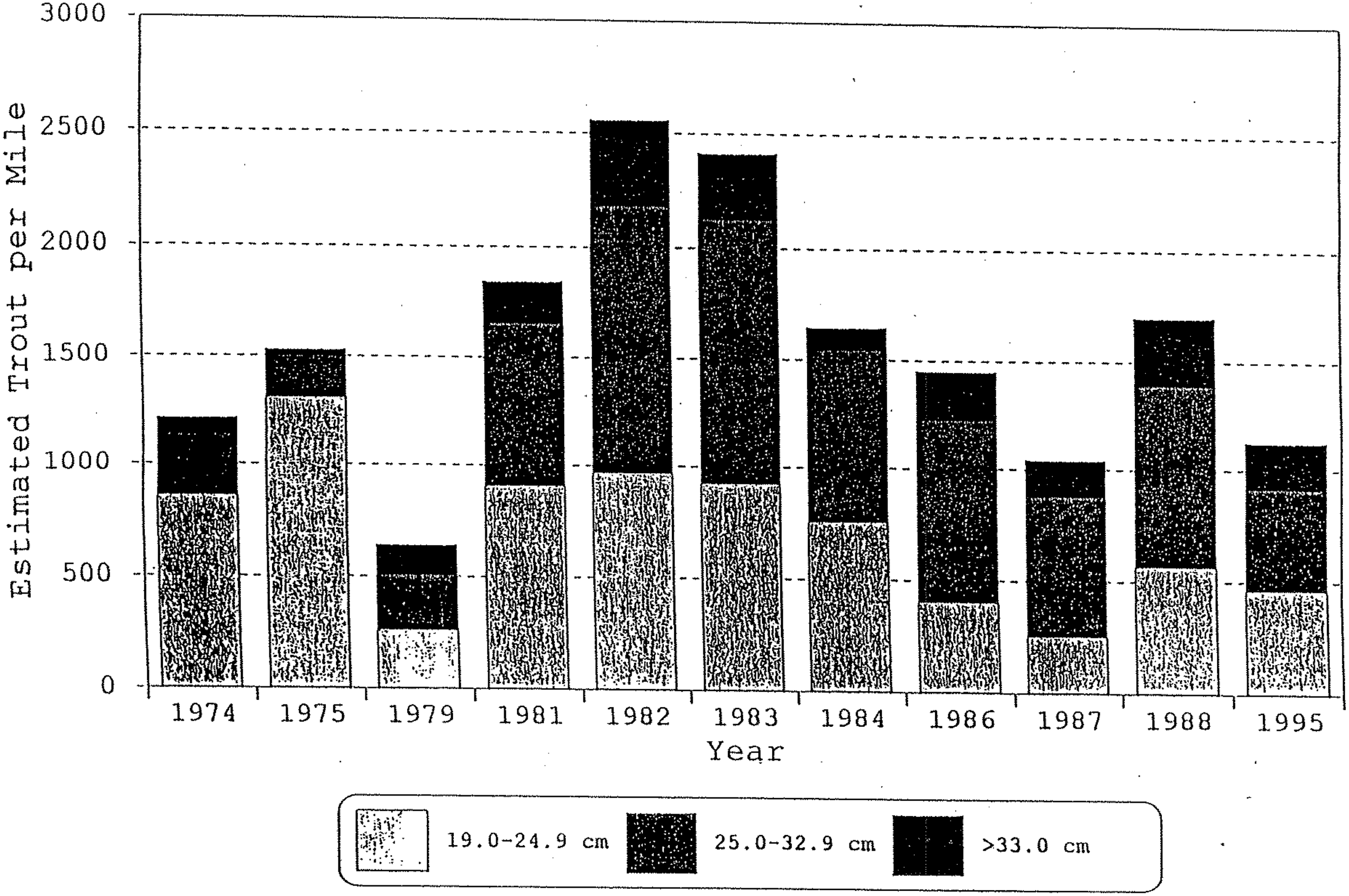
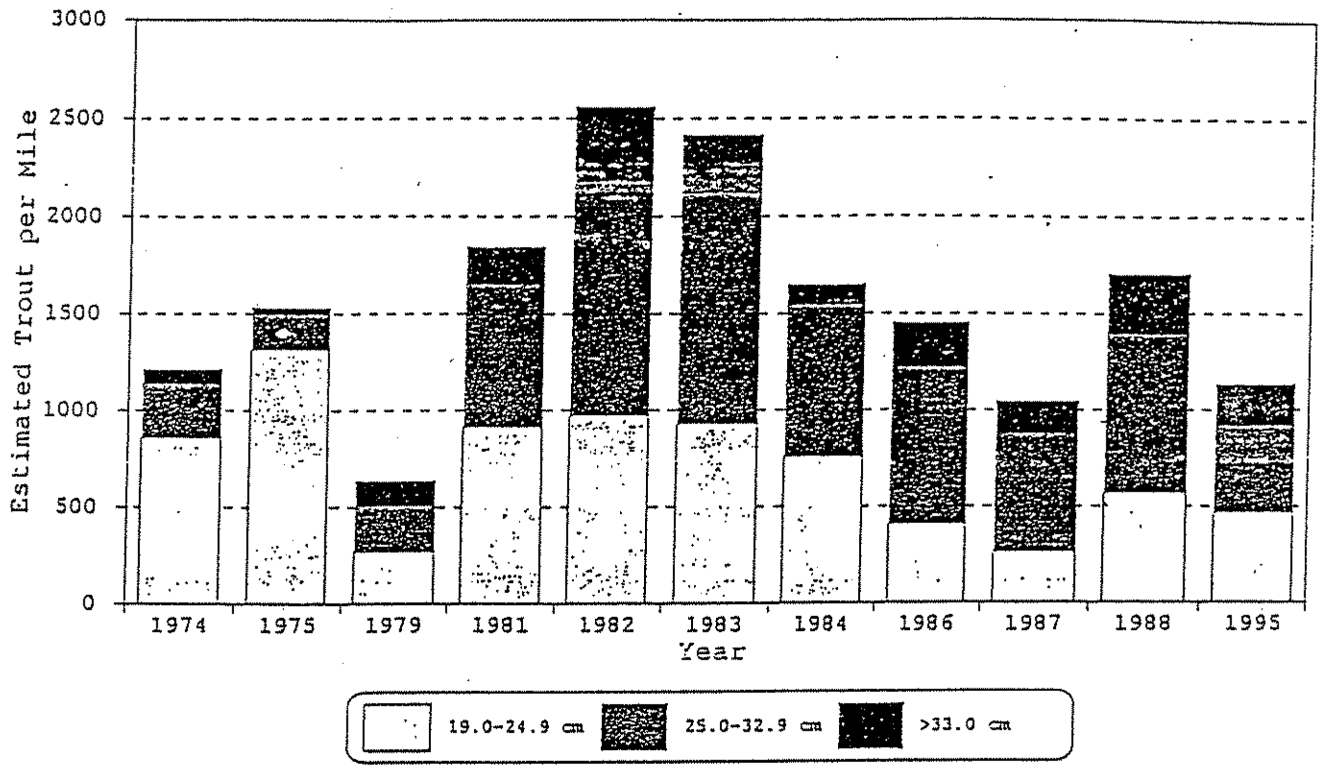


Figure 3.3 Estimated density of rainbow trout by size class in the Nena Creek study section, Deschutes River, by year.

Nena Creek Area, Deschutes River



North Junction Area, Deschutes River

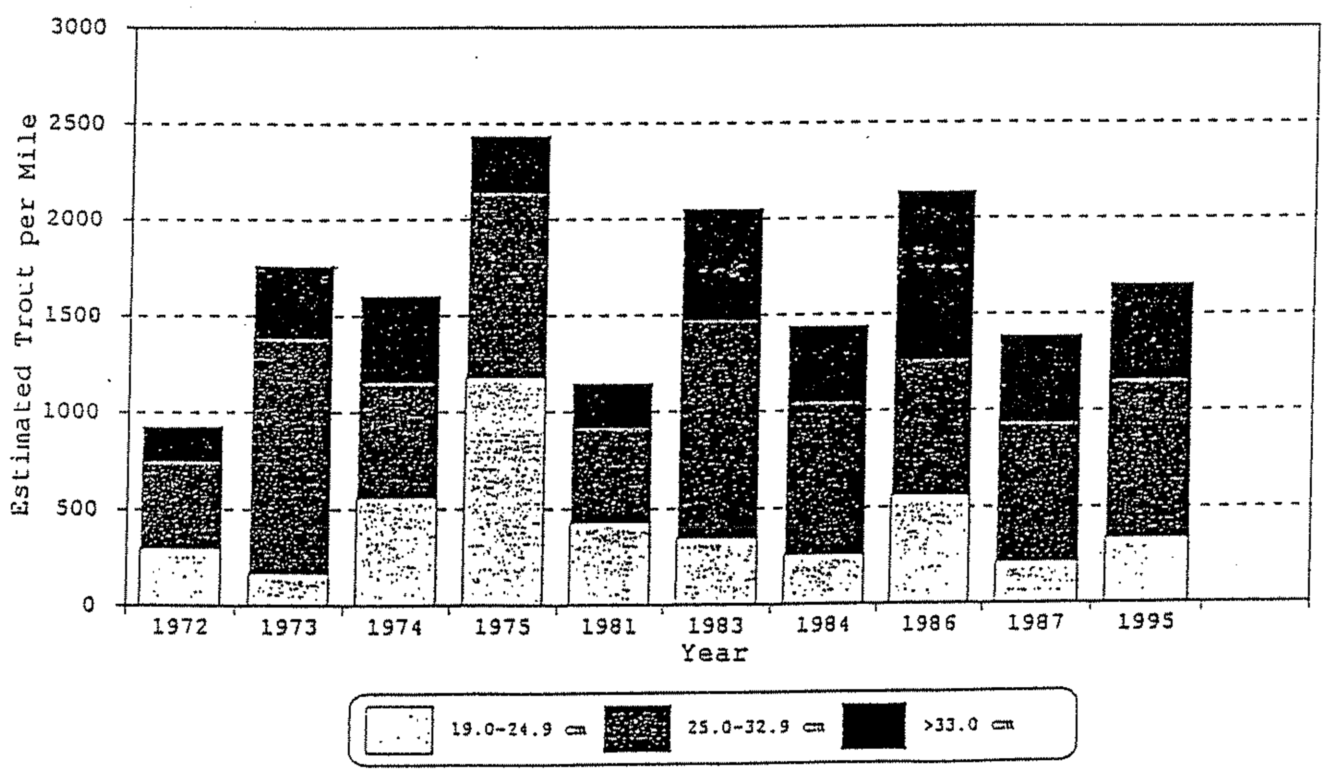


Figure 3.4. Estimated density of rainbow trout by size class in the Nena Creek and North Junction study sections, Deschutes River, by year.

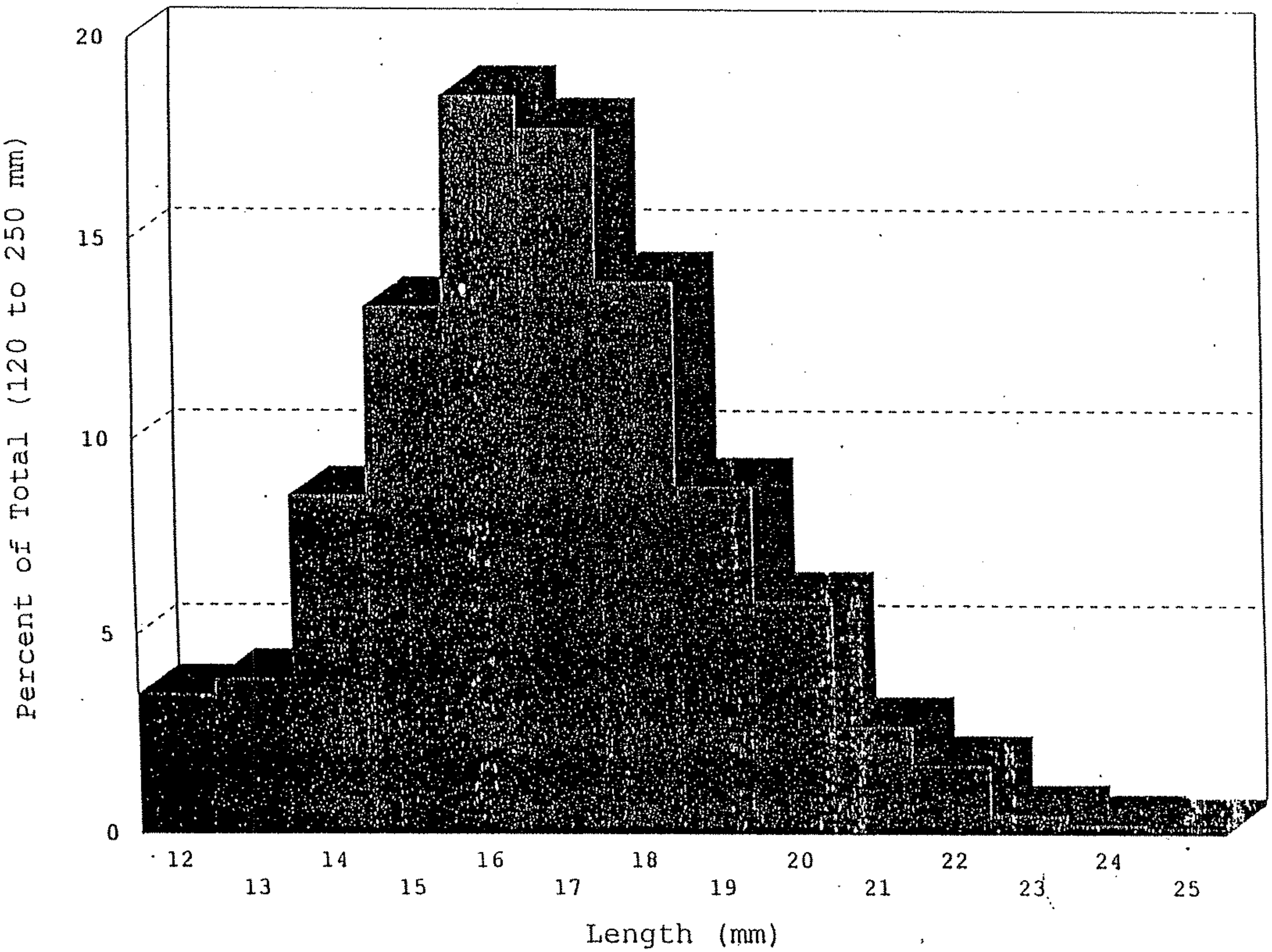


Figure 3.5. Length frequency of juvenile rainbow/steelhead captured in a downstream migrant trap in the Warm Springs River, 1990 - 1995. N=5,419.

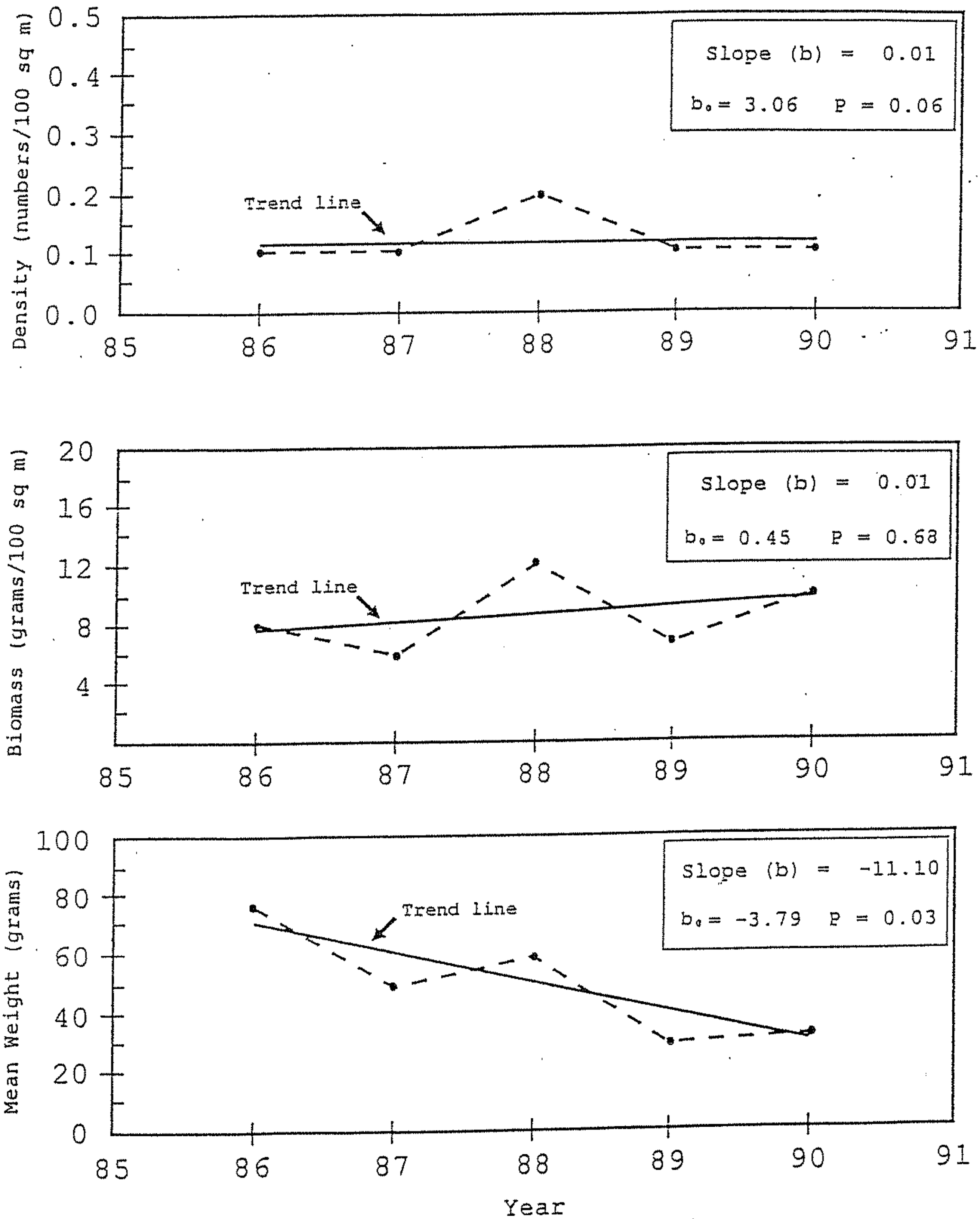


Figure 3.6. Time series densities, biomass, and mean weights of bull trout in the Upper Crossing site on Shitike Creek, Oregon.

LOWER DESCHUTES RIVER SUBBASIN MANAGEMENT PLAN
SECTION 4. SUMMER STEELHEAD

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SUMMER STEELHEAD

WILD SUMMER STEELHEAD

Origin

Summer steelhead, *Oncorhynchus mykiss*, (formerly *Salmo gairdneri*) occur throughout the mainstem lower Deschutes River below Pelton Reregulating Dam (river mile 100) and in most tributaries below the dam. Before construction of the Pelton/Round Butte hydroelectric complex, summer steelhead were also found in the Deschutes River upstream to Big Falls (river mile 128), in Squaw Creek, and in Crooked River (Figure 4.1; Nehlsen 1995). Historic summer steelhead presence in the Metolius River is uncertain (Nehlsen 1995).

Construction of Pelton and Round Butte dams, completed in 1958 and 1964, respectively, included upstream passage facilities for adult chinook salmon and steelhead and downstream facilities for migrating juveniles. By the late 1960's, it became apparent that the upriver runs could not be sustained naturally with these facilities due primarily to inadequate downstream passage of juveniles through the complex and summer steelhead production upstream of the dam complex was lost.

Lower Deschutes River summer steelhead are currently classified as a wild population on Oregon's Wild Fish Management Policy Provisional Wild Fish Population List [OAR 635-07-529(3)]. A population meets ODFW's definition of a wild population if it is an indigenous species, naturally reproducing within its native range, and descended from a population that is believed to have been present in the same geographical area prior to the year 1800. Human caused genetic changes either from interbreeding with hatchery origin fish or habitat modification do not disqualify a population from the wild classification under this definition. We recognize that it is likely the current wild steelhead population in the lower Deschutes River has undergone some of these genetic changes particularly from recent interbreeding with hatchery origin summer steelhead. Irrespective of this, naturally produced summer steelhead in the lower Deschutes River meet ODFW's definition of a wild population.

Schreck et al. (1986) compared biochemical, morphological, meristic, and life history characteristics among steelhead stocks in the Columbia basin. Lower Deschutes River wild summer steelhead were found to be a component of one of three subgroups of stocks found east of the Cascade mountains; specifically, the group formed by stocks found in the Columbia Basin from Fifteenmile Creek in Oregon to the Entiat River in Washington.

Currens (1987) examined differences between resident rainbow trout and steelhead among unisolated tributaries within the Deschutes River basin. Based on morphological and biochemical analysis, little genetic differentiation among steelhead populations in tributaries was found. Differences were found between tributary populations and those in the mainstem lower Deschutes River. This difference may have been the result of sampling adult resident rainbow trout in the mainstem lower Deschutes River and rainbow-like juvenile steelhead from the tributaries.

A large number of wild and hatchery steelhead from other Columbia Basin production areas stray into the lower Deschutes River. An unknown number of these stray steelhead leave the lower Deschutes River and continue their migration up the Columbia River. Others are harvested in fisheries in the lower Deschutes River and some remain in the subbasin to spawn. The amount of genetic interchange between stray wild and lower Deschutes River origin wild summer steelhead is unknown.

Life History and Population Characteristics

Wild summer steelhead juveniles rear in the lower Deschutes River for one to four years before migrating to the ocean. Lower Deschutes River origin wild summer steelhead typically return after one or two years in the Pacific Ocean (termed 1-salt or 2-salt steelhead). A total of eight life history patterns were identified on scales collected from a sample of lower Deschutes River origin wild adult summer steelhead (Olsen et al. 1991). Typical of other summer steelhead stocks, very few steelhead return to spawn a second time in the lower Deschutes River.

Summer steelhead enter the subbasin primarily from June through October (Table 4.1). Steelhead pass Sherars Falls from June through March with peak movement in September or early October.

Wild females consistently out number males in a run year (Table 4.2). Information on sex ratio by age at return, and length-weight ratio of wild summer steelhead is not available.

Wild summer steelhead spawn in the lower Deschutes River, Warm Springs River system, White River, Shitike Creek, Wapinitia Creek, Eagle Creek, Nena Creek, the Trout Creek system, the Bakeoven Creek system, the Buck Hollow Creek system and other small tributaries with adequate flow and a lack of barriers to fish migration. Spawning in White River is limited to the two miles below White River Falls, an impassable barrier. Spawning opportunities in Nena Creek are also limited by a natural barrier.

The relative proportion of mainstem and tributary spawning is unknown. Based on limited spawning ground counts in the mainstem and tributaries, managers believe that mainstem spawning accounts for 30% to 60% of the natural production (ODFW 1987; ODFW unpublished data).

The Warm Springs River system is believed to contribute a large portion of the tributary spawned wild summer steelhead in the lower Deschutes River. Tributary spawning ground counts are incomplete most years because many tributaries are unaccessible during spawning time. Calculation of total numbers of spawners using Warm Springs River tributaries is, therefore, not available. Counts of wild summer steelhead passing the barrier dam at Warm Springs National Fish Hatchery (WSNFH), located at river mile 11.0 on the Warm Springs River, have been greater than what can be accounted for by redd counts in all other tributaries. The Warm Springs system is of particular value as a refuge for wild summer steelhead since all hatchery marked or suspected hatchery origin summer steelhead are not allowed to pass the barrier dam at WSNFH (WSNFH Operational Plan 1992-1996). This effectively excludes all non-Deschutes River origin summer steelhead except stray wild summer steelhead. The number of stray wild summer steelhead being passed above the barrier dam is unknown.

Spawning in the lower Deschutes River and west side tributaries usually begins in March and continues through June (Table 4.1). Spawning in east side tributaries occurs from January through mid-April. Spawning in east side tributaries may have evolved to an earlier time than westside tributaries or the mainstem because stream flow tends to decrease earlier in the more arid eastside streams (Olsen et al. 1991).

Fecundity of wild summer steelhead, sampled in 1970 and 1971, ranged from 3,093 to 10,480 eggs per female with a mean of 5,341 eggs per female (Olsen et al. 1991). Average fecundity is 4,680 eggs per female for fish that have spent one year in the ocean (1-salt) and 5,930 eggs per female for fish that have spent two years in the ocean (2-salt).

Fry emerge in spring or early summer depending on time of spawning and water temperature during egg incubation. Zimmerman and Reeves (1996) documented summer steelhead emergence in late May through June. Juvenile summer steelhead emigrate from the tributaries in spring at age 0 to age 3. Many of the juveniles that migrate from the tributaries continue to rear in the mainstem lower Deschutes River before smolting.

Scale patterns from wild adult steelhead indicate that smolts enter the ocean at age 1 to age 4 (Olsen et al. 1991). Specific information on time of emigration through the Columbia River is not available, but researchers believe that smolts leave the lower Deschutes River from March through June (Table 4.1).

Information on survival rates from egg to smolt and smolt to adult is not available for wild summer steelhead in the lower Deschutes River.

Supplementation History

Managers supplemented natural production with fry and fingerlings from Round Butte Hatchery (RBH) and WSNFH periodically from 1974 to 1984. Fry and fingerling releases were intended to augment natural production rather than provide harvest opportunity. Shitike Creek and tributaries of the Warm Springs River were supplemented with summer steelhead fry or fingerlings from WSNFH. Fingerlings from RBH were released in the lower Deschutes River (Table 4.3). The steelhead released off station in the Warm Springs River tributaries were not differentially marked to distinguish them from the production lot released directly from the hatchery. In general, supplementation did not appear to be successful since no large increase in unmarked returns was noted from these releases. No future supplementation of natural summer steelhead production is anticipated in the lower Deschutes River.

Population Estimates

Population estimates of wild summer steelhead passing Sherars Falls (river mile 44) in the lower Deschutes River have been made annually since 1977 using Peterson mark-recapture estimation techniques. These estimates are made by tagging wild summer steelhead captured at the Sherars Falls adult salmon and steelhead trap (located in the fish ladder at Sherars Falls) and making later recovery of both tagged and untagged fish at WSNFH and at the Pelton trap, the hatchery trap for RBH, located at the base of the Pelton Reregulating Dam. This technique yields an estimated number of wild steelhead passing Sherars Falls.

It is not technically possible at this time to estimate the number of wild summer steelhead entering the mouth of the Deschutes River due to a number of complicating factors including: 1) the only trapping site currently available to monitor summer steelhead population strength in the lower Deschutes River is at Sherars Falls (RM 44); 2) both wild and hatchery origin summer steelhead from other systems are known to stray into the lower Deschutes River and subsequently move back out of the lower Deschutes River into the Columbia River without reaching Sherars Falls for inclusion in population estimates above Sherars Falls; 3) both wild and hatchery origin summer steelhead spawn in tributaries, principally Buck Hollow Creek, and the mainstem lower Deschutes River below Sherars Falls; and 4) harvest of hatchery summer steelhead downstream of Sherars Falls can be estimated through statistical procedures but some unknown level of hooking mortality is experienced by both wild and hatchery origin summer steelhead. With the exception of harvest, summer steelhead numbers affected by these factors cannot be accurately estimated without a trapping site at or near the mouth of the Deschutes River. Therefore, all estimates of summer steelhead run strength in the lower Deschutes River are reported as escapement over Sherars Falls. This inability to calculate run to the river for wild summer steelhead limits managers ability to precisely control harvest through regulation. Thus, management regulations are based on short term trends in run strength and escapement.

Population Status

The estimated number of wild summer steelhead migrating over Sherars Falls has ranged from a low of 480 in the 1994 run year to a high of 9,600 in the 1985 run year, averaging 4,900 for the period of record (Table 4.4).

Specific information on habitat carrying capacity for wild summer steelhead is not available for the lower Deschutes River subbasin.

Specific information on wild juvenile summer steelhead populations in the main stem lower Deschutes River or tributaries is not available.

Based on present habitat, an average fecundity of 5,130 eggs per female, and an assumed egg-to-smolt survival of 0.75%, the maximum steelhead production capacity of the lower Deschutes River is estimated to be 147,659 smolts, with an adult spawning population of 6,575 fish (ODFW 1987). These production estimates were developed during the preparation of the Columbia River Management Plan as directed by terms of the *U.S. v Oregon* court case. The data used to develop these estimates reflect the best information available at that time and are believed to currently be accurate. Both estimates of production capacity (smolts and adults) are based on the assumption that current habitat will sustain past escapement levels and juvenile rearing habitat will sustain the densities predicted from maximum escapement levels. The estimated adult return from a spawner escapement of 6,575 is 9,089 assuming a 6% wild smolt to adult survival rate (ODFW 1987). The estimated return of 9,089 adults to the mouth of the Deschutes River would, theoretically, produce some level of harvestable wild summer steelhead.

A spawning escapement of 6,575 is believed to be adequate to sustain maximum natural production potential during years of good juvenile and adult survival conditions. During years of outstanding survival conditions and high smolt to adult survival, spawning escapement may be even larger (i.e. 1985). Oregon's Wild Fish Management Policy (OAR 635-07-525 to 595) directs ODFW to oppose habitat degradation and harvest strategies that cause a population to decline to a level of 300 or less breeding fish. Oregon's Wild Fish Policy further directs ODFW to address and correct harvest strategies that have depressed a population towards a level of 300 or fewer spawners. If wild summer steelhead fell to this level for one year in the lower Deschutes River, regulations would be enacted to limit recreational angling related mortality. ODFW recognizes, however, that lower Deschutes River wild summer steelhead are a valuable and important component of Oregon's fish resources and a more conservative approach to managing this population when it is at low levels is warranted. Based on this premise, this plan proposes an intermediate management action trigger of 1,000 wild individuals over Sherars Falls for three consecutive years as a conservative criterium for initiating additional protective angling regulations. Conversely, if escapement of 6,575 wild summer steelhead over Sherars Falls is sustained for five consecutive years, consumptive harvest of wild summer steelhead would be proposed, not to exceed 2,500 individuals.

Angling Regulations

Summer steelhead angling and harvest has been historically popular and important for recreational anglers and tribal fishers. Wild summer steelhead could be retained by recreational anglers prior to 1978 under a two fish per day regulation. Natural bait and barbed hooks were legal in the bulk of the lower Deschutes River during this period. An anticipated low return of wild summer steelhead to the lower Deschutes River in 1978 resulted in a closure of the lower Deschutes River summer steelhead recreational fishery on 20 August, 1978. The season re-opened 1 July, 1979 with a wild fish release rule which has remained in effect to date. The use of natural bait and barbed hooks was prohibited starting in 1979 except that bait was allowed in a one mile reach downstream from Sherars Falls. This area was expanded to a three mile reach of river from Sherars Falls downstream to the upstream most railroad trestle in 1990. Currently, the daily bag limit is restricted to two fin marked hatchery origin summer steelhead.

Harvest regulations for recreational fisheries in the subbasin are set by the Oregon Fish and Wildlife Commission (Commission). Oregon State Police and the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) Tribal Police enforce fishing regulations in the subbasin. Tribal police regulate all on-reservation fishing by both members and non-members. CTWS regulations for the on-reservation non-tribal recreational fishery are consistent with ODFW regulations.

CTWS also regulates off-reservation fishing by tribal members. The tribal dipnet fishery primarily occurs in the area immediately below Sherars Falls. The off-reservation treaty fishery, however, is not subject to a tribally imposed bag limit. Rather, CTWS Tribal Council regulates this fishery through time and area closures, depending on stock and run-size status. Members of the CTWS were allowed unrestricted opportunity to harvest wild steelhead until 1991 when season length restrictions were imposed on dipnet fishers for protection of fall chinook. Season length restrictions to protect fall chinook were also imposed in 1992 and 1993 and served to limit harvest of wild summer steelhead. CTWS implemented a wild summer steelhead release regulation for dipnet fishers in 1994 and 1995.

Harvest

Harvest or catch of the different components of summer steelhead runs in the lower Deschutes River has been estimated by statistical harvest estimation procedures since 1970. Statistical harvest estimates have been calculated for fisheries taking place at Sherars Falls for both recreational anglers and tribal fishers, at the start of the Macks Canyon Road, at Kloan, and at both the west and east banks at the mouth of the Deschutes River. The harvest sample at the mouth of the Deschutes River yields an estimate of all land based, power boat, and drift craft angler effort and catch for those anglers fishing downstream from Macks Canyon, with the exception of very minor effort and catch in the Kloan area and on the east bank near the mouth. Previous sampling of east bank catch and effort makes it possible to estimate that component and include it in a total catch figure. The harvest sample at the start of the Macks Canyon Road yields an estimate of all angler effort and catch that leaves the river via the Macks Canyon Road. The Sherars Falls harvest sample yields an estimate of effort and catch by both sport anglers and tribal fishers in the area from Sherars Falls to Buck Hollow Creek. All samples are standardized on a 1 July to 31 October statistically random schedule designed to estimate total effort and catch at each sample point. Catch is categorized by wild, RBH origin, and stray hatchery origin. If all harvest samples are completed on a given year, their sum equals total catch and effort from Sherars Falls downstream to the mouth of the river for the period of the sample with the exception of some minor catch and effort at the Kloan site. A relatively minor catch of summer steelhead does take place after the period of the sample each year; therefore, these figures are not estimates of total catch in the area sampled but are valuable as indices of catch. Additionally, steelhead are harvested from the lower Deschutes River in the area above Sherars Falls, principally in the Maupin, South Junction, Trout Creek, and Warm Springs areas. Harvest can be estimated for these areas from catch record cards (punch card) but insufficient resources are available to complete total harvest estimates for the lower 100 miles of the Deschutes River.

Both recreational anglers and tribal fishers catch wild summer steelhead. Only tribal fishers have been able to legally retain them since 1978. Tribal harvest of wild summer steelhead during years of unrestricted tribal dipnet effort has ranged from a low of 299 in 1990 to a high of 1,649 in 1984 and has averaged 731 for the period of record (Table 4.5). Some limited hook and line harvest of wild summer steelhead by CTWS members does occur in areas upstream of Sherars Falls, primarily during the winter months. The number of wild summer steelhead harvested by tribal fishers in this fishery is not known. Recreational landings of wild summer steelhead in years when total catch below Sherars Falls was estimated ranges from a low of 1,465 in 1994 to a high of 14,330 in 1987 and has averaged 5,869 for the period of record (Table 4.6).

Since it is possible that an individual wild summer steelhead could be caught and released multiple times by recreational anglers and tribal fishers in the sample area, these catch estimates represent an index of catch rather than an accurate estimate of population number. Additionally, some unknown recreational angler and tribal fisher induced hooking mortality of wild summer steelhead occurs. Catch of wild summer steelhead in the individual fisheries sampled shows considerable year to year variation in catch per unit effort and wild to hatchery ratio.

If sustained escapement levels of 6,575 wild summer steelhead are maintained and these escapements translate into the expected adult production of 9,089 wild summer steelhead, some level of consumptive harvest may be possible.

Wild summer steelhead entering the Pelton trap above those required for brood stock have been returned to the Deschutes River at the Pelton trap or the Warm Springs Bridge (river mile 97) to be allowed to spawn.

Currently no specific harvest management goals or harvest allocation agreements exist for wild summer steelhead in the lower Deschutes River subbasin. Although this plan does propose specific harvest management goals and seeks to establish a cooperative harvest management agreement with CTWS, no harvest allocation agreement between treaty and non-treaty parties for wild summer steelhead is proposed by this plan.

This plan does propose a tiered set of escapement levels for wild summer steelhead over Sherars Falls as the mechanism to guide harvest regulations. If wild steelhead escapement over Sherars Falls exceeds 6,575 for five consecutive years then some level of consumptive harvest not to exceed 2,500 wild individuals will be considered. Harvest of hatchery origin summer steelhead will be encouraged. At escapement levels between 1,000 and 6,575 wild summer steelhead over Sherars Falls, harvest of wild summer steelhead will not be considered appropriate but harvest of hatchery origin summer steelhead will be encouraged. If wild summer steelhead escapement over Sherars Falls remains less than 1,000 for three consecutive years then more restrictive angling regulations, such as fly angling only or reduced season length, will be considered to decrease both angler effort and angler induced hooking mortality of wild summer steelhead. Further restrictive angling regulations will be enacted to limit recreational angler related mortality if estimated escapement of wild summer steelhead over Sherars Falls drops below 300 individuals for one year, the number recognized by Oregon's Wild Fish Policy as a minimum viable population level for genetic concerns.

Natural Production Constraints

Major habitat constraints to natural production of summer steelhead in the subbasin are shown in Table 4.7.

Man's activities in the lower Deschutes River subbasin constrain natural production of summer steelhead in the subbasin.

The Pelton/Round Butte hydroelectric complex at river mile 100 is currently a complete upstream passage barrier to anadromous and resident fish and does not have functional downstream juvenile passage. Although much historic summer steelhead habitat and production in the Crooked River has been lost due to dams on that river, historic and current production potential in the mainstem Deschutes River below Steelhead Falls, Squaw Creek, and the Metolius River has been lost because of the Pelton/Round Butte hydroelectric complex (Nehlsen 1995).

Most tributaries utilized by wild summer steelhead for spawning and rearing experience low flows and high temperatures, both of which are related to stream bank degradation, poor riparian habitat conditions, and water withdrawals. Stream bank degradation is a problem throughout the subbasin both in tributaries and in portions of the mainstem.

Recreational and tribal harvest of wild summer steelhead in the subbasin may have had a constraining effect on population size although wild adult summer steelhead in the lower Deschutes River have been protected from recreational harvest by regulation since 1979. Tribal harvest of wild summer steelhead has been limited since 1991. Managers feel that juvenile wild summer steelhead have been well protected from recreational harvest by minimum length regulations enacted for rainbow trout protection on the lower 100 miles of the Deschutes River in 1979. Relatively little length frequency data exists for migrating wild juvenile summer steelhead in the lower Deschutes River. Available data suggest that over 95% of wild juvenile migrants are less than 8 inches in length and are well protected from harvest by either the current slot length limit or the 12 inch minimum length limit that was in effect 1979 to 1984. Additionally, the use of bait was banned from 97 miles of the lower Deschutes River in 1979, further protecting juvenile summer steelhead from capture and/or hooking mortality. Tribal harvest of wild juvenile summer steelhead is believed to be small.

Although no data specific to the lower Deschutes River exists, there is speculation that recreational hooking and handling mortality of wild steelhead adults by hook and line anglers may contribute to adult mortality. This unquantified recreational angler induced mortality may be a significant management concern with very small spawning populations (less than 1,000 wild summer steelhead escapement over Sherars Falls for three consecutive years).

Natural events within the subbasin also constrain natural production in the subbasin.

Sedimentation is likely a limiting factor in mainstem summer steelhead production in the lower Deschutes River downstream from White River. Glacial flour and sediment contributed by White River could cause spawning gravel to become less usable and negatively impact aquatic insect production, decreasing juvenile production potential.

Passage blocked naturally by falls on White River and Nena Creek limits steelhead production in these streams. Several unscreened irrigation diversions in the Trout Creek system contribute to losses of juvenile summer steelhead.

Schroeder and Smith (1989) speculate that there may be potential for interaction between rainbow trout and steelhead and between rainbow trout and other fish species in the lower Deschutes River. The effects of competitive interactions with resident rainbow trout, with juvenile hatchery steelhead, or with other fish species on wild steelhead are largely unknown in the lower Deschutes River (Olsen et al. 1991). A study on the interactions between juvenile rainbow trout and steelhead and their habitat requirements is currently being funded by PGE (Zimmerman and Reeves 1996). This study may provide valuable information on interspecific relationships in the lower Deschutes River.

Prolonged drought conditions that started in the subbasin in 1984 or 1985 and continued more or less until 1994, exacerbated mainstem and tributary habitat deficiencies and may have contributed greatly to declining summer steelhead populations in the lower Deschutes River.

A variety of man's activities outside the subbasin constrain natural production in the subbasin.

Passage conditions for both juvenile and adult anadromous fish at Columbia River mainstem dams contribute to declines in wild summer steelhead. The Dalles Dam, which all Deschutes River migrants must pass, has one of the lower rates of juvenile salmonid passage efficiency for mainstem Columbia dams due to a lack of turbine screening and effective juvenile bypass facilities. Bonneville Dam, particularly Powerhouse 2, does not have particularly effective juvenile turbine screening. Increased spill of water at both The Dalles and Bonneville dams to increase survival of Federal Endangered Species Act listed Snake River salmon should result in better survival of wild lower Deschutes River summer steelhead at these dams. Longer travel time for juveniles through dam created reservoirs in the Columbia, increased water temperature in the reservoir environment, and increased predation near mainstem dams all contribute to increased losses of juvenile and adult wild summer steelhead.

Harvest of wild summer steelhead by treaty tribal fisheries in the mainstem Columbia River is governed by the Columbia River Fish Management Plan (CRFMP 1987). This plan, agreed to by the four treaty tribes, the United States of America, and the states of Oregon, Washington, and Idaho, directs mainstem harvest decisions on wild summer steelhead using run sizes at Bonneville Dam. Treaty tribal impacts to wild summer steelhead are not to exceed 15% of the Group A (those crossing Bonneville Dam April 1 to August 25) wild escapement and 32% of the Group B (those crossing Bonneville Dam August 26 to October 31) wild escapement during fall treaty seasons. Harvest of wild summer steelhead by treaty tribal fisheries in the mainstem Columbia River has been and will continue to be a source of mortality to lower Deschutes River origin wild summer steelhead.

Natural events outside the subbasin also constrain natural production in the subbasin. Ocean productivity is known to be cyclic and responsible for trends in anadromous species survival and abundance. Natural variation in ocean productivity and subsequent survival of summer steelhead in the ocean environment may be an important factor in lower Deschutes River summer steelhead abundance. Protection and enhancement of subbasin habitat and summer steelhead populations remains, however, very important.

Low flow and high water temperatures in the Columbia River during drought years magnify mainstem dam passage problems for both adult and juvenile summer steelhead.

In recent years the lower Deschutes River has received large numbers of out of subbasin stray hatchery and potentially stray wild summer steelhead. Because the incidence of these hatchery strays has been large, it is possible they have introduced significant amounts of genetic material that is maladapted to wild summer steelhead in the lower Deschutes River subbasin. As this genetic material has accumulated in the wild population, the productive capacity of the wild lower Deschutes River summer steelhead has potentially declined and this effect may be at least partially responsible for recent declines in the population.

White River Falls Passage

One opportunity for potentially increasing the abundance of wild summer steelhead in the lower Deschutes River is the White River Falls Passage Project. This project would involve the development of a fish passage facility at White River Falls, located at river mile 2 on White River. Fish passage would be most feasible using a trap and haul system rather than a conventional fish ladder and would open up approximately 140 miles of stream to summer steelhead. The Bonneville Power Administration funded a cooperative study in the early 1980's to investigate the feasibility of anadromous fish production in White River above the falls. This cooperative study, completed in 1985 by ODFW and the U.S. Forest Service, determined that White River above the falls would produce an estimated 2,100 to 3,500 additional steelhead returning to the mouth of the Columbia River (ODFW et al. 1985). The Oregon fish and Wildlife Commission (Commission) considered the passage project in a 26 July, 1985 meeting and did not approve the introduction of anadromous fish above White River Falls for both economic and biological reasons. The Commission was principally concerned that introduction of steelhead into White River above the falls would pose risks to the resident rainbow trout in the basin, thereby conflicting with Oregon's Wild Fish Management Policy that existed at that time. The Commission reconsidered the project during a 6 September, 1985 meeting and indicated a willingness to revisit their position on the project and to address the question of impacts to wild trout. During an 8 December, 1989 meeting, the Commission approved the Northwest Power Planning Council (NWPPC) Deschutes River Subbasin Plan which contains as a program element introduction of anadromous species above White River Falls. The Subbasin Plan was, however, not adopted as Oregon Administrative Rule and the White River Falls Passage Project was never carried out even though it remains an element of an approved subbasin plan.

Several developments since Commission approval of White River Falls passage may lead to a different conclusion if the project was to be reconsidered today. A more detailed analysis of the potential number of anadromous fish the project would produce indicates that the original figures were overly optimistic. Cost of the project has increased due to inflation as time has passed. Both of these factors would lower the cost:benefit ratio for the project from the original ratio to the point where the project today may not have a positive cost:benefit ratio. Increased knowledge of the affects to resident fishes from anadromous introduction indicate that potential genetic concerns may have been underestimated in the original study of White River Falls passage. Additionally, studies completed since 1989 indicate that competitive interactions between resident fishes and introduced anadromous species may be more damaging to resident species than previously thought. More detailed information on these aspects of the project are included in Appendix A and Appendix B.

Additionally, Oregon's Wild Fish Policy (OAR 635-07-525 through 635-07-529) has evolved since the Commission considered the question of introduction of anadromous species above White River Falls and several provisions of those rules would currently prohibit introduction of anadromous species above White River Falls.

The White River Falls Passage Project remains as an enhancement measure in Section 704(d)(1) of the 1984 NWPPC Fish and Wildlife Program but has never been carried out due to initial denial by the Commission in 1985. The NWPPC now recognizes that anadromous introductions above barriers cause negative interactions with indigenous species and that naturally blocked areas frequently provide genetic refuges and angling opportunity and diversity. The NWPPC has recently identified as system wide policy a goal of avoiding further actions to provide fish passage over natural barriers. This policy direction would also likely prohibit the original passage project.

For these reasons, this plan does not propose anadromous fish passage over White River Falls.

HATCHERY PRODUCED SUMMER STEELHEAD

Description of Hatcheries

Round Butte Hatchery (RBH) completed in 1972 to mitigate the effects of the Pelton/ Round Butte hydroelectric project, is the only hatchery releasing summer steelhead in the lower Deschutes River subbasin. Portland General Electric (PGE) funded construction of the hatchery and continues to finance operation and maintenance. The ODFW operates the hatchery. WSNFH reared summer steelhead and released them in the subbasin in 1978 and 1980 (Table 4.8). Steelhead production at WSNFH was discontinued in 1981 due to disease problems and the apparent physical limitations of the facility in rearing 2-year smolts. Future steelhead production at that facility is not planned (WSNFH Operation Plan 1992-1996). Prior to 1972, Cedar Creek, Gnat Creek, Oak Springs, and Wizard Falls hatcheries reared Deschutes River origin summer steelhead for release into the lower Deschutes River.

Brood Stock Origin and Use

Brood stock for hatchery production prior to 1957 were collected from Squaw Creek, a tributary to the Deschutes River above the dam complex. Willamette River and Big Creek stock winter steelhead were used for brood stock in 1958 and 1959, respectively. Skamania River and Siletz river summer steelhead were used as brood stock in 1965 and in 1965-66, respectively (Olsen et al. 1991). The Big Creek stock is known to be somewhat resistant to *Ceratomyxa shasta,* a mysosporean parasite found in the Deschutes River and known to cause a high rate of mortality in salmon and steelhead that are not resistant to it. The Siletz River stock is very susceptible to that organism. These fish likely did not survive and return as adults to make any genetic contribution to the naturally reproducing population. Both the Willamette River and Skamania River stocks exhibit a higher degree of resistance to *C. shasta* and it is possible some adults could have survived from these releases to return to the lower Deschutes River. Potential genetic exchange from these stocks to wild summer steelhead in the subbasin is unknown. All brood stock from 1967 to present have been collected only from the lower Deschutes River.

Brood stock for the summer steelhead program at RBH are currently collected from hatchery origin and wild fish returning to the Pelton trap or from wild fish captured at the Sherars Falls adult trap. Both wild and RBH stock summer steelhead were held for brood stock prior to the 1984 brood year. Brood stock for the 1984 through 1987 brood years were selected only from RBH origin steelhead because of concerns about introducing foreign strains of the Infectious Hematopoietic Necrosis virus (IHNV) into the RBH steelhead program. From 1988 through 1992, managers collected wild steelhead for brood stock in addition to RBH origin steelhead.

Wild brood stock used from 1988 to 1992 was incorporated into production through wild by wild pairing as opposed to a wild by hatchery pairing. Wild by wild offspring accounted for 27% to 34% of releases during those years. Wild brood stock collected in 1993, 1994, and 1995 was used in a wild by hatchery matrix pairing and resulted in wild genetic material being incorporated into the resulting egg take at a 32%, 61%, and 16% rate, respectively.

Managers have tried to incorporate wild summer steelhead into the hatchery program for a number of years. Wild summer steelhead tend to hold in the lower Deschutes River over winter and many that enter the Pelton trap do so in late February and March. These fish are not as sexually mature as the hatchery fish captured earlier in the run and held at the hatchery in water warmer than the river. This difference in time of capture and degree of sexual maturity makes it difficult to incorporate the desired number of wild fish into the brood stock. This difficulty has been overcome, in part, by collecting a portion of the needed wild fish at the Sherars Falls trap in September and October and holding them in the hatchery brood stock ponds until needed. Fish held in this manner tend to mature earlier since water temperature in the brood ponds averages more than 10 degrees warmer then the river and can be used at a higher rate for brood stock.

During 1977 through 1994, the total number of fish held for brood stock ranged from 372 to 1,328 adults. Typically, large number of adults are held for brood stock and spawned because of the potential for losses of fry to viral diseases.

Brood stock are classified into three groups based on time of entry into Pelton trap. Group-1 steelhead enter Pelton trap between October 1 and December 9, Group-2 steelhead enter between December 10 and January 31, and Group-3 steelhead enter between February 1 and March 1. No eggs were taken from Group-1 steelhead from 1987 to 1993. Group 1 production was eliminated to make pond space in the hatchery for the wild x wild production reared during those years. Eggs from Group 1 were taken in brood years 1994 and 1995 and will continue to be collected in the future since separate ponds are not needed for the current wild x hatchery production scenario.

Life History and Population Characteristics

RBH summer steelhead return to the subbasin from late June through October, similar to wild steelhead, and migrate past Sherars Falls during these months, peaking in late September and early October. RBH steelhead enter Pelton trap from October through March.

Returns of RBH origin adult summer steelhead to the Pelton trap indicate that age class structure is not consistent between brood years. Age composition has ranged from 27% to 63% 1-salts, but for the period of record the average return of 1-salts is very close to 50% (Table 4.9).

Sex ratios of RBH steelhead are shown in Table 4.10 (Olsen et al. 1991). In general, females outnumber males in a given run year.

Average lengths of 1-salt and 2-salt RBH steelhead are shown in Table 4.11 (Olsen et al. 1991). Information on adult length-weight relationship is not available.

Fecundity of RBH steelhead is shown in Table 4.12. Average fecundity for 1-salts and 2-salts is 4,860 eggs per female (Olsen et al. 1991). Information on age-specific fecundity is not available.

Average egg-to-smolt survival rate for RBH summer steelhead is 66%. Rate of return to the subbasin of RBH summer steelhead released immediately below Pelton Reregulating Dam ranged from less than 1% to 9% and averaged 1% percent for the 1975 through 1991 brood years. Rate of return to the subbasin has been variable during that period of time but has been generally low since the 1988 brood year. RBH summer steelhead do show the same numerical trend of direction as Group A hatchery summer steelhead at Bonneville Dam, suggesting that RBH summer steelhead are subjected to and influenced by the same mortality factors as other hatchery summer steelhead.

RBH summer steelhead are released as smolts at age 1 in April at four to six fish per pound (Table 4.13). Smolts are released immediately below Pelton Reregulating Dam. In the past smolts were also released at Maupin, Pine Tree, and Macks Canyon. These releases were discontinued after 1988 due to a propensity for these adults to spawn in the wild rather than returning to Pelton trap.

Smolts migrate to the Columbia River soon after release in April. Fessler (1973) estimated that 5% to 10% of the juvenile hatchery steelhead remain in the river as residuals. More recent data suggest that under current hatchery practices and release strategies a lower percentage of hatchery juveniles remain in the river as residuals (ODFW unpublished data).

Population Status

As discussed under the wild summer steelhead section, it is not technically possible to calculate run to the river estimates for hatchery steelhead entering the lower Deschutes River. The most accurate and reliable measure of steelhead abundance in the lower Deschutes River is derived from mark-recapture population estimate procedures estimating the number of hatchery summer steelhead escaping upstream of Sherars Falls. Estimates of total harvest below Sherars Falls are not complete for some years so total harvest figures are not available to account for the portion of the hatchery population removed prior to passing Sherars Falls. If consistent estimates of total harvest below Sherars Falls were available, it is still very doubtful that harvest below Sherars Falls plus escapement of hatchery summer steelhead above Sherars Falls would be an accurate estimate of run to the river mouth. Previous research has shown that many stray hatchery summer steelhead enter the river and are available for harvest but leave the river prior to crossing Sherars Falls and being included in the estimated population passing that point (Olsen et al. 1991).

Estimates of the number of RBH origin summer steelhead escaping above Sherars Falls have been made for all run years from 1977 to present (Table 4.14). The estimated number of RBH origin summer steelhead migrating over Sherars Falls ranged from a low of 1,200 in 1993 to a high of 9,200 in 1987 and averaged 4,800 for the period of record. RBH origin summer steelhead averaged 54% of the estimated number of hatchery origin summer steelhead passing Sherars Falls but has ranged from a low of 22% to a high of 92% for the period of record.

The percentage of RBH origin summer steelhead in the population passing Sherars Falls has generally decreased through time and the percentage of stray hatchery summer steelhead has increased. This shift started in the early 1980's and appears to be related more to an increase in the number of steelhead smolts transported from upper Columbia River dams to below Bonneville Dam than to an increase in the number of steelhead smolts released in the Columbia basin above The Dalles Dam. If transporting steelhead smolts impairs their homing ability even slightly, transportation around Columbia River dams may contribute indirectly to increased straying into the lower Deschutes River because transported smolts in some studies have been shown to survive better than in-river migrants (Park, 1985; Mathews, 1992)

Stray hatchery origin summer steelhead averaged 45% of the total estimated number of summer steelhead passing Sherars Falls from 1977 to 1994, ranging from a low of 8% in 1980 to a high of 88% in 1993 (Table 4.14).

The percentage of RBH origin summer steelhead in the Pelton trap catch has generally decreased since 1983. Returns of RBH origin summer steelhead to the Pelton trap has ranged from a high of 96% in both 1973 and 1974 to a low of 35% in 1993. Conversely, returns of stray hatchery origin summer steelhead to the Pelton trap has ranged from a low of less than 1% in both 1971 and 1974 to a high of 53% in 1993, generally increasing through time since 1983 (Table 4.15).

The summer steelhead mitigation requirement mandated by PGE's Federal Energy Regulatory Commission (FERC) license is an average of 1,800 RBH origin summer steelhead returning annually to Pelton trap, the hatchery's brood stock collection facility. To meet this requirement, the hatchery annually releases approximately 162,000 summer steelhead smolts. The mitigation requirement was met fairly consistently prior to the 1989 return year (Table 4.15).

Techniques to Increase Hatchery Fish Utilization

Off-station juvenile acclimation and adult capture facilities may be a hatchery technique available to increase hatchery fish availability and utilization by subbasin fishers, and also benefit wild steelhead in the subbasin by reducing potential competition and interbreeding. Juvenile hatchery summer steelhead could be acclimated to a specific water source, increasing the potential for them to return to that water source as adults. The returning adults would likely hold in the lower Deschutes River in this vicinity and would be available to subbasin fishers for a longer period of time relative to adults returning to a release site at river mile 100. Off-station direct release of hatchery produced summer steelhead smolts in the lower Deschutes River has been shown to increase angler utilization of returning adults from these releases due to a tendency for these fish to hold near the area of release (Fessler 1974). It is anticipated that off-station acclimated releases would yield similar benefits to subbasin fishers but decrease the potential of returning adults spawning in the wild. Winter steelhead acclimated to a specific water source homed back to that water source with a high degree of affinity in the Siuslaw River system (Lindsay et al. undated).

Adults returning to a juvenile acclimation/adult capture facility located significantly downstream from Pelton trap would be available for trap capture sooner and less likely to stay in the river over winter and potentially spawn with wild summer steelhead. The potential would exist to recycle captured fish downstream to increase angler utilization of these fish and minimize genetic interaction with wild summer steelhead. Lindsay et al. (undated) showed that recycled winter steelhead returned to their acclimated water source with a high degree of accuracy.

Juvenile acclimation has been shown in other systems to enhance smolt to adult survival (Lindsay et al. undated; Whitesel et al. 1994). Additionally, if juvenile summer steelhead were released further downstream than river mile 100, competition for food and space with resident trout and other anadromous juveniles would be decreased.

A juvenile acclimation and adult capture facility site adjacent to White River below White River Falls appears to offer the best opportunity from both the engineering and management goal standpoints but other sites also may be available. The proposed summer steelhead acclimation and adult capture program would be started on an experimental basis as opposed to a full production basis to test the ability of the program to meet the stated objectives.

A portion of the current RBH production would be utilized at the proposed juvenile acclimation facility. The entity that holds the FERC license for the Pelton/Round Butte hydroelectric complex would have to agree to modification of the summer steelhead mitigation agreement measurement and agree to use part of the summer steelhead production at the acclimation facility. An specifically marked acclimated release group large enough for meaningful evaluation would be used annually for a period of five years to test the effectiveness of this approach. Evaluation of adult returns and their behavior would take place at the acclimation/adult capture facility, the Pelton trap, and in recreational and tribal fisheries.

Constraints to Hatchery Production

Infectious Hematopoietic Necrosis is a viral disease that kills substantial numbers of summer steelhead at RBH. The Infectious Hematopoietic Necrosis virus (IHNV) was first detected at RBH in 1975. Both summer steelhead and spring chinook adults at RBH carry IHNV. IHNV has been a problem with summer steelhead, but its effects on production have been ameliorated by changes in hatchery practices. Fisheries managers spawn a large number of adults in order to produce the nearly 750,000 juvenile steelhead necessary to achieve 162,000 smolts. This large number of juveniles is needed due to the potential for losses from IHNV. Fry are reared in small separate groups so that if IHNV infects a group, those fish can be destroyed while the others are reared for release. Managers have also found Infectious Pancreatic Necrosis, furunculosis, and cold water disease in RBH steelhead.

In the presence of IHNV, increases in production of summer steelhead at RBH probably could not occur without an increase in rearing ponds or a decrease in spring chinook salmon production. Currently, the facility is operating at full capacity with the preferred rearing programs of spring chinook salmon, summer steelhead, and brown trout. Brown trout will not be reared at RBH after 1996, however.

Angling and Harvest

Details of angling and harvest were discussed under Wild Summer Steelhead.

Catch of RBH origin summer steelhead has been estimated by expanded harvest census since 1970, although not at all sites all years. Catch of RBH origin summer steelhead by recreational anglers in years when total catch below Sherars Falls was estimated ranged from a low of 184 in 1994 to a high of 3,287 in 1974 (Table 4.16). The percentage of RBH origin steelhead harvested by recreational anglers in years when recreational catch was sampled at all sites has ranged from a low of 11% in 1993 to a high of 92% in 1974 (Table 4.17). During years of unconstrained harvest, tribal fishers harvested a low of 221 RBH origin summer steelhead in 1976 and a high of 1,925 in 1974 (Table 4.16). The percentage of RBH origin adults in the fisheries has decreased over time, due largely to the increasing percentage of stray origin hatchery summer steelhead in the catch.

Stray hatchery summer steelhead have become more numerous in the catch of both recreational anglers and tribal fishers since 1982. During years when recreational catch was sampled at all sites, harvest of stray hatchery summer steelhead ranged from a low of 289 in 1974 to a high of 2,661 in 1989 (Table 4.17). The percentage of stray steelhead harvested by recreational anglers in years when recreational catch was sampled at all sites has ranged from a low of 8% in 1974 to a high of 89% in 1994 (Table 4.17). During years when tribal fishers had unrestricted seasons, a low of 11 stray hatchery summer steelhead was harvested in 1975 and a high of 2,407 was harvested in 1983 (Table 4.18).

Total recreational harvest of hatchery summer steelhead in the lower Deschutes River in years when all sites below Sherars Falls were sampled ranged from a high of 3,576 in 1974 to a low of 1,582 in 1994 (Table 4.17).

A summary of total wild and hatchery origin summer steelhead catch by recreational and tribal fishers during years when all sites below Sherars Falls were sampled is presented in Table 4.19. A summary of total wild and hatchery origin summer steelhead catch by recreational anglers during years when all sites below Sherars Falls were sampled is presented in Table 4.20.

Currently no specific harvest management goals or harvest allocation agreements exist for hatchery produced summer steelhead in the lower Deschutes River. This plan does propose to encourage harvest of hatchery origin summer steelhead and to develop a cooperative harvest management agreement with CTWS.

Historically, RBH steelhead entering Pelton trap were returned to the lower Deschutes River at the Warm Springs Bridge (river mile 97) to pass through the fishery in the upper river or to spawn in the wild (Table 4.21). This practice was discontinued after 1992 due to genetic concerns relative to hatchery fish spawning in the wild. Steelhead were historically recycled to areas below Sherars Falls, but this practice was discontinued in 1981 due to low harvest of these fish and genetic concerns for hatchery fish spawning in the wild. Stray hatchery steelhead entering Pelton trap are currently provided to CTWS for ceremonial and subsistence purposes, as are most RBH steelhead that return above brood stock requirements (Table 4.22).

MANAGEMENT CONSIDERATIONS

Natural Production Issues

The lower Deschutes River subbasin currently supports fewer numbers of wild summer steelhead than were historically present, due principally to habitat limitations in the lower Deschutes and Columbia rivers and the ocean. The subbasin is currently estimated to have the capacity to produce a maximum of 147,659 wild summer steelhead smolts (ODFW 1987). Assuming a smolt to adult survival rate of 6%, this number of smolts is estimated to produce a return of 9,089 adult wild summer steelhead to the lower Deschutes River (ODFW 1987).

Many factors combine to potentially decrease wild summer steelhead production in the subbasin. The Pelton/Round Butte hydroelectric complex blocks anadromous fish from significant portions of their historic range. Potential changes in the flow regime caused by the cumulative water storage in the Deschutes River basin may have caused changes in the flow regime that do not favor anadromous fish production. Water diversion from tributaries and the mainstem has also altered flow patterns resulting in lowered anadromous fish production. Gravel quantity and quality changes that have not favored anadromous fish production may have resulted from water storage in the Deschutes River basin, particularly in the three mile reach immediately downstream from the Pelton/Round Butte hydroelectric complex. Loss of large woody material recruitment to the lower Deschutes River as a result of the Pelton/Round Butte hydroelectric complex and other water storage projects has occurred, potentially resulting in decreased in channel habitat diversity and less of trapping spawning gravel. Long term drought conditions have severely reduced the ability of the system to naturally produce fish. Land use activities in tributary basins have reduced summer steelhead production potential throughout the subbasin because of water withdrawal, altered flow regimes, and decreased habitat. Both inter-specific and intra-specific competition has likely been increased throughout the subbasin as a result of habitat limitations. Beaty (1992; as cited in Beaty 1995) estimated total (dam and reservoir) juvenile passage mortality of 35% to 51% per dam and reservoir project in the lower Columbia River. Juvenile salmonid mortality due to predation alone has been estimated at 7% to 61% in just one reservoir (John Day Reservoir) (Rieman et al. 1991). Additionally, inter-dam mortality of adult salmonids is estimated at 8% in the mainstem Columbia River between Bonneville Dam and McNary Dam (Personal communication, 16 April, 1996, with Don Swartz, Oregon Department of Fish and Wildlife, Clackamas, Oregon). Variations in ocean productivity and subsequent changes in juvenile summer steelhead survival contribute to variability in subbasin population levels. Actual summer steelhead production increases from habitat improvements are unknown.

The Columbia Basin System Planning Deschutes River Subbasin Production Plan adopted by the Northwest Power Planning Council in 1990 and reviewed by the Oregon Fish and Wildlife Commission in late 1989 proposed creation of access to White River by anadromous species (spring chinook and summer steelhead). The objective of that proposal was to increase natural production of both species. The Lower Deschutes River Fish Management Plan, this document, does not carry that proposal forward nor adopt objectives for increased production of anadromous fishes beyond their historic ranges. Maintenance of the productivity and integrity of endemic trout and non-game species is instead given a high priority. Appendix A and

Appendix B of this section provide an analysis of risks and presumed benefits to increasing production of anadromous fishes into White River.

The large influx of out of subbasin stray summer steelhead may be contributing significant amounts of maladapted genetic material to the wild summer steelhead population in the lower Deschutes River subbasin. The cumulative effect of this genetic introgression may contribute to lowered productive capacity of the wild population as evidenced by decreased run strength of wild summer steelhead through time.

Hatchery Production Issues

Round Butte Hatchery is currently at maximum production for summer steelhead and major increases in production are not likely. PGE funds the hatchery to produce an average return of 1,800 summer steelhead to the Pelton trap but is not obligated by mitigation agreements to produce more. The hatchery has a history of problems with viral disease outbreaks that could limit production. This limitation is overcome by taking more eggs than necessary and hatching large numbers of juveniles to negate losses from viral disease outbreaks. The principal limitation of the facility is, however, available pond space. Lack of hatchery brood stock has not been a problem but the timing of wild summer steelhead entering the Pelton trap has made it difficult to obtain wild fish for use as brood stock. This problem has been overcome by collecting a portion of the desired wild fish at the Sherars trap.

The number of wild fish to be incorporated into each generation of RBH summer steelhead has not been determined. An action of this plan is to develop operational guidelines for RBH to accomplish management objectives of the hatchery program and meet Oregon's Wild Fish Management Policy and associated guidelines. The desired amount of wild genetic incorporation will be identified in that document. In the interim, each complete egg take will contain at least 10% wild genetic material.

Wild/Hatchery Fish Issues

The incidence of hatchery steelhead above Sherars Falls poses a serious challenge to the continued genetic health and productivity of this population. The current situation is not consistent with Oregon's Wild Fish Management Policy. While RBH origin summer steelhead contribute to this problem, their impact is much less numerically and genetically than the large number of out of subbasin stray hatchery steelhead also present in the population.

If numbers of hatchery origin summer steelhead captured at the Pelton trap, WSNFH trap, and estimated in angler harvest upstream from Sherars Falls are subtracted from the estimated number of hatchery summer steelhead passing Sherars Falls, many hatchery fish, both RBH origin and stray hatchery origin, remain unaccounted for. Many of these fish are presumed to remain in the wild each year, potentially spawning with wild steelhead. From 1984 to 1994, estimated hatchery origin summer steelhead adults upstream from Sherars Falls exceeded estimated numbers of wild summer steelhead adults six of those ten years (Table 4.23).

Even without the RBH hatchery program, our analysis indicates it would be necessary to remove 95% of the out of subbasin stray hatchery summer steelhead from the lower Deschutes River subbasin in order to meet Wild Fish Management Policy standards (Table 4.24). With RBH hatchery fish included in our analysis, 97% of the out of subbasin hatchery strays would have to be removed from the subbasin to meet Wild Fish Management Policy requirements. Alternatively, the number of wild fish would have to be increased 736% in order to meet Wild Fish Management Plan standards under a scenario where the removal of hatchery fish from the spawning population was set at a more achievable level of 30% additional removal of RBH origin summer steelhead and 60% removal for the out of subbasin hatchery strays. Under this scenario (see Strategy 3, Table 4.24), it is assumed that the 60% removal rate for out of subbasin stray includes fish that "remove" themselves from the lower Deschutes River subbasin by returning to the Columbia and continuing on to their stream of origin prior to spawning.

Our initial analysis of the situation has identified no means currently available to eliminate the necessary number of hatchery summer steelhead from the population. To effectively remove the necessary number of stray hatchery summer steelhead from the spawning population would require either fundamental modification of Columbia Basin hatchery steelhead programs or construction of trapping facilities to process the entire steelhead run at the mouth of the Deschutes River. These options do not appear to be realistic at this time. The Sherars Falls trap facility as currently constructed does not capture a high percentage of the run, and would not even with continuous operation due to passage around the trap at high flows. In addition, recreational angling and tribal subsistence fishing in the subbasin do not provide a sufficient opportunity for removal of stray hatchery fish of the magnitude needed, due in part to incidental impacts which would occur to wild summer steelhead and other species if angling opportunity were increased.

The question of compliance with Oregon's Wild Fish Management Policy (WFMP) for lower Deschutes River wild summer steelhead is a very complicated, serious, and difficult question to address. The effort required to analyze the biological, social, and economic data necessary for resolution will be significant and undertaken at the Commission's request, not as a specific component of this plan.

In this spirit, an action contained in this plan will ask the Commission to determine whether the population should be exempted from Oregon's WFMP, consistent with OAR 635-07-528(1). If the Commission agrees with the request for review of the population status, ODFW will prepare a detailed written analysis of the biological significance of the proposed exemption as required under OAR 635-07-528(3). This analysis will include an investigation of out-of-basin factors contributing to the number of strays, a detailed analysis of how the genetic impact of these strays may have depressed the wild population, a review of the status of the gene conservation group in which the lower Deschutes River population is included, and how the proposed exemption would affect the long term sustainability of that group. This exemption evaluation report will be used to facilitate discussion among interested public and other groups concerning the merits of exempting the population from the WFMP. Based on this report and public review, a decision on exemption will be asked of the Commission one year after adoption of this basin plan as a component of basin plan implementation review.

During the interim, and irrespective of the exemption decision, it is important to recognize that the management intent for lower Deschutes River summer steelhead will be to take actions that afford the greatest feasible protection to the genetic health and productivity of the wild population. In particular, improvements in fish habitat will be aggressively pursued. Habitat improvements should increase the number of wild summer steelhead in the population and provide a larger buffer against the adverse genetic effect of out of subbasin stray summer steelhead.

Data Limitations

It is not possible to calculate run to the river numbers for summer steelhead due to potentially large numbers of stray summer steelhead entering the Deschutes River and subsequently leaving the subbasin before reaching Sherars Falls. The only reliable way to currently measure run size is an estimate of passage over Sherars Falls.

It is currently not technically possible to make accurate preseason or mid-season run strength predictions on either the hatchery or wild summer steelhead in the lower Deschutes River. Without the ability to accurately estimate the number of steelhead juveniles emigrating from the system, it is difficult to calculate preseason run strength predictions. Predicting adult summer steelhead runs to the lower Deschutes is also difficult, since there are only two ocean ages returning from any given brood year. The extended run timing of summer steelhead makes a mid-season run strength prediction virtually impossible without the ability to count each individual at or near the mouth of the river. Catch per unit effort data generated at the Sherars Falls trap generally has a low correlation with subsequent final estimates of numbers of fish passing that point. This inability to predict run strength either before the season or during the season seriously limits the managers ability to fine tune harvest regulations, particularly for wild summer steelhead. This makes it necessary to manage using short term trends in run strength and escapement.

Harvest Issues

Although hatchery fish are currently under-utilized in the subbasin, concern for hooking mortality on wild summer steelhead, rainbow trout, and other species largely precludes more liberal regulations. Tribal fishers in the subbasin have historically harvested wild summer steelhead although CTWS prohibited the take of unmarked summer steelhead by dipnet fishers during shortened harvest seasons in 1994 and 1995. No harvest sharing agreement between CTWS and recreational anglers is proposed for summer steelhead.

Juvenile summer steelhead are protected in the subbasin through terminal tackle restrictions, length restrictions, and time and area closures. Adult summer steelhead are protected in the subbasin through terminal tackle restrictions, and time and area closures. The need to minimize mortality to wild adult summer steelhead may result in more restrictions at very low spawning escapement.

The maximum wild summer steelhead production capacity of the lower Deschutes River has been estimated to be 9,098 adults returning to the mouth of the Deschutes River. To achieve this production capacity would require, on the average, 6,575 spawners; therefore, a harvest of 2,523 (9,098 - 6,575 = 2,523) fish would theoretically be possible at maximum production (ODFW 1987).

Oregon's Wild Fish Policy recognizes the minimum viable population size to be 300 breeding fish. Managers should be conservative with the valuable genetic and cultural resource that lower Deschutes River wild summer steelhead represent. A minimum spawning escapement size of 1,000 passing Sherars Falls for three consecutive years has been identified as the minimum acceptable spawning population used to trigger more restrictive and protective angling regulations.

Since managers do not have the ability to make pre-season or in-season run size estimates, it is necessary to manage harvest from short term escapement trends.

Critical Uncertainties

1. The ability of the wild stock to maintain a discrete phenotype and genotype as the number of stray hatchery summer steelhead in the lower Deschutes River increases is unknown.
2. The ability of the RBH summer steelhead program to maintain a phenotype and a genotype similar to those found in wild lower Deschutes summer steelhead is unknown.
3. The true carrying capacity of the lower Deschutes River for summer steelhead is unknown.
4. The impact of increased production of wild summer steelhead on other anadromous and resident fish species is unknown.
5. Key production areas in the subbasin are known and the productive capacity of these is protected.
6. Actual factors limiting production of summer steelhead in the subbasin are unknown.

MANAGEMENT DIRECTION

Objectives and actions contained in the management direction will be used to set district work plans that form the basis for monitoring and evaluation programs. Completion of actions listed under an objective contribute to the meeting of that objective. Many actions cannot be accomplished under current levels of funding. If funding continues to be limited, ODFW will pursue completion of actions according to priorities as funds become available.

Policies

Policy 1. *Hatchery reared summer steelhead will continue to be released in the lower Deschutes River subbasin.*

Policy 2. *Angler induced hooking mortality of wild lower Deschutes River summer steelhead shall be reduced or eliminated when estimated escapement levels of 1,000 wild summer steelhead or less over Sherars Falls occur for three consecutive years.*

Objective 1. Maintain an estimated escapement of 6,575 wild adults over Sherars Falls annually.

<u>**Assumptions and Rationale**</u>

1. The genetic diversity, adaptiveness, and abundance of wild summer steelhead in the subbasin will be adequately protected by maintaining an annual escapement of 6,575 wild adults over Sherars Falls.
2. The CTWS manage their fisheries consistent with conservation of indigenous species. The CTWS are co-managers in meeting subbasin management plan objectives and will be involved in fish management activities in the lower Deschutes River subbasin at all levels. All action items will be conducted in cooperation with CTWS as co-managers of the resource.
3. The operator of the Pelton/Round Butte hydroelectric complex will be a full partner in meeting subbasin management plan objectives. FERC and other federal agencies will be involved in mitigation related discussions.
4. With adequate spawning escapement (i.e. 6,575), currently available habitats in the subbasin and habitats made available by enhancement projects will yield a maximum smolt summer steelhead smolt production of 147,659. Assuming a 6% smolt to adult survival rate, 9,089 wild adult summer steelhead would be produced.
5. Estimated escapement of wild summer steelhead over Sherars Falls is accurate enough for tracking run size.
6. Out of subbasin harvest will not prevent achieving this objective.
7. Summer steelhead from other river systems will continue to stray into the lower Deschutes River in significant numbers on their journey up the Columbia. Many will remain in the lower Deschutes River subbasin and spawn in the wild.

Actions

Action 1.1. Develop an agreement with USFWS and CTWS to continue blocking hatchery summer steelhead access to the Warm Springs River above the barrier dam at WSNFH.

Action 1.2. Explore the concept of offsite mitigation to benefit wild summer steelhead populations with the operator of the Pelton/Round Butte hydroelectric complex.

Action 1.3. Continue to monitor escapement of wild and stray hatchery summer steelhead adults over Sherars Falls.

Action 1.4. Monitor summer steelhead spawning in the mainstem lower Deschutes River and tributaries to determine habitat utilization.

Action 1.5. Monitor summer steelhead spawning in the mainstem lower Deschutes River and tributaries to determine the hatchery to wild ratio in the spawning population.

Action 1.6. Evaluate presumptive and empirical evidence of stray hatchery spawning with wild steelhead in numbers contrary to WFMP guidelines.

Action 1.7 Seek a review from the Commission of the lower Deschutes River wild summer steelhead population status relative to Oregon's WFMP, consistent with OAR 635-07-528(1).

Action 1.8 If the Commission agrees with this request, present to the Commission, one year after adoption of this subbasin plan, an evaluation report detailing the problem and solutions. A decision on exempting the population from Oregon's WFMP will be made at that time.

Action 1.9. Work with other agencies to reduce straying of hatchery summer steelhead into the lower Deschutes River.

Objective 2. Provide a recreational fishery based on wild summer steelhead, out of sub-basin stray hatchery summer steelhead and lower Deschutes River origin hatchery summer steelhead returns.

Assumptions and Rationale

1. Mortality incidental to catch and release angling may jeopardize the conservation of wild summer steelhead if the estimated escapement over Sherars Falls is below 1,000 for three consecutive years.
2. Mortality incidental to catch and release angling will not jeopardize conservation when the estimated escapement over Sherars Falls is greater than 1,000 wild summer steelhead annually.
3. Harvest of wild summer steelhead will be considered after five consecutive years of meeting the 6,575 escapement goal.
4. Removal of out of basin summer steelhead strays from other river systems is desirable, and should be promoted as long as impacts to lower Deschutes River wild fish are acceptable.
5. Current estimation of catch and release or harvest of summer steelhead by recreational and tribal fishers has an acceptable level of accuracy to monitor compliance with basin management objectives.

6. The CTWS manage their fisheries consistent with conservation of indigenous species. The CTWS are co-managers in meeting subbasin management plan objectives and will be involved in fish management activities in the lower Deschutes River subbasin at all levels. All action items will be conducted in cooperation with CTWS as co-managers of the resource.
7. The operator of the Pelton/Round Butte hydroelectric complex, as a condition of their FERC license, will continue to fund a hatchery program intended to return an average of 1,800 adult summer steelhead of Round Butte Hatchery origin annually to the Pelton trap to replace those lost through construction and operation of the dam complex.
8. The operator of the Pelton/Round Butte hydroelectric complex will be a full partner in meeting subbasin management plan objectives. FERC and other federal agencies involved will be agreeable to mitigation other than subbasin hatchery production.
9. Off-station juvenile acclimation will not increase the number of hatchery summer steelhead spawning in the wild.
10. Acclimation and release of juvenile hatchery steelhead in a tributary stream will increase angler catch of hatchery fish in the area of the acclimation site as well as provide an opportunity to recycle captured adults.
11. Acclimating a portion of current Round Butte Hatchery summer steelhead production at a site downstream from river mile 100 would decrease competition between salmon, rainbow trout, wild steelhead and hatchery steelhead in the upper portion of the lower Deschutes River subbasin.
12. Acclimation of juveniles, and subsequent collection of returning adults at the release/recapture site should reduce the number of adult hatchery summer steelhead spawning in the wild.
13. Establishment of a juvenile acclimation/adult capture facility could contribute to tribal fishing opportunities on hatchery stocks.
14. Hatchery origin brood stock could be collected at an off-station adult capture facility.
15. The CTWS and ODFW are willing to identify a process to develop a cooperative harvest management agreement.

Actions

Action 2.1. Encourage recreational and tribal harvest of hatchery steelhead in the lower Deschutes River.

Action 2.2. Implement additional special angling regulations to further reduce or eliminate angling related mortality of wild summer steelhead if estimated escapement over Sherars Falls remains less than 1,000 for three consecutive years.

Action 2.3. Immediately implement further angling regulations to protect wild summer steelhead if estimated escapement over Sherars Falls reaches 300 or less for any one run year.

Action 2.4. Provide for a consumptive harvest of wild summer steelhead in the subbasin not to exceed 2,523 fish when the estimated escapement over Sherars Falls of 6,575 wild summer steelhead is maintained for five consecutive years.

Action 2.5. Determine mortality induced by hooking and handling wild summer steelhead in recreational fisheries.

Action 2.6. Monitor catch by recreational anglers and tribal fishers.

Action 2.7. Develop a method of predicting hatchery and wild steelhead escapement over Sherars Falls at a mid-season point.

Action 2.8. Evaluate potential sites for juvenile acclimation/adult capture, assess cost, risks, and presumed benefits, and accept or reject this as a strategy for meeting plan objectives.

Action 2.9. If an acceptable strategy, negotiate modifications of the Pelton/Round Butte complex FERC license mitigation obligations, seek funding, and establish facility. Split releases of Round Butte Hatchery production between the current location at river mile 100 and the acclimation facility.

Action 2.10. Operate the facility and evaluate its contribution to achieve plan objectives and facility benefits.

Action 2.11. Operational guidelines to implement hatchery programs to accomplish management objectives of the hatchery program and be consistent with Oregon's Wild Fish Management Plan standards will be developed as required by OAR 635-07-541(3) and will be appended to this plan.

Action 2.12. Develop a cooperative harvest management agreement with CTWS.

Action 2.12. Develop an agreement with CTWS relative to providing them with summer steelhead from Round Butte Hatchery for consumption.

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SECTION 4. SUMMER STEELHEAD

FIGURES AND TABLES

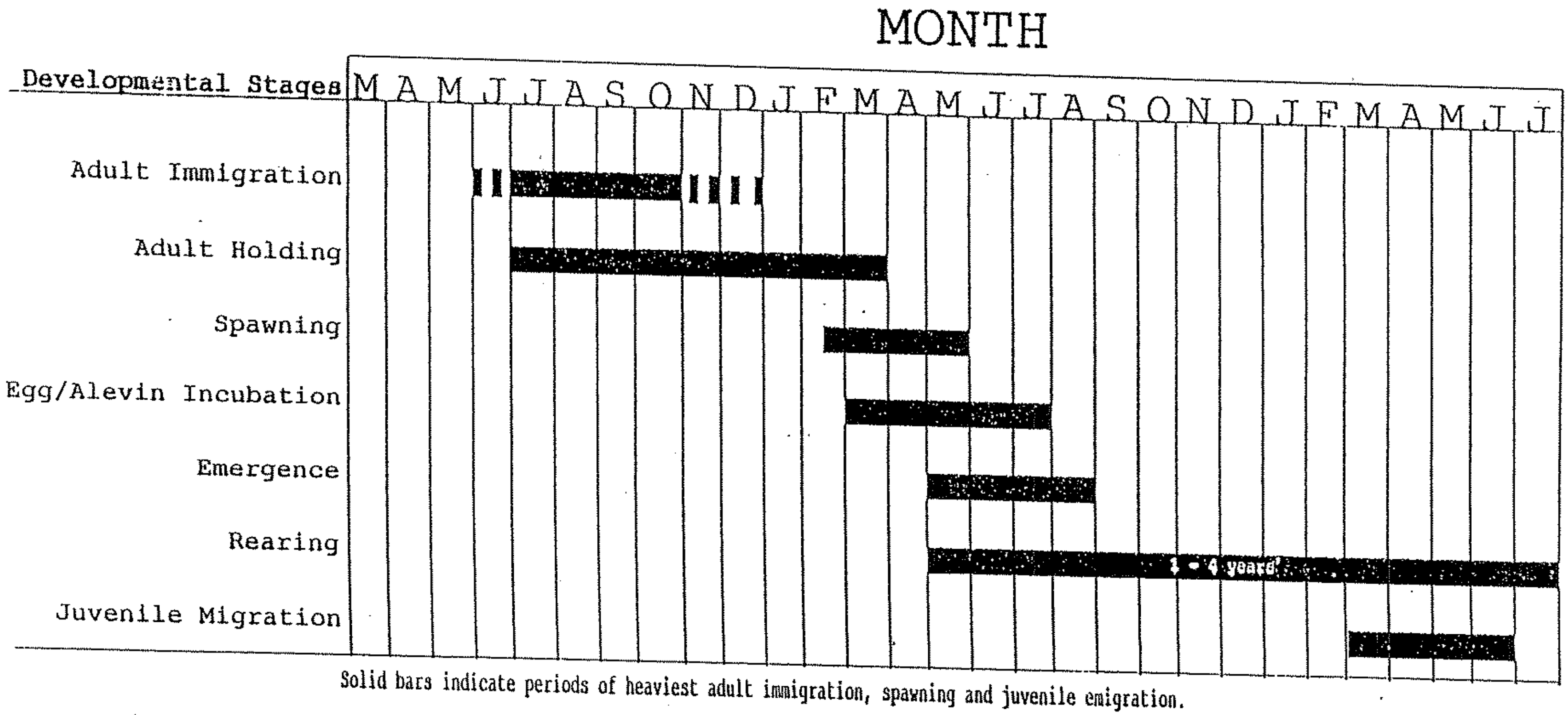

Table 4.1. Freshwater life history for summer steelhead in the Deschutes River. Developmental stage timing represents basin-wide average.

Table 4.2. Sex ratio of wild summer steelhead captured at Warm Springs National Fish Hatchery, 1977-94 run years.

Run Year	% Males	% Females
1977	35	65
1978	23	77
1979	38	62
1980	32	68
1981	34	66
1982	22	78
1983	40	60
1984	35	65
1985	36	64
1986	35	65
1987	25	75
1988	32	68
1989	38	62
1990	31	69
1991	45	55
1992	32	68
1993	47	53
1994	48	52

Table 4.3. Releases of hatchery summer steelhead in the lower Deschutes River subbasin for supplementation of natural production.

Release Year	Hatchery	Number	Size (fish/lb)	Location	Mark
1974	RBH	116,106	142	Deschutes mouth	--
1976	RBH	138,650	96.0	Deschutes mouth	--
1981	WSNFH	35,000	54.4	Warm Springs R.	AD+CWT
	WSNFH	20,000	54.4	Beaver Creek	AD+CWT
	WSNFH	28,000	54.4	Mill Creek	AD+CWT
	WSNFH	15,000	54.4	Badger Creek	AD+CWT
	WSNFH	27,332	781	Shitike Creek	--
1982	WSNFH	16,668	981	Beaver Creek	--
	WSNFH	15,000	981	Mill Creek	--
	WSNFH	35,000	981	Badger Creek	--
	WSNFH	3,000	981	Wilson Creek	--
	WSNFH	79,748	753	Shitike Creek	--
1983	WSNFH	5,000	440	Beaver Creek	--
	WSNFH	54,400	440	Badger Creek	--
	WSNFH	5,000	440	Wilson Creek	--
	WSNFH	5,000	440	Swamp Creek	--
	WSNFH	31,718	413	Shitike Creek	--
	RBH	150,006	26.6	Deschutes R.[a/]	ADRM
1984	WSNFH	80,481	993	Shitike Creek	--
	RBH	150,015	51.2	Deschutes R.[b/]	ADLM

a/ Released at Pine Tree (RM 39).
b/ Released at Macks Canyon (RM 25), Beavertail Campground (RM 31) and Pine Tree.

Table 4.4. Estimated number of steelhead that migrated past Sherars Falls, 1977-94 run years.

Run Year	Wild	Round Butte Hatchery	Stray Hatchery	Total
1977	6,600	6,100	900	13,600
1978	2,800	3,200	300	6,300
1979	4,200	5,400	600	10,200
1980	4,100	5,500	500[a/]	10,100
1981	6,900	3,800	1,200[a/]	11,900
1982	6,567	3,524	1,249[a/]	11,340
1983	8,228[b/]	7,250	7,684[a/]	23,162
1984	7,721[b/]	7,563	3,824[a/]	19,108
1985	9,624[b/]	7,382	5,056[c/]	22,062
1986	6,207[b/]	9,064	9,803[c/]	25,074
1987	5,367[b/]	9,209	8,367	23,943
1988	3,546	3,849	2,909	10,304
1989	4,278	2,758	3,659	10,695
1990	3,653	1,990	2,852	8,495
1991	4,826	3,778	8,409	17,049
1992	904	2,539	4,261	7,704
1993	1,487	1,159	4,293	6,936
1994	482	1,781	4,391	6,654

a/ May include some AD CWT marked steelhead that originated from Warm Springs NFH although few of these ever returned to that facility.

b/ May include some unmarked hatchery steelhead outplanted as fry into the Warm spring River from Warm Springs NFH.

c/ May include adults from a release of 13,000 smolts from Round Butte Hatchery that were accidentally marked with the same fin clip as steelhead released from other Columbia basin hatcheries.

Table 4.5. Estimated catch of wild summer steelhead in Deschutes River recreational and tribal fisheries. a/ Estimates for recreational fisheries include fish caught and released under a regulation adopted in 1979.

Run Year	Mouth to Macks Canyon g/	Macks Canyon Access Road	Sherars Falls	
			Sport	Tribal
1970	1,840	619	--	--
1971	--	1,795	--	--
1972	2,871	1,484	--	--
1973	3,142	1,754	184	528
1974	2,935	1,573	115	678
1975	2,968	1,146	112	366
1976	--	1,125	90	169
1977	3,085	1,374	215	968
1978b/	--	253	335	380
1979	--	1,323	339	411
1980	3,606	1,622	446	981
1981	4,003	2,681	473	688
1982	3,519	1,872	538	549
1983c/	5,649	2,294	434	901
1984c/	--	--	546	1,649
1985c/	--	--	553	1,487
1986	--	--	284	1,245
1987	8,338	2,908	416	988
1988	--	--	198	346
1989	4,003	1,017	135	529
1990	1,386	572	79	299
1991	3,781	--	59d/	75d/
1992	1,503	504	--e/	10f/
1993	1,785	354	--e/	22f/
1994	861	331--e/	14f/h/	
1995	1,358	283	--e/	46f/i/

a/ Sherars Falls samples standardized to June 15 - Oct 31. Others standardized to July 1 – Oct 31.

b/ Recreational fishery closed on August 20.

(Continued on next page)

Table 4.5. (Continued) Estimated catch of wild summer steelhead in Deschutes River recreational and tribal fisheries. a/ Estimates for recreational fisheries include fish caught and released under a regulation adopted in 1979.

c/ Estimates may include a few unmarked steelhead outplanted as juveniles from Warm Springs NFH
d/ Season at Sherars Falls area open October 1 to October 31.
e/ Season closed June 16 to October 31.
f/ Steelhead harvested during a fall chinook fishery that varied in season length.
g/ Does not include estimated east bank catch after 1979. Includes estimated Kloan area catch 1970, 1972-1975, 1977, 1980.
h/ Additional 9 summer steelhead of unknown origin kept. Includes 1 wild summer steelhead voluntarily released.
i/ Includes 45 wild summer steelhead released.

Table 4.6. Estimated recreational and tribal catch of wild summer steelhead in the lower Deschutes River from the mouth to Sherars Falls in years when all harvest samples were completed, 1973-94 run years.

Run Year	Recreational Catch a/c/	Tribal Catch
1973	5,080	528
1974	4,623	678
1975	4,226	366
1977	4,674	968
1980	5,674	981
1981	7,157	688
1982	5,929	549
1983	8,377	901
1987	11,662	988
1989	5,155	529
1990	2,037	299
1992b/	2,007	10
1993b/	2,139	22
1994b/	1,192	14
1995b/	1,641	46

a/ Includes fish caught and released under a regulation adopted in 1979.

b/ Recreational angling closed at Sherars Falls June 15 to October 31. Tribal seasons constrained by season length after with. Not all tribal catch was retained.

c/ Does not include estimated east bank mouth catch after 1979. Does include estimated catch at Kloan 1970, 1972-1975, 1977, 1980.

Table 4.7. Major habitat constraints to summer steelhead production in the lower Deschutes River subbasin. From Lower Deschutes Subbasin Plan.

Location	Habitat Constraints a/
Deschutes River	SED, SBD, GQL, GQN, CVR, PTR, ISP, ITC, PSB
Buck Hollow Creek and tributaries	FLO, TEM, SBD, GQL, FLD
Bakeoven Creek and tributaries	FLO, TEM, SBD, FLD
Nena Creek	PSB, FLO, TEM, SBD
Warm Springs River and tributaries	TEM, SED, PTR, GQL, CVR, GQN, FLO, DIV, PSI
Trout Creek and tributaries	TEM, SBD, SED, CVR, FLO, PSB, FLD, ICE, CHN, GRA, CHM
Shitike Creek	CHN, SBD, SED, CVR, MT
Other Deschutes River tributaries	FLO, TEM, SBD, SED, PSB, GRA

a/ CHM=chemical pollution, CHN=channelization, CVR=in-stream cover, DIV=unscreened or poorly operating diversion, FLD=flash flooding, FLO=low flow, GQL=gravel quality, GQN=gravel quantity, GRA=gradient, ICE=ice, ISP=inter-specific competition, ITC=intra-specific competition, PSB=passage blocked, PSI=passage impeded, PTR=pool to riffle ratio, SBD=streambank degradation, SED=sedimentation, TEM=high temperature.

Table 4.8. Summer steelhead production releases from Warm Springs National Fish Hatchery, 1978 and 1980 broods.

Brood Year	Release Date	Number of Smolts	Location	Mark
1978	05/79	89,380	Warm Springs R.	AD+CWT
1980	04/81	4,486	Warm Springs R.	AD+CWT

Table 4.9. Returns of Round Butte Hatchery steelhead to Pelton trap, 1969-91 broods. 1992 brood year returns incomplete.

Brood Year	1-Salt	Percent	2-Salt	Percent	Total
1969	2,225	65	1,179	35	3,404
1970	1,230	39	1,675	61	2,905
1971	3,163	56	2,474	44	5,637
1972	4,337	76	1,391	24	5,728
1973	348	33	718	67	1,066
1974	365	31	798	69	1,163
1975	1,322	53	1,196	47	2,518
1976	536	56	417	44	953
1977	2,195	63	1,276	37	3,471
1978	919	48	978	52	1,897
1979	782	37	1,318	63	2,100
1980	229	47	262	53	491
1981	2,177	56	1,746	44	3,923
1982	1,532	51	1,452	49	2,984
1983	1,701	55	1,413	45	3,114
1984	1,227	52	1,106	48	2,333
1985	378	29	938	71	1,316
1986	309	45	382	55	691
1987	447	49	461	51	908
1988	145	27	395	73	540
1989	970	49	994	51	1,964
1990	163	49	169	51	332
1991	21	17	102	83	123
1992	651	--	--	--	--

Table 4.10. Percentage females of wild summer steelhead captured in Pelton trap and at Warm Springs National Fish Hatchery (WSNFH) and of Round Butte Hatchery (RBH) origin steelhead captured in Pelton trap, 1972-94 run years.

Run Year	Wild Steelhead		RBH Origin Steelhead
	Pelton Trap	WSNFH	
1972	63	--	61
1973	75	--	58
1974	70	--	64
1975	68	--	73
1976	51	--	62
1977	66	65	59
1978	69	77	65
1979	68	62	51
1980	69	68	62
1981	65	66	54
1982	73	78	63
1983	63	60	45
1984	66	65	47
1985	56	64	55
1986	74	65	53
1987	69	75	60
1988	58	68	57
1989	59	62	49
1990	70	69	57
1991	57	55	48
1992	75	68	68
1993	74	53	63
1994	69	52	48

Table 4.11. Mean fork length (inches) of Round Butte Hatchery summer steelhead adults sampled at Sherars Falls, 1975-87 broods. 1987 brood year incomplete.

Brood Year	N	1-Salt Length	Range	N	2-Salt Length	Range
1975	426	23.6	17-29	473	27.4	20-31
1976	213	23.1	20-30	178	27.1	20-31
1977	859	23.5	20-29	530	26.2	20-31
1978	462	22.8	20-28	326	26.9	20-33
1979	255	22.7	19-28	182	26.5	22-31
1980	27	23.6	20-33	33	26.4	22-31
1981	332	23.5	19-28	187	27.3	22-31
1982	93	23.2	20-28	192	27.3	22-32
1983	280	23.4	20-31	457	27.7	20-32
1984	349	23.2	20-31	299	26.4	21-32
1985	119	22.8	20-34	465	27.2	21-31
1986	200	23.6	21-34	277	26.4	21-31
1987	244	23.2	20-27	--	--	--

Table 4.12. Fecundity of Round Butte Hatchery summer steelhead, 1977-95 brood years.

Brood Year	Eggs/Female
1977	4,355
1978	4,297
1979	5,148
1980	4,798
1981	4,550
1982	5,488
1983	5,511
1984	4,177
1985	5,502
1986	5,052
1987	5,147
1988	5,398
1989	5,407
1990	4,598
1991	4,682
1992	4,590
1993[a/]	4,801
1994[a/]	4,340
1995a/	4,296

a/ Includes wild females used as brood stock.

Table 4.13. Summer steelhead production releases from Round Butte Hatchery, 1973-94 broods.

Brood Year	Release Date		Number a/	Location b/	Mark
1973	05/74		100,248 (s)	Rereg. Dam	LVRP
	05/74		84,149 (s)	Beavertail	ADLVRM
		Total	184,397		
1974	05/75		33,510 (s)	Rereg. Dam	RV
	05/75		34,776 (s)	Rereg. Dam	LV
	05/75		35,004 (s)	Rereg. Dam	LVRV
	05/75		10,773 (s)	Maupin	ADRM
	05/75		3,964 (s)	Beavertail	ADRM
		Total	168,027		
1975	05/76		26,483 (s)	Rereg. Dam	LVRM
	05/76		26,972 (s)	Rereg. Dam	RVLM
	05/76		27,000 (s)	Rereg. Dam	RVRM
	05/76		26,610 (s)	Beavertail	RPRM
	05/76		25,752 (s)	Beavertail	LPRM
	05/76		25,769 (s)	Beavertail	LPLM
		Total	158,586		
1976	04/77		82,906 (s)	Rereg. Dam	LVRP
	03/77		27,440 (s)	Buck Hollow Cr.	ADRV
	04/77		27,515 (s)	Buck Hollow Cr.	ADLVRV
	03/77		27,030 (s)	Buck Hollow Cr.	ADLV
		Total	164,891		
1977	04/78		27,195 (s)	Rereg. Dam	LV
	04/78		26,565 (s)	Rereg. Dam	RV
	04/78		27,627 (s)	Rereg. Dam	LVRV
	04/78		25,542 (s)	Buck Hollow Cr.	LPRM
	04/78		27,489 (s)	Buck Hollow Cr.	LPLM
	04/78		28,050 (s)	Buck Hollow Cr.	RPRM
		Total	162,468		

(Continued)

Table 4.13. (continued) Summer steelhead production releases from Round Butte Hatchery, 1973-94 broods.

Brood Year	Release Date	Number [a/]	Location [b/]	Mark
1978	05/79	27,207 (s)	Rereg. Dam	LVRM
	05/79	21,334 (s)	Rereg. Dam	RVRM
	04/79	27,572 (s)	Pine Tree	LVRVLM
	04/79	49,105 (s)	Pine Tree	RVLM
	05/79	24,381 (s)	Columbia River	LVLM
	Total	149,599		
1979	04/80	28,744 (s)	Rereg. Dam	LPLM
	04/80	28,056 (s)	Rereg. Dam	LP
	04/80	24,759 (s)	Rereg. Dam	LPRM
	04/80	28,837 (s)	Pine Tree	RPLM
	04/80	25,001 (s)	Pine Tree	RPRM
	05/80	27,284 (s)	Columbia River	RP
	Total	162,681		
1980	04/81	26,813 (s)	Rereg. Dam	LV
	04/81	27,516 (s)	Rereg. Dam	LVRV
	04/81	25,263 (s)	Rereg. Dam	LVRVRM
	04/81	25,403 (s)	Rereg. Dam	RV
	04/81	25,615 (s)	Pine Tree	RVLP
	04/81	25,897 (s)	Macks Canyon	LVRP
	Total	156,507		
1981	04/82	26,885 (s)	Rereg. Dam	RVRM
	04/82	27,144 (s)	Rereg. Dam	RVLM
	04/82	27,292 (s)	Maupin	RVRM
	04/82	26,975 (s)	Maupin	RVLM
	04/82	27,553 (s)	Pine Tree	RVRM
	04/82	26,312 (s)	Pine Tree	RVLM
	Total	162,161		
1982	04/83	50,594 (s)	Rereg. Dam	LP
	04/83	57,888 (s)	Rereg. Dam	RP
	05/83	36,660 (s)	Maupin	LP
	05/83	13,067 (s)	Maupin	RP
	Total	158,209		

(Continued)

Table 4.13. (continued) Summer steelhead production releases from Round Butte Hatchery, 1973-94 broods.

Brood Year	Release Date		Number a/	Location b/	Mark
1983	04/84		54,614 (s)	Rereg. Dam	ADRV
	04/84		56,351 (s)	Maupin	ADRV
	04/84		54,458 (s)	Pine Tree	ADRV
		Total	165,423		
1984	04/85		66,511 (s)	Rereg. Dam	ADRP
	04/85		54,884 (s)	Maupin	ADRP
	04/85		54,611 (s)	Pine Tree	ADRP
		Total	176,006		
1985	04/86		53,949 (s)	Rereg. Dam	ADLPRM
	04/86		63,746 (s)	Maupin	ADLPLM
	04/86		56,799 (s)	Pine Tree	ADLPLM
		Total	174,494		
1986	04/87		50,431 (s)	Rereg. Dam	ADLP
	04/87		109,050 (s)	Maupin	ADRP
		Total	159,481		
1987	04/88		53,402 (s)	Rereg. Dam	ADRVRM
	04/88		109,117 (s)	Maupin	ADRVLM
		Total	162,519		
1988	04/89		52,182 (s)	Rereg. Dam	ADRPLM
	04/89		41,748 (s)	Rereg. Dam	ADRPRM
	04/89		62,906 (s)	Maupin	ADLPLM
		Total	156,836		
1989	04/90		108,683 (s)	Rereg. Dam	ADRM
	04/90		52,925 (s)	Rereg. Dam	ADLM
		Total	161,608		
1990	04/91		107,695 (s)	Rereg. Dam	ADRP
	04/91		55,570 (s)	Rereg. Dam	ADLP
		Total	163,265		

(Continued)

Table 4.13. (continued) Summer steelhead production releases from Round Butte Hatchery, 1973-94 broods.

Brood Year	Release Date		Number a/	Location b/	Mark
1991	04/92		108,682 (s)	Rereg. Dam	ADRM
	04/92		52,890 (s)	Rereg. Dam	ADLM
		Total	161,572		
1992	04/93		111,908 (s)	Rereg. Dam	ADRP
	04/93		54,235 (s)	Rereg. Dam	ADLP
		Total	166,143		
1993	04/94		164,961 (s)	Rereg. Dam	ADLM
		Total	164,961		
1994	04/95		167,198 (s)	Rereg. Dam	ADRM
		Total	167,198		

a/ (s)=smolts
b/ Rereg. Dam=Deschutes River, RM 100; Beavertail=Deschutes River, RM 31; Maupin=Deschutes River, RM 52; Buck Hollow Cr.=Deschutes River, RM 43; Pine Tree=Deschutes River, RM 39; Columbia River=Columbia River below Bonneville Dam.

Table 4.14. Estimated number of hatchery origin steelhead that migrated past Sherars Falls, 1977-94 run years.

Run Year	Round Butte Hatchery	Percent	Stray Hatchery	Percent	Total Number
1977	6,100	87	900	13	7,000
1978	3,200	91	300	8	3,500
1979	5,400	90	600	10	6,000
1980	5,500	92	500a/	8	6,000
1981	3,800	76	1,200a/	24	5,000
1982	3,524	61	1,249a/	39	5,773
1983	7,250b/	49	7,684a/	51	14,934
1984	7,563b/	66	3,824a/	34	11,387
1985	7,382b/	59	5,056c/	41	12,438
1986	9,064b/	48	9,803c/	52	18,867
1987	9,209b/	52	8,367	48	17,576
1988	3,849	57	2,909	43	6,758
1989	2,758	43	3,659	57	6,417
1990	1,990	41	2,852	59	4,842
1991	3,778	31	8,409	69	12,187
1992	2,539	37	4,261	63	6,800
1993	1,159	21	4,293	79	5,452
1994	1,781	29	4,391	71	6,172

a/ May include some AD CWT marked steelhead that originated from Warm Springs NFH although few of these ever returned to that facility.

b/ May include adults from a release of 13,000 smolts from Round Butte Hatchery that were accidentally marked with the same fin clip as steelhead released from other Columbia basin hatcheries.

Table 4.15. Number and percent composition of summer steelhead in Pelton trap, 1971-94 run years. Deschutes hatchery refers to hatchery steelhead from Deschutes stock that were reared at Oak Springs, Wizard Falls, Cedar Creek, and Gnat Creek hatcheries prior to 1973 and at Round Butte Hatchery beginning in 1973.

Run	Wild		Deschutes Hatchery		Stray Hatchery	
Year	Number	%	Number	%	Number	%
1971	394	11	3,166	89	14	<1
1972	387	14	2,409	85	30	1
1973	142	3	4,838	96	37	1
1974	227	3	6,811	96	27	<1
1975	169	9	1,739	89	48	2
1976	244	18	1,083	80	29	2
1977	233	10	2,120	87	80	3
1978	136	7	1,732	88	110	5
1979	223	8	2,612	90	54	2
1980	169	7	2,195	91	47	2
1981	245	11	1,760	82	156	7
1982	344	17	1,547	75	167	8
1983	814	17	2,439	52	1,452	31
1984	603	13	3,278	70	795	17
1985	686	14	3,153	66	943	20
1986	467	10	2,640	57	1,538	33
1987	160	7	1,484	61	796	32
1988	123	7	1,247	75	300	18
1989	136	9	829	56	524	35
1990	82	7	606	54	428	38
1991	101	6	1,365	59	849	37
1992	59	4	1,157	70	427	27
1993	65	12	190	35	288	53
1994	2770	2	753	53	642	45

Table 4.16. Catch of Round Butte Hatchery origin hatchery steelhead in Deschutes River sport and tribal fisheries, 1970-95. f/

Year	Mouth to Macks Canyon e/g/	Macks Canyon access road	Sherars Falls	
			Sport	Tribal
1970	83	166	--	--
1971	--	603	--	--
1972	328	893	--	--
1973	650	1,144	180	802
1974	942	2,055	290	1,925
1975	612	432	112	557
1976	--	385	52	221
1977	444	499	120	1,051
1978a/	--	241	39	443
1979	--	681	251	511
1980	656	666	288	1,155
1981	486	488	172	614
1982	410	386	177	531
1983	543	387	202	880
1984	--	--	270	1,675
1985	--	--	195	1,287
1986	--	--	153	1,421
1987	335	309	121	973
1988	--	--	106	599
1989	392	146	69	453
1990	96	80	44	496
1991	197	--	33b/	77b/
1992	168	83	--c/	--c/
1993	135	45	--c/	16d/
1994	128	31	--c/	39d/
1995	140	119	--c/	11d/

a/ Recreational fishery closed on August 20.
b/ Season at Sherars Falls area open October 1 to October 31.
c/ Season at Sherars Falls closed June 16 to October 31.
d/ Estimated from the percentage of Deschutes origin hatchery summer steelhead in the catch at the Sherars Falls trap.
e/ Does not includes estimated east bank catch after 1979. Does include estimated catch at Kloan 1970, 1972-1975, 1977, 1980.
f/ Sherars Falls samples standardized to June 15 to Oct 31. Others standardized to July 1 to Oct 31

Table 4.17. Estimated recreational catch of RBH and stray origin summer steelhead in the Deschutes River July 1 to October 31 from the mouth to Sherars Falls in years when all harvest samples were completed, 1973-95. b/

	Round Butte Hatchery		Stray Hatchery		Total
Run Year	Number	Percent	Number	Percent	Number
1973	1,974	86	315	14	2,289
1974	3,287	92	289	8	3,576
1975	1,156	81	279	19	1,435
1977	1,063	69	471	31	1,534
1980	1,610	69	723	31	2,333
1981	1,146	65	622	35	1,768
1982	973	58	713	42	1,686
1983	1,132	35	2,142	65	3,274
1987	765	29	1,913	71	2,678
1989	607	23	2,088	77	2,695
1990	220	14	1,319	86	1,539
1992a/	251	16	1,369	84	1,620
1993a/	180	12	1,303	88	1,483
1994a/	159	13	1,085	87	1,244
1995a/	259	12	1,833	88	2,092

a/ Recreational angling closed at Sherars Falls June 15 to October 31.

b/ Does not include estimated east bank mouth catch after 1979. Does include estimated catch at Kloan 1970, 1972-1975, 1977, 1980.

Table 4.18. Catch of stray hatchery steelhead in Deschutes River recreational and tribal fisheries, July 1 to October 31, 1970-95.

Year	Mouth to Macks Canyon e/g/	Macks Canyon access road	Sherars Falls	
			Sport	Tribal
1970	28	12	--	--
1971	--	67	--	--
1972	134	65	--	--
1973	200	115	0	23
1974	165	117	7	80
1975	192	94	3	11
1976	--	96	19	55
1977	365	87	19	149
1978a/	--	50	8	124
1979	--	148	69	134
1980	511	136	76	154
1981	419	117	86	158
1982	378	202	133	534
1983	1,080	461	601	2,407
1984	--	--	185	1,125
1985b/	--	--	380	1,417
1986b/	--	--	337	2,362
1987	1,514	286	113	872
1988	--	--	135	352
1989	1,746	233	109	841
1990	1,043	135	141	792
1991	1,833	--	183c/	487c/
1992	1,198	171	--d/	--d/
1993	1,157	146	--d/	63e/
1994	955	130	--d/	170e/
1995	1,489	334	--d/	74e/

a/ Recreational fishery closed on August 20.
b/ May include some adults that returned from a release of 13,000 juveniles from Round Butte hatchery that were mistakenly marked with the same fin clip as fish from other Columbia River hatcheries.
c/ Season at Sherars Falls area open October 1 to October 31.
d/ Season at Sherars Falls closed June 16 to October 31.
e/ Estimated from the percentage of stray hatchery summer steelhead in the catch at the Sherars Falls trap.
f/ Does not include estimated east bank mouth catch after 1979. Does include estimated catch at Kloan 1970, 1972-1975, 1977, 1980.

Table 4.19. Estimated recreational and tribal catch of summer steelhead in the Deschutes River July 1 to October 31 from the mouth to Sherars Falls in years when all harvest samples were completed, 1973-95 run years. c/

Run Year	Wild a/	Round Butte Hatchery	Stray Hatchery	Total
1973	5,608	2,776	338	8,722
1974	5,301	5,212	369	10,822
1975	4,592	1,713	300	6,605
1977	5,642	2,114	620	8,376
1980	6,655	2,765	878	10,298
1981	7,845	1,760	780	10,385
1982	6,478	1,504	1,247	9,229
1983	9,278	2,330	4,549	16,157
1987	12,650	1,738	2,785	17,173
1989	5,684	1,060	2,926	9,670
1990	2,336	716	2,111	5,163
1992b/	2,017	251	1,369	3,637
1993b/	2,161	196	1,366	3,723
1994b/	1,206	198	1,255	2,659
1995b/	1,641	270	1,897	3,808

a/ Includes fish caught and released under a regulation adopted in 1979.

b/ Recreational angling closed at Sherars Falls June 15 to October 31. Tribal catch not included.

c/ Does not include estimated east bank mouth catch after 1979. Does include estimated catch at Kloan 1970, 1972-1975, 1977, 1980.

Table 4.20. Estimated recreational catch of summer steelhead in the Deschutes River July 1 to October 31 from the mouth to Sherars Falls in years when all harvest samples were completed, 1973-95. c/

Run Year	Wild a/		Round Butte Hatchery		Stray Hatchery		Total Number
	Number	Percent	Number	Percent	Number	Percent	
1973	5,080	69	1,974	27	315	4	7,369
1974	4,623	56	3,287	40	289	4	8,199
1975	4,226	75	1,156	20	279	5	5,671
1977	4,674	75	1,063	17	471	7	6,208
1980	5,674	71	1,610	20	723	9	8,007
1981	7,157	80	1,146	13	622	7	8,925
1982	5,929	78	973	13	713	9	7,645
1983	8,377	72	1,132	10	2,142	18	11,650
1987	11,662	81	765	5	1,913	14	14,340
1989	5,155	66	607	7	2,088	27	7,850
1990	2,037	57	220	5	1,319	38	3,576
1992b/	2,007	55	251	6	1,369	39	3,627
1993b/	2,139	59	180	4	1,303	37	3,622
1994b/	1,192	49	159	7	1,085	44	2,436
1995b/	1,641	44	259	7	1,833	49	3,733

a/ Includes fish caught and released under a regulation adopted in 1979.

b/ Recreational angling closed at Sherars Falls June 15 to October 31.

c/ Does not include estimated east bank mouth catch after 1979. Does include estimated catch at Kloan 1970, 1972-1975, 1977, 1980.

Table 4.21. Hatchery and wild summer steelhead recycled through fisheries in the Deschutes River, 1971-95 run years.

Run Year	Below Sherars Falls	Warm Springs Bridge And Pelton Trap
1972	1,667	0
1973	3,695	0
1974	2,339	0
1975	0	71
1976	0	48
1977	0	56
1978	667	501
1979	984a/	1,305
1980	373	1,041
1981	0	960
1982	0	1,108
1983	0	1,614
1984	0	1,682
1985	0	1,526
1986	0	1,995
1987	0	1,118
1988	0	410
1989	0	342
1990	0	289
1991	0	235
1992	0	76b/
1993	0	53b/
1994	0	16b/
1995	N/A	N/A

a/ Includes 77 fish recycled at Maupin City Park.
b/ Recycled only at the Pelton trap.

Table 4.22. Summer steelhead provided to Warm Springs Tribes from fish returning to Pelton trap, 1974-95 run years.

Run Year	Number
1974	1,209
1975	106
1976	0
1977	893
1978	1
1979	0
1980	296
1981	566
1982	217
1983	2,030
1984	1,802
1985	2,350
1986	2,259
1987	2,259
1988	682
1989	886
1990	485
1991	138
1992	1,710
1993	1,155
1994	289
1995	866

Table 4.23. Estimated number of Round Butte Hatchery (RBH) and stray hatchery summer steelhead that may have spawned naturally in the Deschutes River, 1977-94 run years a/.

Run	Estimated Number past Sherars Falls		Number at Pelton Trap		Number at WSNFH		Estimated Hatchery Harvest b/		Estimated Hatchery Spawners Above Sherars		Estimated Wild
Year	Stray	RBH	Stray	RBH	Stray	RBH	Stray	RBH	Stray	RBH	Spawners
1977	900	6,100	80	2,120	--	--	---	---	---	---	6600
1978	300	3,200	110	1,732	--	--	---	---	---	---	2800
1979	600	5,400	54	2,612	--	--	---	---	---	---	4200
1980	500	5,500	47	2,195	--	--	---	---	---	---	4100
1981	1,200	3,800	156	1,760	--	--	---	---	---	---	6900
1982	1,600	3,200	167	1,547	--	--	---	---	---	---	6600
1983	7,700	7,200	1,452	2,439	91	31	---	---	---	---	8200
1984	3,800	7,600	795	3,278	66	18	311	631	2628	3673	7700
1985	5,100	7,400	943	3,153	16	15	609	876	3532	3356	9600
1986	9,800	9,100	1,538	2,640	545	60	629	580	7088	5920	6200
1987	8,400	9,200	796	1,484	516	12	407	442	6681	7262	5400
1988	2,900	3,800	300	1,247	166	28	367	486	2067	2039	3500
1989	3,700	2,800	525	829	162	10	507	382	2506	1579	4300
1990	2,900	2,000	400	606	123	2	479	320	1898	1072	3700
1991	8,400	3,800	849	1,365	374	14	856	385	6792	2036	4900
1992	4,300	2,500	427	1,157	100	5	557	314	3216	1024	900
1993	4,300	1,200	283	190	192	4	693	195	3132	811	1500
1994	4,400	1,800	642	758	18	0	535	219	3205	823	500

a/ Number past Sherars Falls - Number at Pelton Trap - number at WSNFH - hatchery harvest above Sherars Falls = estimated spawners above Sherars Falls.

b/ Punchcard harvest did not differentiate above or below Sherars Falls harvest prior to 1984.

Table 4.. .. Estimated number and proportion of Deschutes summer steelhead spawners that were out of subbasin hatchery strays, Round Butte Hatchery fish, and wild fish for 1984 to 1994. Three strategies demonstrating the proportion of out of basin strays that need to be removed from the population (Rh4) or proportional increase in numbers of wild fish (Ew) in order to meet Wild Fish Management Policy compliance standards for hatchery fish.

	SPAWNERS							Strategy 1	Strategy 2	Strategy 3
Run	Stray Hatchery		Round Butte Hatchery		Wild		Total Number	No RBH Program	RBH and 30% removed	RBH less 30% Strays less 60%
Year	Number	Proportion	Number	Proportion	Number	Proportion	Spawners	Rh4 a/	Rh4 b/	Ew c/
1984	2,628	0.188	3,673	0.262	7,700	0.550	14,001	0.85	0.90	1.93
1985	3,532	0.214	3,356	0.204	9,600	0.582	16,488	0.86	0.89	2.04
1986	7,055	0.369	5,920	0.308	6,200	0.323	19,208	0.95	0.98	8.36
1987	6,681	0.345	7,262	0.375	5,400	0.279	19,343	0.96	1.00	9.34
1988	2,067	0.282	2,039	0.268	3,500	0.460	7,606	0.91	0.95	3.90
1989	2,506	0.299	1,579	0.188	4,300	0.513	8,385	0.91	0.93	3.69
1990	1,896	0.284	1,072	0.161	3,700	0.555	6,668	0.90	0.92	3.10
1991	6,792	0.495	2,036	0.147	4,900	0.357	13,728	0.96	0.97	9.83
1992	3,216	0.626	1,024	0.199	900	0.175	5,140	0.99	1.00	26.95
1993	3,132	0.585	811	0.149	1,500	0.276	5,443	0.97	0.98	15.25
1994	3,205	0.708	823	0.182	500	0.111	4,528	0.99	1.00	48.87
Averages	3,886	0.398	2,690	0.222	4,382	0.380	10,958	0.95	0.97	7.36

a/ Rh4 under Strategy 1 is the proportion of the out of subbasin hatchery strays that must be removed from the spawning population in order to meet WFMP compliance for a strategy where no hatchery summer steelhead are released from Round Butte Hatchery.

b/ Rh4 under Strategy 2 is the proportion of out of subbasin hatchery strays that must be removed from the spawning population in order to meet WFMP compliance for a strategy that maintains current Round Butte Hatchery summer steelhead production but removes an additional 30% of the adult return prior to spawning.

c/ Ew is the proportional increase in the number of wild spawners needed in order to meet WFMP compliance for a scenario where an additional 30% of the Round Butte Hatchery origin summer steelhead and 60% of the out of subbasin hatchery strays are removed from the population prior to spawning.

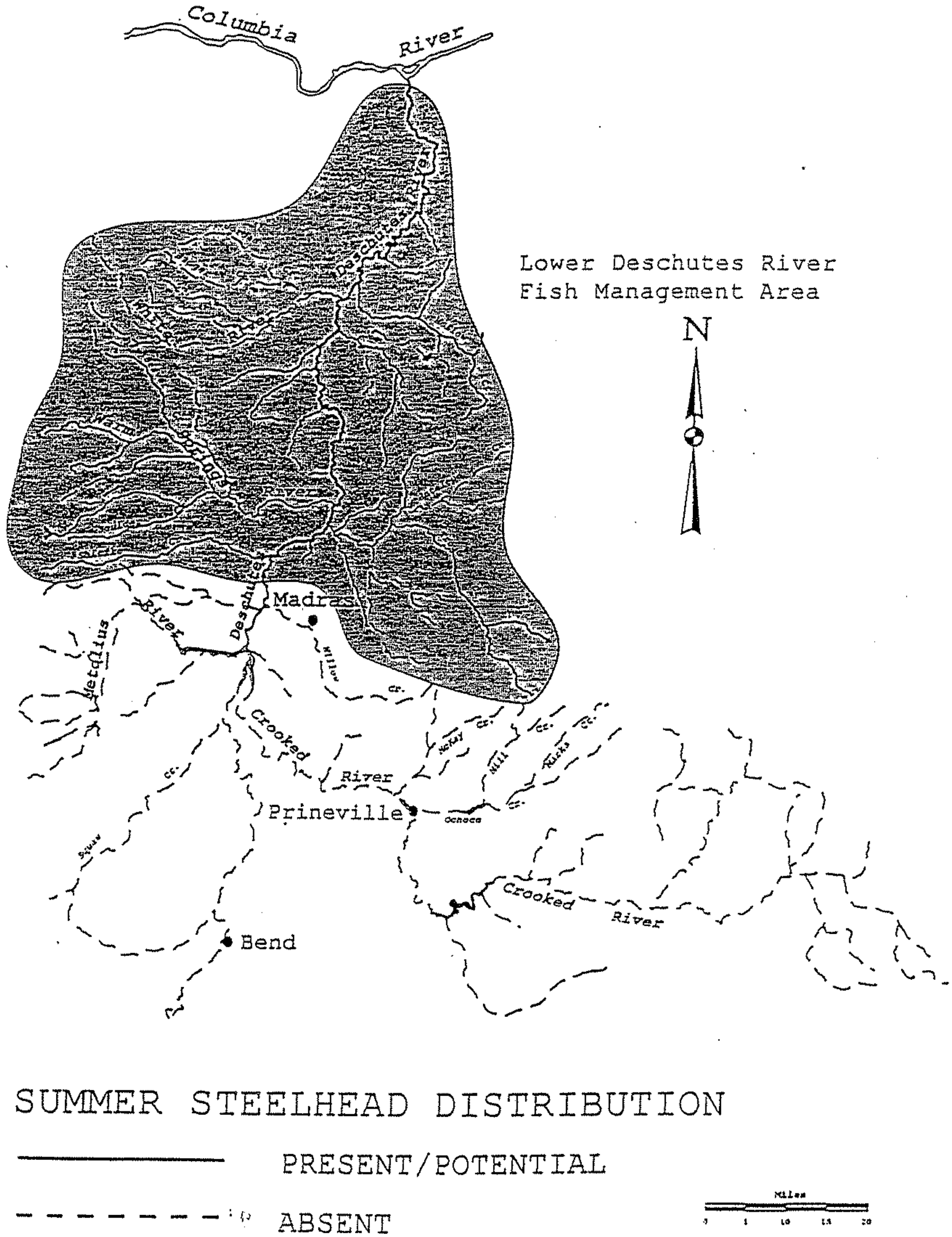

Figure 4.1. Summer steelhead distribution in the lower Deschutes River subbasin.

APPENDIX A

WHITE RIVER RISK ASSESSMENT

White River:
Risk Assessment of a Proposal
to Introduce Anadromous Fish above
White River Falls

Physical Description of the Basin

White River is a tributary of the Deschutes River. The head of the mainstem is in White River Glacier on the southeast slope of Mt. Hood. The river drains about 420 square miles. A series of three drops totaling 180 feet comprise White River Falls which is located 2 miles above the confluence of White River and the Deschutes. White River Falls forms a complete barrier that isolates the stream-bound aquatic organisms in the ecosystem above the falls from those in the ecosystem below it. Several other, smaller falls are located in the upper basin above the main falls (ODFW, et al. 1985).

The Columbia River is known to have reached it's current course two to three million years ago after being relocated northward by successive Columbia River basalt flows during the Miocene. A north-flowing, ancestral Deschutes River was also present in approximately its current location since the Miocene (Orr et al. 1992). White River was probably formed during Pliocene uplifting of the eastern Cascades about two million years ago. An ancestral White River occupied the site of the current river prior to the formation of the present Mt. Hood, which began during the early Pleistocene (Wise 1969).

The building of Mt. Hood modified all of the rivers that drain it by filling their basins with mud and lava flows. The most recent eruption impact occurred during the Old Maid eruptive period when a pyroclastic flow in about 1800 triggered a lahar (mud flow) down the mainstem of the White River to its confluence with the Deschutes. This mud flow was similar to the one that occurred on the Toutle River during the 1980 eruption of Mt. St. Helens. An evaluation of potential future Mt. Hood eruptions indicates that the White River mainstem remains highly vulnerable to eruption impacts, particularly to mud flows (Crandell 1980).

Mt. Hood also was glaciated to various extents through the Pleistocene and into the Holocene. Glaciers extended from the mountain peak down river valleys to various distances as the glaciers advanced and retreated. White River Glacier, currently restricted to the very upper basin, extended a significant distance down the main river basin as recently as 15,000 years ago.

These geological activities would have seriously impacted, possibly even eliminated, fish populations in the mainstem White River. The occurrence of a barrier like White River Falls at nearly the mouth of the river would have prevented recolonization of the basin from the Deschutes after such catastrophic episodes if the falls predated the episodes. However, an alternative source of colonizers was present in the White River basin. A large part of the White River basin, including the large tributaries of Tygh Creek and Badger Creek, have been protected from all of the geological events by a ridge that follows the Hood River fault. Tributaries that drain the east slope of the Hood River fault have not been subjected to either lahars or glaciers and would have provided ancient refuge areas from which fish could have recolonized back into the rest of the basin.

Currently, the mainstem White River originates from the glacier then flows through old mud flows and glacial deposits in an unstable channel. The river carries a high sediment load and is very turbid. Fine sand and sediment deposition in slack water areas is common. Highest flows are associated with snow-melt freshets in the late winter and spring. The other subbasins are unaffected by sediment from the current glacier and mud flow deposits. These tributaries tend to be clearer with cleaner gravels. The upper basin tributaries are at higher elevations, are more timbered, and have cooler water temperatures than the lower basin tributaries (Uebel, et al. 1983; ODFW et al. 1985).

Comparison of the Fish Species Assemblages above and below the Falls

The available data indicates that there are seven indigenous fish species above White River Falls. The assemblage includes the White River redband trout (*Oncorhynchys mykiss ssp.*), mountain whitefish (*Prosopium williamsoni*), longnose dace (*Rhinichthys cataractae*), and at least two species of sculpin (*Cottus beldingi* and *C. confusus*) and possibly four (including *C. rhotheus,* and *C. bairdi*). The distribution of indigenous fishes is shown in Figure 1, (based on data from ODFW et al. 1985). The presence of the sculpin *C. bairdi* in White River requires verification; however, if it is present its occurrence in that tributary is unique because this species is not known from any other location in the Deschutes. *C. bairdi* is considered by some to be a member of an ancestral fauna that remains only as discontinuous remnants scattered through the Columbia basin (Bisson and Bond 1971). The identification of the dace is also uncertain. Speckled dace, *Rhinichthys osculus* , is also known to occur above old barriers. The White River redband trout is listed as a state sensitive species.

Two exotic species have been introduced above the falls, including brook trout (*Salvelinus fontinalis*) and largemouth bass (*Micropterus salmoides*). Brook trout are present in Clear and Frog creeks, where they may have displaced the indigenous redband trout, in a section of the upper mainstem and Barlow creeks, and in upper Boulder Creek. Largemouth bass were found just below Rock Creek Reservoir on Rock Creek. Hatchery rainbow trout (*O. mykiss irideus* (Behnke 1992)) have also been planted in the basin. The hatchery trout are a domesticated coastal rainbow stock that was founded from populations in Northern California about 100 years ago and are considered to be a different subspecies than the indigenous White River redband trout.

The species assemblage below the falls includes at least nine indigenous species that are not above the falls. Two races of chinook salmon (*O. tshawytscha*), northern squawfish (*Ptychocheilus oregonensis*), bridgelip and largescale suckers (*Catostomus columbianus* and *C. macrocheilus*), chiselmouth (*Acrocheilus alutaceus*), redside shiner (*Richardsonius balteatus*), pacific lamprey (*Lampetra tridentatus*), bull trout (*Salvelinus confluentus*), and sockeye salmon (*O. nerka*) are found only below the falls. Inland steelhead and redband trout (anadromous and resident *O. mykiss gairdneri* (Behnke 1992)) are also below the falls but may also be a different subspecies than the trout above the falls. The list of nongame fish species below the falls may be incomplete and additional species may be present. Additional introduced exotic species are also present below the falls.

Uniqueness of the Species above the Falls

Populations that become physically isolated from other populations in the same species, and remain isolated over geological time, diverge from their parent species eventually forming new species. This divergence occurs because there is no longer gene flow between the isolated population and other populations in the species. Genetic changes that result from mutations, differing selection pressures, or genetic drift are no longer shared between the isolated population and the other populations in the species and eventually they become recognizably different. According to the evolutionary species concept, a group of organisms constitutes a "species" when it becomes reproductively isolated from all other groups and begins to evolve independently of them (Endler 1989). Typological species concepts requires that independent evolution of the group has occurred long enough for diagnosable distinct characteristics to form before the group is considered a "species" (Cracraft 1989). The biological species concept, which is the most commonly recognized, requires that independent evolution and differentiation has occurred to the extent that the group is completely unable to breed with other organisms, including sympatric members of the parent or sibling species.

The "correct" species concept to use depends on the application. Generally the topological and biological species concepts are more practical for taxonomic applications. But it has been argued that the evolutionary species concept is more appropriate for conservation (Rojas 1992) because the conservation of a single group fails to conserve the biodiversity located in other groups that are completely reproductively isolated from the protected group. This thinking has been translated into conservation management where breeding populations and metapopulations (a group of populations that are connected by gene flow) are the focus of management action. It has been proposed at a national level that "evolutionary units", defined as groups with an independent evolutionary future, be the unit of protection under the federal Endangered Species Act (National Research Council 1995). Oregon Department of Fish and Wildlife has also adopted this approach through the recognition and protection of "gene conservation groups" (OAR 635-07-536 through 538).

The time required for an evolutionary unit to become measurably different at any particular trait is variable. Some mechanisms of genetic change affect populations quickly. For example, selection for resistance to a virulent disease pathogen may change a group that is described by this trait in just a few generations. In contrast, isolated populations in similar environments may undergo parallel selection and remain apparently similar to each other for a long period of time. The traits that are most often selected to detect patterns of reproductive isolation are biochemical traits that are more affected by the evolutionary mechanisms of gene flow, neutral mutation and genetic drift than by selection since over time these traits will remain common to the two groups only if there is a reproductive connection between them.

It has also become evident that in fishes many genetic changes can accumulate between geographically isolated groups without full reproductive isolation being attained as required by the biological species concept. For example, cutthroat (*O. clarki*) can still breed with rainbow (*O. mykiss*), even though these are recognized as different taxonomic species that have been isolated from each other for a very long time. Thus independently evolving units can merge back together producing a new pattern of biodiversity and even occasionally producing new species.

All of the fish populations above White River Falls have been physically isolated from their conspecifics for a long geological time and therefore constitute an evolutionary species. The actual age of White River Falls has not been determined. However the amount of differentiation in the one species that has been studied, the White River redband trout, suggests that the time of isolation has been lengthy because significant differences have accumulated. The other species, although they have not been studied, have experienced the same duration of isolation and should be expected to be as distinctive from their conspecifics as is the trout.

Genetic Studies of the White River redband trout

The systematics of the White River redband trout, including allozyme and morphological variation, were studied by Currens et al. (1990). In this study, the populations of White River redband were compared to each other, and to other redband trout populations in the Deschutes River, in other Columbia River tributaries, and in Fort Rock Basin, one of Oregon's closed Great Basins. These comparisons demonstrate that significant morphological and allozyme differences distinguish the White River redband populations from all other conspecifics. The uniqueness of the group is such that it possibly qualifies for its own subspecies designation or at least for an alternative subspecies designation relative to the *O. mykiss* elsewhere in the Deschutes basin.

The most recent model of *O. mykiss* subspeciation was published by Behnke (1992) and includes three possible subspecies, commonly called coastal rainbow/steelhead (*O.m. irideus*), inland redband/steelhead (*O.m. gairdneri*) and Oregon Basin redband trout (*O.m. newberrii*). The coastal and inland groups are thought to have diverged during a period of physical isolation caused by the last Pleistocene ice advance, called the Fraser Glaciation, that began about 20 thousand years ago. During this period the *O. mykiss* lineage split and the line that lead to the inland subspecies refuged in North America, including in the Columbia Basin, while the line that lead to the coastal subspecies apparently refuged in Alaska or Asia. After the last glacial retreat the coastal subspecies expanded back to North America, interbreeding with or replacing the North American subspecies along the Oregon coast and up the Columbia River to the Cascade Mountains. Wishard et al. (1984) studied redband from the Owyhee River, a tributary of the Snake River, and disputed an early proposal (Behnke 1979) that the inland redband/steelhead should be recognized as a distinct taxonomic species separate from the coastal rainbow/steelhead. Recent studies of Great Basin and Klamath River redband trout populations demonstrate that a considerable amount of divergence exists between each of these groups when compared to each other, and between these groups and all Columbia basin populations (Currens et al., 1990 and unpublished data). These results prompted Behnke (1992) to propose the third subspecies to include all Great Basin populations. However, it appears that each of the Great Basin groups (Catlow Valley, Chewacan Basin, Warner Basin, Goose Lake Basin, and Fort Rock Basin) as well as the Klamath Basin group could be described as separate subspecies.

The White River redband trout clusters more similarly to the Great Basin groups using biochemical data, although all are very distinct from each other, than to any Columbia basin group. This is a somewhat surprising finding considering the geography of the groups. This clustering can be demonstrated quantitatively by statistical measurements of genetic distance (Currens et al. 1990). The group, of those included in the study, that was most similar to the White River group is the one in Fort Rock Basin. Studies of Salmonidae fish and *Limnaea* snail fossils found in Fort Rock Basin, and of the geology of the basin, indicate that Fort Rock Basin drained into the upper Deschutes River during the late Pliocene about two million years ago (Allison 1979; Allison and Bond 1983). An alternative, possibly younger, connection into the Crooked River has also been proposed (Orr et al. 1992). These connections between basins provide a mechanism for connections between ancestral fish populations in the basins. However, the White River and Fort Rock populations are still highly divergent from each other, even though together they are more divergent from the other *O. mykiss* populations that occupy the rest of the Deschutes Basin. Therefore the connections were probably in a geologically distant time before the current *O. mykiss* in the rest of the Deschutes invaded the system.

In comparison, a more recent isolation event has occurred between the Malheur River in the Snake River Basin and the Malheur Lake Basin. This more recent geological connection is reflected in the biochemical data. Redband in the Donner and Blitzen River in Malheur Lake basin, although distinctive, clearly cluster with inland Columbia redbands (Currens, unpublished data). Malheur Lake basin, now a closed basin isolated by a lava flow, drained into the Malheur River as recently as a few thousand years ago (Bisson and Bond 1971, Orr et al. 1992).

The data suggests that the trout in the White River and the trout in Fort Rock Basin had a common ancestor, from which each have now substantially diverged, that is older than the late Pleistocene ancestor that is generally recognized for coastal rainbow/steelhead and inland redband/steelhead in the Columbia basin. The relationship between this older "Deschutes" ancestor and an ancestor of current Columbia River fish or other Great Basin ancestors is unknown.

One theory is that there were multiple invasions of fish species from the ocean into the Columbia basin and other basins that coincided with glacial advances (periods of blockages and subspecies divergence) and glacial retreats (periods of range expansions and subspecies reemergence or displacement), and with several blockages on the mainstem Columbia River caused by lava dams and land slides (Waters 1973). In another theory, supported by some fossil and structural evidence, an ancestral Snake River flowed across the north end of the Great Basin in the early Pliocene (about 5 million years ago) prior to the formation of the current basin and range complex of closed basins (Wheeler and Cook 1954, Baldwin 1981, Orr et al. 1992). This theory suggests that the current distribution of living mollusks and fish species in the closed basins are remnants of the fauna from this system.

It is possible that a combination of these theories explain the relationship between the subspecies. The trout in Fort Rock and White River may be remnants of an older trout fauna that were isolated by geological events while populations below the barriers were replaced or interbred with new invaders. As a result of this ancient ancestry, isolation and subsequent divergence, and possible multiple invasions of *O. mykiss* ancestors, the White River redband remains a very unique trout when compared to other members of the *O. mykiss* complex.

Distinctiveness of the White River Fish Assemblage

The biological data on the White River redband trout suggests that the White River isolation event is geologically very old. Geologists generally consider waterfalls to be ephemeral features; however, the distinctiveness of the trout and its closer similarity to Great Basin trout than to any other Columbia Basin trout suggest that the White River Falls may be exceptionally old, perhaps hundreds of thousands to a million years old. This geological age would be substantial enough for a considerable amount of evolutionary change in all of the stream-bound aquatic organisms in the White River ecosystem, even if the changes relied on a slow accumulation of genetic mutations.

The mainstem White River has a known history of catastrophic events caused by glaciers and the eruptions of Mt. Hood. Catastrophic events can be associated with punctuated population changes and rapid, abrupt evolutionary changes because abrupt extinctions, bottlenecks, founder affects and population expansions can rapidly modify the pool of genetic variation present in an isolated system. In addition, the high, natural turbidity of White River may impose quite unique selection pressures on the species present. All of these events should be expected to increase the evolutionary divergence of all the fish species above the falls.

Two other fish species, the mountain whitefish and longnose dace, may be of particular taxonomic interest because their populations are very small and have a very limited distribution (ODFW et al. 1985, Chilcote et al. 1992). These demographic characteristics increase the likelihood that genetic changes will occur due to genetic drift and other random events. Of the four sculpin, *C. confusus*, appears to be common while the identification of two other species is uncertain. Each of the species in the White River fish assemblage warrants further study.

Genetic Variation and Local Adaptations within the White River Basin

The study of the White River redband trout (Currens et al. 1990) indicates that the trout within the White River basin are not all in the same gene pool. The populations in upper Tygh Creek appear to be particularly divergent from the rest of the basin. This finding makes sense because the upper Tygh Creek populations, and several others in the basin, are physically isolated from the mainstem populations by further waterfall barriers. The ages of these upper waterfalls are also uncertain. However, all of the trout in White River cluster much more similarly with each other than with any populations outside of the basin. Therefore, the upper waterfalls appear to be younger than the mainstem waterfall that isolates the entire basin. Alternatively, populations from above those upper falls have served as a source of colonizers for the mainstem after various catastrophic events, but the colonization occurred long enough ago that subsequent divergence has occurred.

The trout within the basin also appear to differ in life history behaviors. All fish species that occupy the mainstem White River must be adapted to the turbid conditions caused by the mud flows and glacier outwash. The trout population in the mainstem appears to have a fluvial life history and migrates between the mainstem, which appears to be preferred rearing habitat, and accessible tributaries, which are cleaner and may be better spawning habitat (ODFW et al. 1985). The populations above the Tygh Creek barriers have resident life histories as would be expected above a barrier (Northcote 1981) and have not evolved in the turbid mainstem. The dace and several sculpin populations are also isolated above falls and away from the turbid mainstem. Possible migratory behavior of other sculpins is unknown. The whitefish, in contrast, are found only in the lower mainstem where the water is still turbid, but less so than further up the mainstem.

Anticipated Biological Impact of Planting Anadromous Salmonids above White River Falls

The Northwest Power Planning Council Deschutes Subbasin Plan included proposals to breach White River Falls and plant hatchery steelhead and/or spring chinook in the basin with the intent of establishing natural spawning populations of the introduced species. This proposal included various options ranging from laddering the falls, which would provide full access by any species able to use the ladder; to installing a trap-and-haul facility below the falls which would permit more selective and controlled passage of fish above the falls. The trap-and-haul facility was the most favored option, therefore, this risk assessment only addresses that option and considers only the selective introduction of steelhead and chinook. This assessment assumes that the other species, both indigenous and exotic, that are below the falls would not be able to cross the breach. If a laddering option were considered, further impacts would need to be evaluated. The expected distribution of the introduced chinook and steelhead in White River is shown in Figure 2. This distribution assumes that additional natural and artificial barriers above the main falls area are also breached as indicated in the original proposal (ODFW et al. 1985). All seven indigenous fish species would become sympatric with the introduced species under this proposal.

It is not possible to prove that the introduction of an exotic species will impact a native ecosystem without actually making the introduction and documenting the impact. Often the impacts of an exotic species introduction are through subtle ecological disruptions that take many years to be recognized and are unmitigatible once they occur. Therefore, this assessment cannot "prove" that the introduction of exotic species into the White River ecosystem will cause an impact. Rather, the following assessment reviews other cases of introductions, considers the situation in White River, and identifies "probable risks" of an introduction.

Chinook and steelhead are naturally sympatric with all of the White River species (as currently classified) in other parts of their species distributions. Thus, the introduction of chinook and steelhead into White River was originally considered to be a benign action because it was assumed that since the species have evolved successful sympatry elsewhere they would be compatible in White River. However, the fish in White River are highly diverged, perhaps even unique subspecies, and they have not been sympatric with anadromous salmonids since their isolation. Therefore, the assumption of compatibility based on other locations is not valid.

Some *Oncorhynchus sps.* salmonid fossils found in the Fort Rock basin were identified as possible ancestral chinook, but were only found in Pliocene formations. The salmonids in more recent formations appear to be *O. mykiss* fossils (Allison and Bond 1983). If the White River isolation event is approximately as old as the Fort Rock isolation event, the aquatic species in White River have not evolved with chinook or steelhead for a very long geological time, if they were ever sympatric. The fate of the ancestral Deschutes trout is unknown but it is possible that it was replaced by a later invasion of Columbia River *O. mykiss* and other species, except where it was refuged above barriers. The refuged remnants may also be vulnerable to replacement by the same species should the barriers be breached.

Probable impacts on the White River fish assemblage caused by the introduction of steelhead include direct competitive affects on the White River redband trout, genetic introgression through interbreeding with the White River redband trout, direct competitive and/or predatory affects on the other six fish species, and indirect impacts caused by ecological disruptions elsewhere in the aquatic ecosystem. Probable impacts caused by the introduction of chinook include direct competitive and/or predatory affects on all seven fish species and indirect impacts caused by ecological disruptions. It is also possible for either species to introduce disease vectors into the ecosystem.

The proposal to introduce anadromous salmonids into White River assessed probable impacts on the White River redband trout but did not consider impacts on other species (ODFW et al. 1985). Four of the nine methods used in the proposal to estimate potential steelhead production in the White River assumed that the White River redband trout populations (excluding several populations above some of the larger upper falls which would not be breached) would be replaced by steelhead production. If this assumption does not hold the anticipated steelhead production on which the economic analysis for the proposal was based will be considerably less than reported.

Studies indicate that the assumption that steelhead would replace the resident trout is valid. Bjornn (1978) documented that steelhead introduced into a resident trout population in the Lemni basin in Idaho caused an 80% to 90% decline in the trout population over thirteen years. The trout production was replaced by steelhead production. The impact in Bjornn's study was entirely due to competition since all steelhead in the study stream were hatchery fry and there was no natural steelhead production. In this study, the resident trout lineage in the Lemhi system had evolved naturally with steelhead since the population was either a residualized steelhead/trout population (with residualization caused by the construction of a dam lower in the system) or naturalized hatchery rainbow trout, or a combination of these. The impact in White River may be different, and probably more severe, since the trout and other species present did not evolve in the presence of steelhead or any other large anadromous salmonid.

Genetic introgression, caused by interbreeding between the steelhead and trout, would also contribute to the decline of White River redband trout. Natural production by steelhead was the intended objective of releases above the falls. Allozyme data (Currens et al. 1990) indicates that the White River redband trout populations in the lower mainstem have interbred to some extent with the domestic coastal rainbow trout introduced into the system. It is unknown whether this interbreeding with hatchery trout caused a decrease in fitness. Since the White River redband trout can and will breed with coastal rainbow hatchery trout, and since there is evidence that naturally sympatric inland redband and steelhead are behavioral polymorphisms within single gene pools, it can be assumed that the White River redband trout will be able to breed with the introduced inland steelhead. Both the hatchery trout and steelhead have phenotypes, including anadromous behavior in the steelhead, and different spawning behaviors, fecundities, morphologies, and various domestic traits that are not desired in the White River redband. Because of the apparent antiquity of the isolation of the White River redband trout and the resultant distinctiveness of the group, possibly to the extent of being unique subspecies, no level of interbreeding between the indigenous trout and either introduced inland steelhead or coastal rainbow is biologically acceptable.

Bjornn's (1978) study also addressed interactions between species in sympatric spring chinook and steelhead populations. His results indicated that, although there were differences in habitat use by spring chinook and steelhead, steelhead production was less when they were sympatric with spring chinook. The rate of growth of steelhead and the size of yearling steelhead was less when chinook were present. Bjornn did not address a possible impact of chinook on trout, however it appears from his results that the competitive hierarchy in a system with resident trout and introduced steelhead and introduced chinook place chinook as most competitive, steelhead next, and resident trout as least competitive.

Further indication that salmon would have a competitive, and possibly predatory impact on trout is provided in a review by Wright (unpublished manuscript). Wright assessed possible impacts of introduced chinook and coho on indigenous cutthroat and rainbow trout above Snoqualmie Falls on the Snoqualmie River in Washington. He compared habitat preferences in trout populations with and without naturally sympatric salmon and concluded that zero-aged trout that evolved allopatric to salmon would probably be displaced from preferred rearing habitats and may be preyed upon by the earlier emerging, larger and more aggressive salmon.

Other literature (for example, Hearn 1987; Faush 1988; Pimm 1987; Taylor et al. 1984) have also reviewed impacts to wild fish caused by the introduction of exotic species. Few studies, however, have systematically documented trout declines caused by exotics because the exotics were introduced without any baseline study of the indigenous trout population. In many cases, it appears that the indigenous trout was replaced entirely by the introduced species since possible indigenous species are no longer present at all. Within the White River it appears that the introduced brook trout have already displaced the White River redband trout from Clear Creek since brook trout are the only trout species present and there appears to be no physical reason why White River redband trout should not be in that tributary.

Studies of the impacts of introduced chinook and steelhead on resident whitefish and nongame fish are not present in the literature because inventories of these species has not been a priority of fisheries managers. However, over the years of exotic fish introductions many populations, and perhaps even some species, may have been lost. One possible extinction of an apparently rare and unique sculpin species that was living above a falls following the introduction of chinook has been observed (Carl Bond, personal communication). All of the indigenous fish species are apparently insectivores (ODFW et al. 1985) and occupy the areas that will be affected by the introductions. It can be anticipated that these species, particularly the whitefish and dace since they are already rare, may be very vulnerable to competition and predation by salmonids that are larger and more aggressive than the White River redband trout with which they evolved.

Another possible impact that may affect any of the indigenous fish in White River is the introduction of disease vectors. Species that have not evolved along with a disease vector to which they are susceptible tend to have a low tolerance of it since there has been no selection for resistivity. The introduction of exotic diseases could cause sudden population crashes. Several fish diseases that are common in the Deschutes are absent in White River, including infectious hematopoietic necrosis (IHN) virus, infectious pancreatic necrosis (IPN) virus, and the parasite *Ceratomyxa shasta*. White River redband trout have been shown to have very low resistivity to *C. shasta* in the Deschutes. It is not known whether the necessary intermediate host for *C. shasta* is present in White River (ODFW et al. 1985).

An Evaluation of the 1985 Proposal to Isolate Redband Populations with Barriers

The 1985 proposal to introduce chinook and steelhead above White River Falls recognized that the indigenous redband trout was very unique and would probably be impacted by the introductions (ODFW et al. 1985). The proposal suggested that the impact could be mitigated by not breaching several of the falls in the upper White River, and by building artificial barriers across several other tributaries to isolate some trout. This proposal would also isolate some sculpin, although it is not clear that all four species would be included. The dace and whitefish, which occupy a lower tributary and the lower mainstem, would not be "protected."

This proposal would indeed protect the redband trout and sculpin populations in upper Tygh Creek that are already isolated by natural falls. However, as demonstrated for the redbands by Currens et al. (1990), these naturally isolated populations are not part of the gene pool of the populations in the mainstem and cannot be considered to be "representative" of them.

The construction of artificial barriers to isolate other populations would itself cause an impact first by fragmenting the mainstem population and second by interfering with the natural fluvial life history behaviors of the trout.

The first impact, population fragmentation, impacts the level of genetic variation available to the populations by eliminating natural gene flow between them. Natural gene flow is an important source of new genetic variation for populations. A decrease of genetic variation causes a decrease in long term adaptability. This impact may not be evident for a long time but would eventually be observed as a slow decline and possible extinction of some population fragments and as the increased vulnerability of populations to catastrophic events such as fires, droughts, and volcanic eruptions and mud flows.

The construction of artificial barriers would also interfere with the mainstem population's fluvial life history pattern of migrating between the mainstem and tributaries of the White River. ODFW et al. (1985) demonstrated in their inventories that rearing in the mainstem White River was apparently important to the trout because rearing populations were larger and growth rates were higher in the mainstem than in the tributaries. The trout apparently migrate between spawning areas in the tributaries and rearing areas in the mainstem. Sculpin may also be migratory.

Access to tributaries, or recolonization potential from tributaries, has probably been an important element in the persistence of fish in the White River given the history of catastrophic mud flows down the mainstem. This pattern may be similar to that seen in the Great Basin systems where historically fish migrated between lakes or marshes and tributaries, apparently refuging in tributaries during catastrophic droughts that dry up the lakes and marshes. The loss of this ability to migrate and refuge due to channelization and the presence of artificial barriers in those systems are one of the factors that are making the Great Basin populations so vulnerable to drought events. The construction of artificial barriers in White River Basin could lead to the loss of fish in the mainstem due to natural, predictable, catastrophic events and the inability of fish to recolonize into the mainstem from the blocked tributaries.

Application of Oregon's Wild Fish Management and Wild Fish Gene Resource Conservation Policies to the Introduction Proposal

A status assessment of the White River redband trout, the mountain whitefish and other species was included in the 1992, 1994 and 1995 Wild Fish Management Biennial Progress Reports (Chilcote et al. 1992, Kostow et al. 1994, Kostow 1995). The historical hatchery program of stream releases of coastal rainbow into White River was determined to have an unacceptable impact on the wild redband trout and has been discontinued. The population of whitefish is considered to be very small and vulnerable with a distribution restricted to a short reach of the mainstem above the falls. If any of the species are found to be unique enough to formally constitute subspecies status, they are endemics with a limited world distribution. The White River redband has been designated as a gene conservation group and is currently included in the state sensitive species listing of inland rainbow/redband trout east of the Cascades. Information about the nongame species is very limited.

The Wild Fish Management Policy (as amended in 1992) and the Wild Fish Gene Resource Conservation Policy (adopted in 1992) address a number of elements that apply to the proposed introduction of steelhead and chinook above White River Falls.

WILD FISH MANAGEMENT POLICY SECTION 635-07-527

Paragraph (1)(l): The Wild Fish Management Policy applies to all of the indigenous fish species above White River Falls.

Paragraph (2)(c) and associated guidelines: Because of the uniqueness of the White River redband trout, no level of interbreeding between the indigenous trout and introduced coastal rainbow or inland steelhead would be biologically acceptable. According to the current

Department guidelines, "no level" is measurably between 0 and 5 percent of the natural spawning population. In this case, the lowest possible level (as near 0% as possible) would be recommended.

Paragraph (6)(b): The Department is directed to oppose the construction of artificial blockages that fragment a population, and to improve genetic exchange across existing artificial blockages if possible.

Paragraph (7): The Department is directed to oppose actions that cause a wild population to decline due to competition, predation, or the introduction of disease vectors caused by the release or transplant of fish.

Paragraph (12): The Department is directed to place a high priority on the protection of fish species or subspecies that have a limited world-wide distribution. This paragraph would apply if the White River redband trout or any other species becomes formally classified as subspecies.

WILD FISH GENE RESOURCE CONSERVATION POLICY SECTION 635-07-537

Paragraph (1): The Department is directed to designate as gene conservation groups populations, or groups of populations, that have had low or zero gene flow with conspecifics over geological time. Based on the existing data the White River fish assemblage each comprise at least one gene conservation group for their species since they have clearly been isolated from conspecifics for a long geological time. There are several upper water falls that further isolate populations of redband trout and sculpins. For the redband trout, at least, the isolation between some of the populations within the basin has been for a substantial enough geological time that the isolated groups are measurably genetically distinct and may be their own gene conservation group. The 1994 and 1995 reports (Kostow et al. 1994, Kostow 1995)) describes the White River redband trout as one gene conservation group. Gene conservation groups have not been described for the other species pending further systematics data on these. Possible further sub-division of the redband trout that takes into consideration the other barriers in the basin may be applied in the future.

Paragraph (2): The Department is directed to consider the loss of any gene conservation group to constitute a serious depletion of that species.

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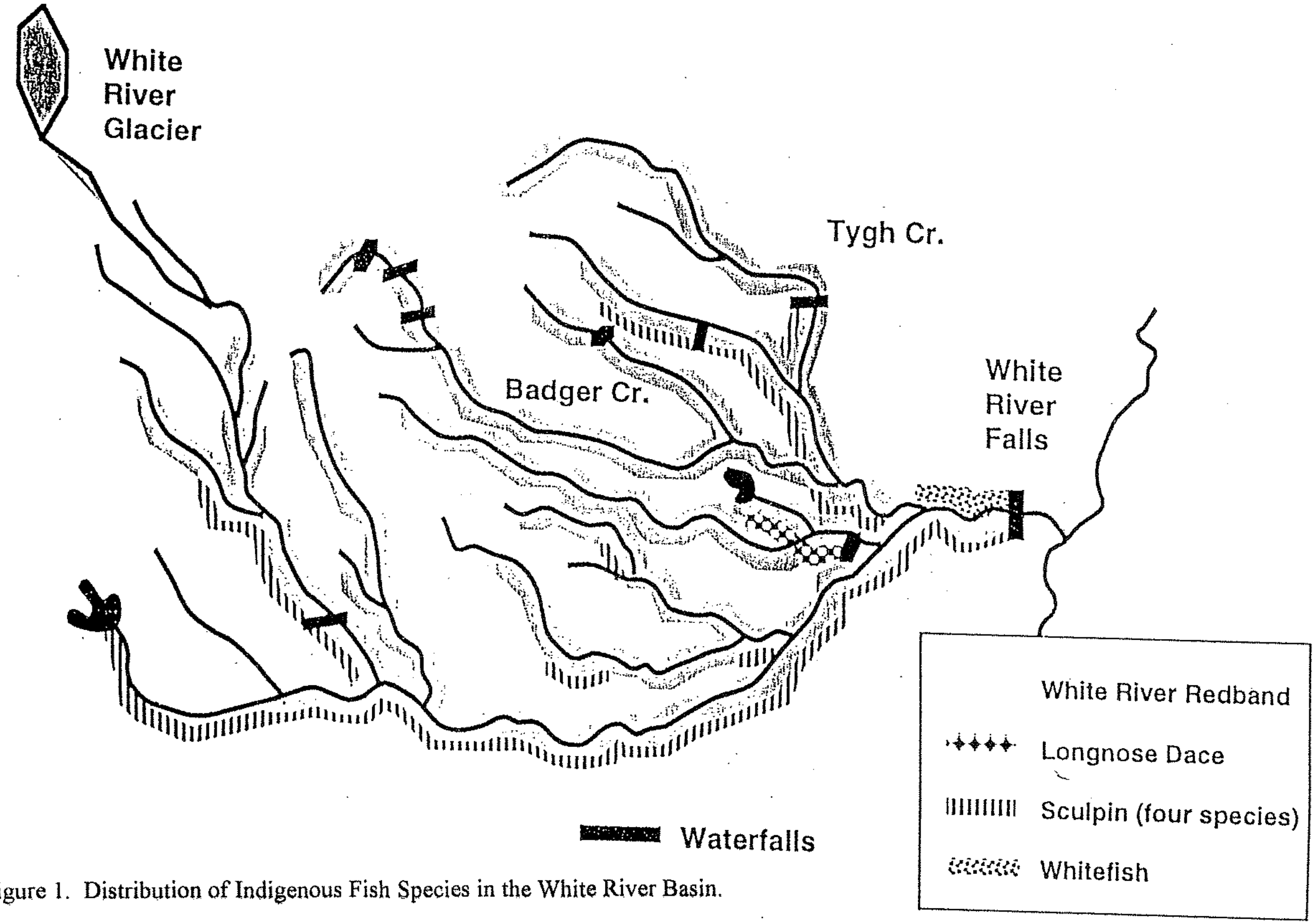

Figure 1. Distribution of Indigenous Fish Species in the White River Basin.

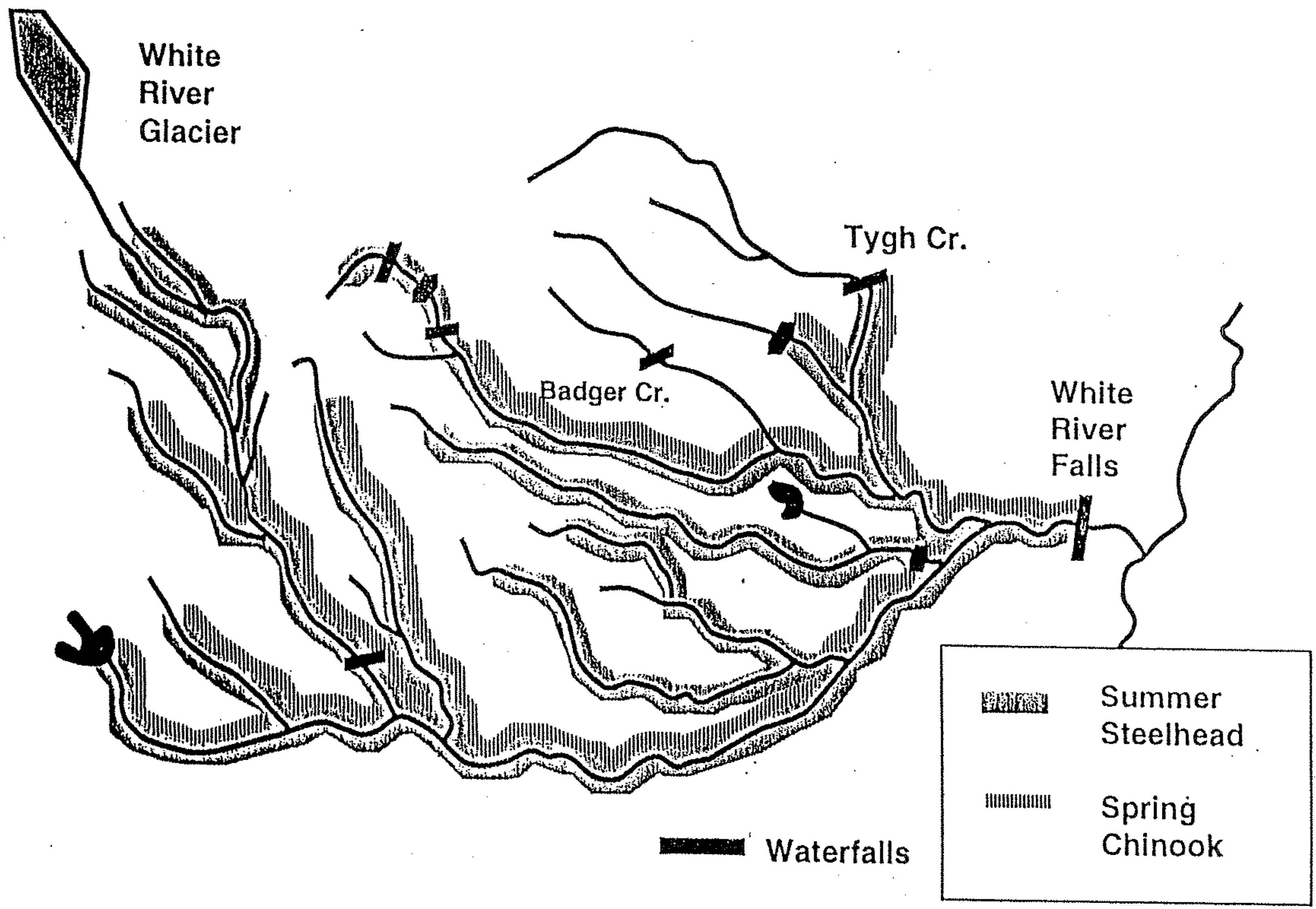

Figure 2. Expected Distribution of Introduced Species in the White River Basin.

APPENDIX B

INTRODUCTION OF SPRING CHINOOK ABOVE WHITE RIVER FALLS

REVISION OF 1985 COST/BENEFIT ANALYSIS

Introduction of Spring Chinook Above White River Falls

Revision of 1985 Benefit/Cost Analysis

Background

Over the past 30 years, introduction of anadromous fish into the White River has been proposed as a production strategy in several reports and planning documents. The most notable of these was the comprehensive analysis prepared in 1985 for the BPA by ODFW, USFS, and two private consulting firms (ODFW et al., 1985). Consistent with earlier assessments, this report concludes the anadromous fish introduction option is cost effective, has significant production benefits, and is consistent with protecting the unique resident trout which exist above White River Falls.

Within the context of the ongoing development of the lower Deschutes River subbasin fish management plan, the issue of providing passage at White River Falls for spring chinook was once again been raised. Recent developments with respect to endangered species, Wild Fish and Gene Conservation policies, and changing public attitudes suggests the need to reevaluate this proposed strategy. These issues are addressed in a separate report.

The benefit/cost analysis done in the 1985 report assumes that both summer steelhead and spring chinook would be introduced above White River Falls. Because the focus now is only on spring chinook the analysis needs to revisited.

Benefits

The forecasted economic benefits for spring chinook presented in Appendix D of White River Falls Report is $1,855,347. It should be noted that this estimate is based on the assumption that the predicted run size will be 1,926 fish. However, the expected run size predictions actually presented in the final report (pg. 35) range from 1,400 to 2,100 adults. A more representative picture of potential benefits is that for a run size of 1,400 fish the predicted benefit is $1,348,643 and for a run of 2,100 fish $2,022,964. (These estimates were calculated assuming the ratio of benefit to run size is the same for 1,400 and 2,100 run sizes as it was for the run size of 1,926 presented in the report).

Benefit/Cost

The cost estimate for the preferred alternative from Table 23 of the White River Falls report was $4,296,000. Therefore, the revised benefit/cost for spring chinook introduction above White River Falls is 0.43. This is in contrast to the 1.42 benefit/cost ratio estimated in the 1985 report which was based upon the introduction of both spring chinook and steelhead above White River Falls.

It should be noted this benefit/cost analysis ignores the negative ecological impact of introducing spring chinook on the indigenous resident fish species. In particular, production of resident trout and whitefish will likely decline. Since these species both contribute to sport fisheries, their decline represents a negative economic impact and should be included in the overall analysis. This was not done.

In summary, the potential economic benefits from spring chinook production above White River falls is less than the cost of providing passage at this barrier by a ratio of 0.43 to 1.00.

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LOWER DESCHUTES RIVER SUBBASIN MANAGEMENT PLAN
SECTION 5. SPRING CHINOOK SALMON

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SPRING CHINOOK SALMON

NATURALLY PRODUCED SPRING CHINOOK

Origin

Spring chinook salmon, *Oncorhynchus tshawytscha*, historically spawned in the mainstem Deschutes River upstream from the location of the Pelton/Round Butte hydroelectric complex, in Squaw Creek, the Metolius River, the Warm Springs River system and Shitike Creek (Figure 5.1). Historic use of Crooked River by spring chinook salmon is documented but conflicting reports exist on when this population was lost (Nehlsen 1995).

Construction of Pelton and Round Butte dams, completed in 1958 and 1964, respectively, included upstream passage facilities for adult chinook salmon and steelhead and downstream facilities for migrating juveniles. By the late 1960's it became apparent that the upriver runs could not be sustained naturally with these facilities due primarily to inadequate downstream passage of juveniles through the project. As a result, in 1968 Portland General Electric (PGE) agreed to build and finance the operation of an anadromous fish hatchery at the base of Round Butte Dam to mitigate for losses above the dams.

Oregon's Provisional Wild Fish Population List currently recognizes natural production of spring chinook from two separate populations; one in the Warm Springs River and one in Shitike Creek, both located on the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) reservation. It is uncertain at this time, however, if the two groups have enough genetic differences to qualify as separate populations. Spawning occurs in the Warm Springs River and tributaries Mill Creek and Beaver Creek, and in Shitike Creek.

Life History and Population Characteristics

Wild spring chinook adults enter the Deschutes River in April and May (Table 5.1). The run arrives at Sherars Falls in mid-April and peaks in early to mid-May with most spring chinook salmon passing the falls by mid-June.

Wild spring chinook age at return to the Warm Springs National Fish Hatchery (WSNFH) trap, located at river mile 9, averages 4% age-3 (jacks), 78% age-4 and 18% age-5 (Table 5.2). Very few age-6 spring chinook are seen in the population. The age distribution has been very consistent, ranging from 63% to 83% age-4 fish (Table 5.2). Females comprise about 62% of the age-4 and age-5 fish returning to the Warm Springs River. The average fecundity of spring chinook salmon returning to Warm Springs National Fish Hatchery (wild and hatchery populations) was 3,300 eggs per female for 1978 through 1985.

Wild spring chinook salmon spawning in the Warm Springs River occurs primarily above WSNFH. Wild spring chinook salmon begin arriving at WSNFH in late April or early May, once water temperatures exceed 50°F, and continue until late September. All fish passing WSNFH must enter a trap at the hatchery and be passed above that facility to gain access to the spawning areas. Since 1986, only wild spring chinook have been allowed upstream into the spawning areas (WSNFH Operational Plan 1992-1996). The wild population currently meets the most strict guidelines of OAR 635-07-527, Oregon's Wild Fish Management Policy.

The run peaks at the hatchery by the first of June, with a second smaller peak in late August or early September. In most years, approximately 70% of the run arrives at Warm Springs Hatchery by June 1 and 90% by July 1 (Lindsay et al. 1989). Most of the fish that pass WSNFH are believed to hold in the Warm Springs River canyon within about seven miles of the hatchery until August when they continue upstream to the spawning areas.

Time of entry into Shitike Creek and locations of holding areas are unknown although both are believed to be similar to those in the Warm Springs River.

Spawning in the Warm Springs River system begins the last week in August and peaks by the second week in September. Spawning is completed by the last week in September (Table 5.1; Lindsay et al. 1989). The majority of wild spring chinook spawning takes place upstream from WSNFH; only 3% of all spring chinook redds counted in the Warm Springs River from 1982 through 1995 were downstream from WSNFH (CTWS unpublished data). This may be in response to summer water temperatures in that reach that approach the upper limit for chinook spawning (Fritsch and Hillman 1995). Few hatchery origin spring chinook spawn in the wild downstream from WSNFH. One of 14 spring chinook carcasses examined during spawning surveys downstream of WSNFH from 1986 to 1995 was a hatchery origin spring chinook as determined by fin mark. Managers have no evidence that wild spring chinook spawn in either the mainstem lower Deschutes River or tributaries other than the Warm Springs River or Shitike Creek.

Spawning in Shitike Creek is believed to occur at about the same time as in the Warm Spring River.

The run size of wild spring chinook salmon in the Deschutes River has been estimated annually since 1977 by summing harvest and escapement. Estimated total harvest has been obtained each year since 1977 (except 1985 and 1986) by conducting statistical harvest surveys of the tribal subsistence and sport fisheries at Sherars Falls. With the exception of a small number of wild spring chinook that spawn downstream from WSNFH or in Shitike Creek, all others are captured and counted at WSNFH. The average run size of wild spring chinook into the Deschutes River from 1977 through 1995 was 1,913, with a range of 241 to 3,895 (Table 5.3).

Minor numbers of unmarked (presumably wild) spring chinook are captured annually at the Pelton trap, the trap for Round Butte Hatchery (RBH). These fish are not entered into run to the river accounting since to do so would introduce a source of error into the stock recruitment relationship developed for the Warm Springs River returns.

Redd counts in Shitike Creek indicate an estimated average spawning escapement of 49 adult spring chinook annually from 1982 to 1995. Of 17 spring chinook carcasses sampled during redd counts in Shitike Creek from 1986 through 1995, no hatchery origin spring chinook were found, indicating that this escapement is composed of wild spring chinook (CTWS unpublished data).

The Shitike Creek spring chinook population is recognized as a separate population on Oregon's Provisional Wild Fish Population List and qualifies as a small population under Oregon's Wild Fish Policy. Managers are unsure if spring chinook spawning in Shitike Creek are a separate population or if they are the same population that spawns in the Warm Springs River. Actions contained in this plan propose to collect data to help answer this question.

No escapement goal for spring chinook into Shitike Creek has been established and insufficient information on production potential and adult escapement is available to do so. The CTWS have, however, started to collect downstream migrant juvenile data in Shitike Creek that may help identify spawning escapement needs and production potential there. Additionally, the CTWS are considering using an upstream migrant adult trap in Shitike Creek to better quantify the number of spring chinook entering the system.

Managers believe that, absent a specific escapement goal for spring chinook in Shitike Creek, an adequate number of spawning adults will reach Shitike Creek and the population's genetic resources will be protected if wild spring chinook into the lower Deschutes River are managed to meet the optimum spawning escapement goal into the Warm Springs River of 1,300 adults over the WSNFH barrier dam. This belief requires the assumption that Shitike Creek spring chinook are subject to similar harvest and mortality rates prior to spawning as Warm Springs River origin wild spring.

If the Shitike Creek spring chinook group is identified as a separate population from the Warm Spring River population, managers believe that an optimum escapement goal exists for that population. Data will be collected to identify that goal and it will be incorporated into this plan.

Emergence of spring chinook salmon in the Warm Springs River probably begins in February or March (Table 5.1). Information on completion of emergence in the Warm Springs River is not available, but may be similar to the John Day River where emergence is completed by May (Lindsay et al. 1986).

Juvenile spring chinook migrate from the Warm Springs River in two peaks, a fall migration from September through December, and a spring migration from February through May (Lindsay et al., 1989). The fish migrating in the fall are age 0, range in size from 3.1 inches to 4.3 inches fork length, and do not have the appearance of smolts. Most spring migrants are age 1 fish, range in size from 3.5 inches to 5.1 inches fork length, and have the bright silver coloration characteristic of smolts. The total number of fall and spring migrants from the Warm Springs River ranged from 28,038 fish to 131,943 fish for the 1975 through 1993 broods, the last brood to complete migration (Table 5.4; CTWS unpublished data).

Wild spring chinook salmon that migrate from the Warm Springs River in the fall at age 0 appear to rear over winter in the Deschutes or Columbia rivers before entering the ocean the following spring at age 1. During research activities in the late 1970's, spring chinook salmon that were marked in the fall as age 0 migrants from the Warm Springs River were recaptured in the Deschutes River the following spring. Wild spring chinook salmon smolts generally migrate through the Columbia River in April and May at age 1 based on recoveries of marked smolts (Table 5.1; Lindsay et al. 1989).

Survival of juvenile spring chinook salmon in the Warm Springs River appears to be density dependent. Survival of 1975 through 1990 broods, the last to be completed, from egg deposition to migration was highest at low egg densities, which has compensated for low spawner abundance (Table 5.5).

Current smolt production capacities of the Warm Springs River system is estimated to be 132,000 smolts (ODFW 1987).

A stock-recruitment model for wild spring chinook returning to Warm Springs River was developed by Lindsay et al. (1989) using the data available at that time. Additional data has been added as it has become available and the model now includes 15 brood years (Olson 1996). This model suggests an optimum spawning escapement goal of 1,300 and a minimum of 1,000 adults escaping upstream from the barrier dam at WSNFH. Wild spring chinook escapements of this magnitude are believed to allow for prespawning mortality, sufficient natural selection to provide genetic variability, and maintenance of evolutionary potential.

This model shows that the stock has returned recruits at levels above that required to maintain the stock except in 1989 and 1990 brood years, indicating a fairly healthy and productive stock, although it is likely that returns from the 1991 brood year will also be lower than required for replacement. Additional brood year return data will be added as it becomes available to refine this model.

A number of other predictive models using cohort analysis and correlation with upriver spring chinook run strength have been developed (Olson 1996, CTWS unpublished data). Managers have used the lower range of predicted return from these models to develop conservative harvest management strategies to provide sufficient wild spring chinook escapement.

Natural Production Constraints

Major habitat constraints to production of spring chinook salmon in the lower Deschutes subbasin are shown in Table 5.6. Habitat problems in the Warm Springs River and Shitike Creek system are related to degraded stream banks and riparian areas, and water quality and quantity problems, especially on years of below normal precipitation and low stream flow. High water temperature, low flow, sedimentation, and gravel quality are problems in the lower Warm Springs River and tributaries.

Estimated pre-spawning mortality of wild spring chinook passed above WSNFH has ranged from 34% to 75% and has averaged 47% from 1977 to 1995. Adult spring chinook holding over summer in the Warm Springs River upstream from WSNFH suffer pre-spawning mortality as a result of several disease factors. Actions contained in this plan would seek to identify causes of pre-spawning mortality.

Since 1982, most wild spring chinook captured at WSNFH and passed upstream to spawn have been inoculated with erythromycin to prevent the vertical and horizontal transmission of *Renibacterium salmoninarum*, the bacteria that causes bacterial kidney disease (BKD), in an attempt to decrease pre-spawning mortality. In recent years WSNFH managers have inoculated wild adults passed upstream until water temperatures exceed 60°F. After that time adults are not inoculated due to increased stress associated with increased handling needed to inoculate. This protocol results in inoculation of about 70% of the wild run passed upstream.

Lindsay et al. (1989) recommended eliminating routine inoculation of wild fish with erythromycin unless the ratio of wild fish to redds above WSNFH exceeds 4.0 to minimize the risk of developing resistant strains of bacteria and to prevent alteration of any genetic component of the wild stock. This plan does not forward this recommendation since no drug resistant strain of *Renibacterium salmoninarum* have been found after extensive testing both in the wild and in the laboratory (personnel communication, Craig Banner, ODFW Pathology Section, Corvallis, Oregon, March 26, 1996). Additionally, wild adult spring chinook returning to the Warm Springs River have been subjected to selective pressure and mortality from *Renibacterium salmoninarum* throughout their life and if an individual was genetically predisposed to mortality from BKD it would likely have succumbed prior to returning as an adult.

New upstream passage facilities using coded wire tag detection and automatic fish routing scheduled to be operational in 1996 at WSNFH will result in less wild fish handling and subsequently less inoculation. Approximately 10% of the wild run will be handled for biosampling and tag detector verification with the rest of the run passed upstream without handling. Only that 10% will be inoculated to protect them from potential disease mortality following handling.

This plan does propose the inoculation of all returning wild spring chinook adults at WSNFH if run size in any year is predicted to be less than 500 to the mouth of the Deschutes River or if the ratio of fish per redd remains greater than 4.0 for more than two consecutive years. Additionally, juvenile wild and hatchery origin spring chinook captured at the CTWS juvenile trap near the mouth of the Warm Springs River have been sampled to screen for levels of BKD. This juvenile screening will continue through time and it may be possible to develop adult inoculation triggers using this method. This action recognizes concerns relative to the potential for development of drug resistant bacteria potentially resulting from routine inoculation of a large percentage of the wild spring chinook run but should increase the percentage of adults that survive to spawn in low return years.

The Pelton/Round Butte hydroelectric complex at river mile 100 is currently a complete upstream passage barrier to anadromous and resident fish. A fish ladder, the Pelton ladder, was built to facilitate anadromous fish passage at the complex but was abandoned after facilities at Round Butte Dam failed to effectively pass juvenile salmonids downstream. The Pelton ladder extends from below Pelton Reregulating Dam to Pelton Dam, which impounds Lake Simtustus. The ladder is 10 feet wide, 6 feet deep, and 2.8 miles long and was originally designed and constructed to allow passage of adult chinook salmon and summer steelhead around the Reregulating Dam to Lake Simtustus. From Lake Simtustus, fish were passed over Round Butte Dam by means of a trap and tramway. While some limited downstream migration is possible as evidenced by successful passage of kokanee, hatchery rainbow and brown trout from the reservoir complex into the Deschutes River below the Pelton Reregulating Dam, the lack of effective downstream passage of juvenile salmonids is the reason efforts to perpetuate naturally spawning runs above the hydroelectric complex were abandoned and hatchery compensation initiated by PGE in 1968 (Nehlsen 1995).

The number of adult spring chinook that spawned above the hydroelectric complex is unknown. The Metolius River was the major spring chinook spawning and rearing area of the upper Deschutes subbasin (Davidson 1953; as cited in Nehlsen 1995). Up to 580 adult spring chinook were captured at a hatchery rack in the Metolius River during the years 1948 to 1958 but this number of fish was thought to be considerably less than what was historically present (Nehlsen 1995). Regardless of the true production potential upstream of the hydroelectric complex, loss of these areas currently constrains natural production in the subbasin. This constraint would be reduced if passage for spring chinook was reestablished over the hydroelectric complex.

Several out of subbasin factors constrain natural production of spring chinook in the subbasin. Beaty (1992; as cited in Beaty 1995) estimated total (dam and reservoir) juvenile passage mortality of 35% to 51% per dam and reservoir project in the lower Columbia River. Juvenile salmonid mortality due to predation alone has been estimated at 7% to 61% in just one reservoir (John Day Reservoir) (Rieman et al. 1991). Additionally, inter-dam mortality of adult salmonids is estimated at 8% in the mainstem Columbia River between Bonneville Dam and McNary Dam (Personal communication, 16 April, 1996, with Don Swartz, Oregon Department of Fish and Wildlife, Clackamas, Oregon). Natural variations in estuary and ocean productivity (i.e. El Niño events) may be a very serious constraint to production of all anadromous fish.

Spring chinook originating in the Deschutes subbasin have historically been harvested in both ocean and Columbia River fisheries. Coded wire tag recoveries from 1977-79 brood year wild spring chinook, the only lower Deschutes River subbasin wild spring chinook to be coded wire tagged, showed that 33% of total harvest for those brood years was in the ocean, 24% in the Columbia River, and 43% in the lower Deschutes River. RBH and WSNFH origin fish were harvested at lower rates out of the subbasin with 17% and 13% out of subbasin harvest, respectively, during generally comparable brood years (Lindsay et al. 1989). This difference could be due to a larger percentage of 5-year old adults in the wild population. These larger adults would be legal to retain in most ocean fisheries at that time.

HATCHERY PRODUCED SPRING CHINOOK

The first hatchery supplementation program in the Deschutes subbasin was incubation of eggs of unknown Columbia basin stock from Carson National Fish Hatchery in hatchboxes in the Warm Springs River in 1958. The first recorded release of juvenile hatchery fish into the subbasin was the 1961 release of an unknown stock of fish obtained from Carson National Fish Hatchery. Juvenile hatchery fish were released in the subbasin in 1961 and 1962 and have been released annually from 1964 to present.

Hatchery origin jacks were outplanted into the subbasin in 1970 and adults were outplanted into the subbasin in 1968 and 1970.

Non-indigenous stocks introduced into the subbasin include the Santiam stock and unknown Columbia basin stocks of fish obtained from Carson and Eagle Creek national fish hatcheries and McKenzie, Oak Springs, Wizard Falls, and Fall River hatcheries (Olsen et al. 1994). The contribution of these releases to the current genetic makeup of wild spring chinook in the subbasin is unknown.

Spring chinook salmon have been released into the lower Deschutes River subbasin from RBH since 1973 and from WSNFH since 1980.

Available information indicates that no or very few hatchery origin spring chinook adults spawn in the mainstem Deschutes River, Shitike Creek, or the Warm Springs River below WSNFH. Rather, they return to their respective hatchery and do not spawn in the wild. Lindsay et al. (1989) make reference to RBH adults being observed in Shitike Creek but the absence of spawned out hatchery fish during carcass surveys suggests that these fish left the system rather than spawning there. One of 14 spring chinook carcasses examined during spawning surveys in the Warm Springs River downstream of WSNFH from 1986 to 1995 was a hatchery origin spring chinook as determined by fin mark. Hatchery origin spring chinook have not been allowed access into the Warm Springs River spawning grounds above WSNFH with the exception of 1982 to 1986 but are retained at the hatchery for broodstock. Since 1986, only wild fish have been allowed upstream to spawn.

Round Butte Hatchery

Description of Hatchery

PGE, the current operator of the Pelton/Round Butte hydroelectric complex, constructed and funds operation of RBH to mitigate for lost production of wild spring chinook salmon and summer steelhead above the Pelton/Round Butte hydroelectric project. RBH is operated by the Oregon Department of Fish and Wildlife. Operation of the hatchery began in 1972 after it was agreed that natural production above the hydroelectric facility was not adequate to sustain the runs.

The spring chinook salmon production program at RBH currently consists of two different rearing techniques. Both techniques result in the release of full term smolts that migrate through the lower Deschutes River rapidly. This is believed to minimize interaction with wild fish. One technique involves rearing approximately 25,000 to 30,000 juvenile chinook salmon at the hatchery until the spring of their second year (age 1+), and then trucking them 10 miles downstream for release immediately below Pelton Reregulating Dam. The second scenario involves rearing approximately 200,000 juvenile chinook salmon at the hatchery until fall of the year following egg-take (Age 0+) and trucking them to Pelton ladder in November where they rear over winter until they are allowed to migrate volitionally the following April at age 1+.

Ladder rearing takes place in two modified portions of the lower ladder. Modifications to the ladder were completed in 1995 to double the previous capacity of the ladder rearing program from three rearing cells to six. This expansion allows an additional 187,000 spring chinook smolts to be reared in the ladder environment. These modifications were completed under a Northwest Power Planning Council amendment to the Columbia River Basin Fish and Wildlife Program with a goal of increasing fish production in Pelton ladder as a low-capital means of contributing to additional adult returns in the Columbia River basin and Deschutes River subbasin. Bonneville Power Administration (BPA) funded the project. Production from one new cell and the three old cells will be released into the Deschutes River after 1995, an increase of about 62,000 smolts above previous production. This number will allow direct comparison, over time, of smolt to adult survival rate for fish reared in the existing and expanded ladder sections without unwanted genetic and environmental consequence (Smith 1991). Releasing the additional production into the Deschutes River from the new ladder cell was granted a categorical exclusion under the National Environmental Policy Act (NEPA). Production from the other two new cells will be released into the Hood River as a component of the ongoing Northwest Power Planning Council's Hood River Production Plan, pending a favorable decision under NEPA. Juvenile spring chinook from the 1994 brood were placed in one new ladder rearing cell in 1995 for release into the Deschutes subbasin in 1996.

Juveniles are separated in these serial rearing cells by means of gated orifices and rotary drum screens positioned directly upstream from gated walls separating each rearing cell. Water supply to and flow exiting from the two ladder rearing sections are isolated due to disease concerns.

Rearing juvenile spring chinook in the Pelton ladder has proven to be a unique and effective technique for increasing adult spring chinook returns. Smolts reared in the ladder have shown higher smolt to adult return rates than smolts reared in the hatchery environment (Smith 1991). For example, average return rate for five brood years from 1977 to 1983 of spring chinook (adults and jacks) reared in the ladder was 1.6%. Average return rate of spring chinook (adults and jacks) reared in ponds during the same time period was 0.5% (Lindsay et al. 1989). Spring chinook smolts rear well in the ladder, apparently benefiting from the semi-natural rearing conditions and volitional migration. Chinook in the Pelton ladder are fed once per day, five days per week. Fish migrating from the Pelton ladder enter the Deschutes River immediately downstream from the Pelton Reregulating Dam. Juvenile chinook that have not emigrated from the ladder by mid-May are destroyed.

Brood Stock Origin and Use

Brood stock for the current program at RBH is collected from returns to the Pelton trap at the Pelton Reregulating Dam. Brood stock was collected from the wild run passing Sherars Falls during the low hatchery run years of 1977 through 1980. All brood stock for RBH has been collected from fish returning to Pelton trap since 1981. Fish for brood stock are collected throughout the run, proportional to their abundance, to maintain diversity in the time of return. Approximately 300 adults and 30 jacks are held to meet mitigation requirements mandated by the Federal Energy Regulatory Commission's (FERC) license to PGE to operate the Pelton/ Round Butte hydroelectric project. An additional 200 adults and 50 jacks are held to provide broodstock for the increased ladder rearing program funded by BPA. Marked and unmarked (presumably wild) fish are spawned. All unmarked spring chinook returning to the Pelton trap are held for brood stock. Unmarked spring chinook have made up 5.1% to 39.4% of the broodstock held for spawning from 1985 to 1994.

Few stray hatchery spring chinook are recovered annually in the Deschutes River subbasin, but they have included jacks and adults coded wire tagged and released as juvenile fish at sites located over a wide geographical area. Coded wire tags have been recovered from spring chinook released as juvenile fish in subbasins located in Washington and Idaho as well as coastal subbasins that include the Rogue River in Oregon and the Trinity River in California (Olsen et al. 1994). Some out of subbasin stray hatchery spring chinook captured at the Pelton trap each year could potentially be used for broodstock in the RBH program if they were marked with the same fin mark as RBH origin returns. The consequences of using out of basin strays in the RBH brood stock is unknown.

Spring chinook salmon are reared at RBH to satisfy mitigation requirements contained in PGE's FERC operating license. The spring chinook mitigation requirement is an average of 1,200 adult spring chinook salmon, at least 600 of which must be mature females, returning to the hatchery's brood stock collection facility at the Pelton trap. To meet this requirement, the hatchery released approximately 270,000 spring chinook smolts until 1993 when releases were decreased to approximately 230,000. The reduction in juvenile releases was made to fund coded wire tagging of all juveniles released rather than only fin marking a portion of the production. Spring chinook salmon releases from RBH are shown in Table 5.7. More detailed information on smolt releases is contained in Appendix A.

With the exception of several groups released in 1974, all spring chinook released from RBH have been fin marked and all have been marked with an adipose fin clip and coded wire tagged since 1993.

Spring chinook salmon returning to Pelton trap in numbers greater than those needed for brood stock at RBH are provided to the CTWS for ceremonial and subsistence use (Table 5.8).

Life History and Population Characteristics

Hatchery spring chinook salmon enter the Deschutes River from early April to early June. Adult spring chinook salmon first arrive at Pelton trap in early May. Fifty percent of the adults enter the trap by the first week in June and 75% enter by mid-June. Jacks tend to arrive at Pelton trap a week later than adults.

Average fecundity of age-4 spring chinook at RBH is 3,500 eggs. On average, age-3 spring chinook salmon have 2,300 eggs per female.

Eggs are taken from adult spring chinook from late August to early September. These eggs are incubated at 42°F and hatch in December through January.

Average survival rates at RBH are 85% from egg to fry and 91% from fry to smolt, for a rate of 77% from egg to smolt.

Smolts are released as yearlings in April at 5 to 12 fish per pound with a target size at release of 5 fish per pound from RBH and 9 fish per pound from the Pelton ladder. Fish released in spring emigrate to the Columbia River anywhere from several days to several months after release (Lindsay et al. 1989).

Deschutes River hatchery spring chinook enter the ocean at age-1 and return at age-3 through age-5. The age composition of all coded wire tag recoveries of RBH origin spring chinook averages 24% age-3 (jacks), 73% age-4, and 3% age-5, a higher percentage of age-3 and a lower percentage of age-5 fish than either the wild population or WSNFH returns (Table 5.9).

Recent return rates to the subbasin of spring chinook salmon from RBH average 0.5% for fish released as yearlings in spring from the hatchery and 1.6% for fish released as yearlings in spring from Pelton ladder. The average return rate for the 1978 to 1989 brood years was 0.8% (Table 5.10; ODFW, unpublished Round Butte Hatchery manual).

Constraints to Hatchery Production

Although RBH has problems with disease in the spring chinook program, the mitigation requirement of an average of 1,200 spring chinook salmon returning to Pelton trap has been met most years since 1985 with the increase in production from the Pelton ladder. Bacterial kidney disease (BKD) has been a problem with spring chinook salmon at RBH. Juveniles are fed erythromycin-treated feed as a prophylactic treatment to reduce the incidence of BKD. Adults held for brood stock are injected with erythromycin to reduce mortality from BKD. These measures appear to have reduced the disease load in the hatchery and allowed the release of healthier smolts. Return rates from erythromycin-fed smolts have been higher than from non-medicated smolts. Spring chinook juveniles are treated using feed containing erythromycin and adults held for brood stock are injected twice with erythromycin prior to spawning. Long term genetic or fish health risks from prophylactic treatment are believed to be low.

Spring chinook salmon at RBH are carriers of the viral disease infectious hematopoietic necrosis (IHN) and viral erythrocytic necrosis (VEN). Although there has never been an out-break of either disease in spring chinook salmon at RBH, the presence of the virus has prevented Deschutes River stock from being transferred to other river basins (Lindsay et al. 1989). Under recent decisions made by ODFW pathologists, smolts reared in the Pelton ladder can be released in other Columbia River tributaries if these smolts pass an extensive pathology examination prior to transport and release. ODFW has approved the concept of releasing Deschutes River stock spring chinook into the Hood River system. The first releases were made in 1993 but were not produced in the Pelton ladder.

Further increases in production of spring chinook salmon at RBH probably could not occur without an increase in rearing ponds or a decrease in summer steelhead production. RBH is operating at full capacity with the preferred rearing programs of spring chinook salmon, summer steelhead, and brown trout. The brown trout program will be discontinued after 1996.

Warm Springs National Fish Hatchery

Description of Hatchery

WSNFH was constructed on the Warm Springs River after the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) Tribal Council requested that the Bureau of

Sport Fisheries and Wildlife (now the U.S. Fish and Wildlife Service) determine the feasibility of a permanent fish hatchery on the reservation. WSNFH was authorized by Federal Statute 184, on May 31, 1966 to stock the waters of the CTWS reservation with salmon and trout. The U.S. Fish and Wildlife Service (USFWS) operates WSNFH on lands leased from the CTWS.

The USFWS recognizes that the CTWS has the sole management responsibility for fishery resources on CTWS lands. The USFWS and CTWS have entered into a five year Operational Plan cycle with the objective of assuring that the operation of the hatchery is compatible with and compliments CTWS fishery management goals. The Operational Plan specifies, among other items, production goals, wild brood stock usage guidelines, and fin marking of all juvenile spring chinook. The Operational Plan gives some level of assurance that hatchery operations will not jeopardize the genetic makeup of wild spring chinook in the Warm Springs River. The current WSNFH Operational Plan expires in October, 1996 and the Warm Springs Hatchery Evaluation team is currently updating the Operational Plan to guide operations during the 1997-2001 period.

WSNFH rears only spring chinook salmon. Rearing other species at the facility was abandoned due to water temperature and fish health problems (WSNFS Operation Plan 1992-1996). The design capacity of the hatchery is 1.2 million smolts but the current production goal is the release of 750,000 juveniles (WSNFH Operational Plan 1992-1996). Actual current spring chinook production varies according to brood stock availability. A summary of spring chinook salmon released from Warm Springs Hatchery is shown in Table 5.11. More detailed information is contained in Appendix B.

Brood Stock Origin and Use

The original brood stock for WSNFH was taken from wild spring chinook returning to the Warm Springs River (Table 5.12). The WSNFH Operational Plan identifies Warm Springs River spring chinook as the stock of choice to be used at the facility.

Typically, only spring chinook indigenous to the Warm Springs River are used for brood stock. Over the years there have been a few out of subbasin hatchery stray spring chinook, based on coded wire tag recoveries, that could have been spawned with the Warm Springs stock (Olson et al. 1995). The results from using these out of subbasin stray hatchery fish for brood stock are unknown.

Brood fish are currently collected throughout the run in proportion to their time of return, based on direction from the WSNFH Operations Plan. Approximately 70% of the fish are collected from late April through May, with a minimum of 90% collected by July 1. To reach full capacity at the hatchery, wild fish can be used for hatchery brood stock after 1,000 wild spring chinook have been passed above the hatchery to spawn. To maintain genetic diversity in the hatchery stock, a minimum of 10% wild brood stock are used each year in the hatchery if wild fish returns are sufficient to meet escapement goals above WSNFH. Wild spring chinook have been incorporated into the brood stock 14 of 18 years of operation but have been used only one year in the last five due to insufficient wild spring chinook escapement.

Due to low returns of hatchery reared adults to WSNFH, eggs from RBH were provided to WSNFH in 1981, 1983, 1994, and 1995.

Life History and Population Characteristics

Spawning usually begins in late August and continues once per week until mid-September. Eggs are incubated initially in water chilled to 52° F. As ambient water temperatures fall below 52 F, eggs are incubated in river water at ambient temperatures between 34° F and 52 F and hatch in November or December.

WSNFH spring chinook age at return to the mouth of the Deschutes River averages 12% age-3 (jacks), 80% age-4 and 8% age-5 (Table 5.13). The hatchery does produce a higher percentage of age-3 fish in comparison with the wild production and mean fork length of wild fish is greater than that of hatchery fish that return to WSNFH (Olson et al. 1995).

Run timing of WSNFH origin adult and jack spring chinook is one to three weeks later than wild spring chinook. Approximately 70% of all wild spring chinook pass the facility by June 1 and 90% pass by July 1 while 51% of the hatchery returns are captured by June 1 and 83% by July 1. Spawning time for the two groups is similar, however (Olson et al. 1995).

Average fecundity of age-4 spring chinook at WSNFH is 3,300 eggs per female.

Average survival rates at WSNFH are 90% for egg to fry and 80% for fry to smolt, for a rate of 72% from egg to smolt.

The rate of return to WSNFH of hatchery spring chinook from 1978 to 1989 brood years averaged 0.2% (Table 5.10). Spring chinook released from WSNFH do not show a tendency to spawn in the Deschutes or Warm Springs rivers below the hatchery, but rather return to that facility with great affinity. One of 14 spring chinook carcasses examined during spawning surveys downstream of WSNFH from 1986 to 1995 was a hatchery origin spring chinook as determined by fin mark. Managers have no evidence that hatchery spring chinook spawn in either the mainstem lower Deschutes River or its tributaries.

Spring chinook salmon are released from WSNFH in fall and spring. Prior to 1989, the fall release group consisted of the faster growing fish, usually larger than 20 fish to the pound at the time of release. The number of fish released in the fall depends on the number of fish attaining that size. Since 1989, faster-growing larger juveniles are allowed to migrate out of the hatchery volitionally from October 1 to November 15. The current fall release program at WSNFH is considered limited and experimental. The remaining juveniles are kept over the winter at the hatchery and released in mid-April (Olson et al. 1995). WSNFH releases yearlings in April at about 12 fish per pound and subyearlings in October at about 10 fish per pound.

WSNFH has a history of poor smolt to jack and adult return rates relative to RBH (Table 5.10). Returns to the facility are apparently limited by water quality and fish health (Olson et al. 1995). Water temperatures and rearing conditions at the hatchery were less than ideal for raising salmon when the rearing ponds were dependent upon untreated river water. Daily maximum summer temperatures often reach 68°F and winter daily maximum temperatures are often only slightly greater than freezing. Water for holding broodstock and incubating eggs is currently chilled and treated to minimize pathogens. Effluent water from WSNFH meets current US Environmental Protection Agency standards.

The impact of juvenile releases from WSNFH on wild fish in the Warm Springs and Deschutes rivers needs to be closely examined, particularly the experimental fall release program (Olson et al. 1995). These juveniles may over winter in the Deschutes or Columbia rivers and compete with wild fish prior to smolting. It is USFWS policy to release functional smolts from their hatcheries.

WSNFH is committed to operating within the guidelines established by the Northwest Power Planning Council's Integrated Hatchery Operation Team (IHOT). IHOT was established by the Council to help ensure that hatchery operations will be consistent with the regional goal of rebuilding wild and naturally spawning fish runs.

Constraints to Hatchery Production

Spring chinook salmon production at WSNFH is constrained by a low return of hatchery adults for brood stock due to less than optimum survival from smolt to adult. A brood stock of approximately 700 adults is needed to produce 750,000 smolts, the current capacity of WSNFH. Water quality and fish health have constrained smolt production at that facility.

BKD is also a problem at this hatchery. Efforts are being made to reduce mortality from BKD by culling obviously infected adults from the brood stock. This is accomplished by screening brood stock using enzyme-linked immunosorbant assay and florescent antibody technique, one-to-one spawning of males and females, and separate incubation to allow culling eggs of individual carrier females. Starting in 1993, juveniles are fed erythromycin-treated feed as a prophylactic treatment to reduce the incidence of BKD.

Hatchery Fish Population Status

The run size of hatchery spring chinook in the Deschutes River has ranged from 14 fish to 6,864 fish between 1977 and 1995. Return of adult and jack spring chinook to RBH has ranged from 14 to 2,241 adults and jacks during those years. Return of adults and jacks spring chinook to WSNFH has ranged from 52 to 2,538 during the same years (Table 5.14). The increase in run size to RBH in the 1980's is believed to be a result of improvements in rearing practices at RBH and an increase in the number of juveniles reared in the Pelton ladder.

Juvenile Acclimation and Adult Capture

Off-station juvenile acclimation and adult capture facilities may be a technique available to increase the availability of hatchery spring chinook to fishers in the Deschutes subbasin. Juvenile hatchery spring chinook could be acclimated to a specific water source, increasing the potential for them to return to that water source as adults. The returning adults would likely hold in the river in this vicinity and be available to subbasin fishers for a longer period of time than adults returning to a release site at in the Warm Spring river or at river mile 100. If the acclimation and adult capture facility was located in the vicinity of Sherars Falls, it is likely that adults returning to that facility would hold in the Sherars Falls vicinity and be available to sub-basin fishers for a longer period of time. Additional angling opportunities in areas near Sherars Falls may be possible if adults returning to the acclimation/adult capture facility do hold in the Deschutes River in that vicinity. Hatchery origin spring chinook are known to currently move quickly from Sherars Falls to their respective hatcheries and are not available to subbasin fishers for extended periods of time decreasing harvest opportunities. Wild spring chinook in the sub-basin are known to move from Sherars Falls to WSNFH at an average rate of 2.0 miles per day and may not be exposed to harvest pressures at Sherars Falls for extended periods of time (Lindsay et al. 1989).

Adults returning to a juvenile acclimation/adult capture facility significantly downstream from the Pelton trap would be captured sooner and would be available to recycle through the fisheries at Sherars Falls in a timely and cost effective manner. Meaningful recycling of hatchery spring chinook would increase catch of these fish by subbasin fishers, increasing the contribution and utilization of the hatchery product at low risk to the wild populations. Additionally, if juvenile spring chinook were released further downstream than river mile 100, interaction with other fishes would be decreased, potentially benefiting wild fishes.

Higher smolt to adult survival has been shown in acclimated versus direct release hatchery summer steelhead due principally to reduced stress levels at time of release (Whitesel et al., 1994). It is anticipated that spring chinook will show the same response in the Deschutes River.

Several programs in Oregon are currently acclimating juvenile spring chinook in off-station situations and results to date, although incomplete, are promising relative to adults successfully homing to the capture facility and holding for a period of time in the area of acclimation, increasing utilization by fishers.

Presumptive evidence from current hatchery spring chinook programs in the Deschutes River suggest that juvenile acclimation and adult capture at an off-station site will achieve the desired objectives. Spring chinook released directly from RBH home to the Pelton trap with a great degree of affinity; only 2.5% of all coded wire tagged spring chinook recovered at the WSNFH trap during return years 1990 through 1994 were RBH origin (unpublished coded wire tag recovery data, Pacific States Marine Fisheries Commission tag recovery files). No evidence exists that significant numbers of hatchery origin spring chinook currently spawn in the wild. It is likely that acclimated spring chinook would exhibit a similar degree of homing to the acclimation water source.

Risks to the wild spring chinook population from this program are low. Based on current hatchery spring chinook homing behavior in the subbasin, acclimated spring chinook that did not return to the acclimation/adult capture site would return to the Pelton trap or the WSNFH barrier dam rather than spawning in the wild. Managers currently have no evidence that wild or hatchery origin spring chinook spawn in the mainstem lower Deschutes River. Changes in spring chinook spawning behavior could be monitored by periodically conducting helicopter redd count flights similar to those currently done for fall chinook.

A juvenile acclimation and adult capture facility site adjacent to White River below White River Falls appears to offer the best opportunity from both an engineering and management standpoint but other sites may be available. The proposed spring chinook acclimation and adult capture program would be started on an experimental basis as opposed to a full production basis to test the ability of the program to meet the stated objectives.

A portion of the current RBH production would be utilized at the proposed juvenile acclimation facility. An acclimated release group large enough for meaningful evaluation would be used annually for a period of five years to test the effectiveness of this approach. Evaluation of adult returns and their behavior would take place in the Sherars Falls fishery using current harvest sampling procedures, at the acclimation/adult capture facility, the Pelton trap, and the barrier dam at WSNFH. Additionally, experimental test fisheries outside of the traditional Sherars Falls area using both hook and line and dipnet fishers could be implemented to evaluate the potential for additional harvest opportunities.

No off station direct releases of hatchery reared spring chinook have been made in the Deschutes River nor are they proposed by this plan.

ANGLING AND HARVEST

Harvest of spring chinook salmon in the Deschutes River occurs primarily in a three mile section from Sherars Falls (river mile 43) downstream to the upstream most railroad trestle. This section of river is the only area of the lower Deschutes River where the use of bait by recreational anglers is permitted. A large recreational fishery and a tribal fishery for spring chinook salmon occurs from early April to mid-June.

Both wild and hatchery origin spring chinook are harvested in ocean and Columbia River fisheries, although, as discussed, wild spring chinook contribute more to out of subbasin fisheries than hatchery fish. This difference may be accounted for by the higher percentage of wild age 5 spring chinook. Coded wire tagged RBH spring chinook for brood years 1975 through 1991 were recovered out of subbasin at a 26% rate while coded wire tagged WSNFH spring chinook for brood years 1978 through 1991 were recovered out of subbasin at a 20% rate (PSMFC data base, unpublished). Ocean harvest of 1975 through 1991 brood year RBH origin spring chinook principally took place off Oregon, Washington, and British Columbia. A very small number of spring chinook during these brook years were harvested off Alaska. Ocean harvest of 1978 through 1991 brood year WSNFH origin spring chinook took place off Oregon, Washington, and British Columbia (PSMFC data base, unpublished).

Recreational and tribal harvest of spring chinook salmon in the Deschutes River is shown in Tables 5.3 and 5.14. Harvest of hatchery and wild spring chinook has averaged 1,002 fish and 737 fish, respectively, from 1977 through 1993. The spring chinook season was closed in 1981, 1984, and 1994 for recreational and tribal fishers based on the low predicted return of wild spring chinook. The spring chinook season was closed for recreational anglers in 1995 but tribal fishers were allowed an abbreviated season by CTWS Tribal Council. Harvest rates of wild and hatchery spring chinook salmon are similar, averaging 32% for the wild stock and 36% for the hatchery stock. Anglers expend an average of 3,300 angler days and 16,800 hours annually in the recreational fishery and 1,200 hours in the tribal fishery at Sherars Falls (Lindsay et al. 1989). The catch and effort in the recreational fishery has increased as hatchery returns have increased.

Spring chinook returning in numbers greater than needed for brood stock requirements at RBH were recycled through the recreational and tribal fisheries at Sherars Falls from 1985 through 1988 (Table 5.15). The low harvest rate on spring chinook recycled through the fisheries is believed to be due to the time of the recycling. Sufficient numbers of spring chinook salmon for recycling do not enter Pelton trap until the third or fourth week in May, after the fishing effort in the Sherars Falls area has declined. Fish recycled through the fishery at that time are not subjected to an intense fishery and are harvested at a low rate. Increased harvest of hatchery spring chinook could be achieved if more timely recycling of these fish to the fishery could take place, such as from an acclimation facility on the lower White River.

The Oregon Fish and Wildlife Commission (Commission) sets harvest regulations for recreational fisheries in the subbasin. The salmon season has been from April 1 to October 31 below Sherars Falls and from the fourth Saturday in April to October 31 above Sherars Falls in most years. The Commission has restricted recreational fisheries in the lower Deschutes River to barbless flies and lures, except for the three mile section from Sherars Falls downstream to the upstream most railroad trestle where bait may be used with barbless hooks. The catch limit for salmon and steelhead has been two adults per day in any combination, six adults per week, and

10 jack salmon per day, 20 per week. Oregon State Police and CTWS Tribal Police enforce fishing regulations in the subbasin.

The CTWS regulates all on-reservation fishing by both members and non-members. The CTWS also regulates off-reservation fishing by tribal members. Tribal regulations for the on-reservation recreational fishery are consistent with Oregon Department of Fish and Wildlife regulations. The off-reservation treaty fishery at Sherars Falls, however, is not subject to a tribal imposed bag limit. Rather, the CTWS Tribal Council regulates this fishery through time and area closures, depending on stock and run-size status.

Harvest of spring chinook salmon at Sherars Falls has been monitored since 1977 with a statistical harvest survey. For specific information about harvest survey methodology, see Lindsay et al. (1989).

Currently, no specific harvest management goals or treaty and non-treaty harvest allocation agreements exist for spring chinook salmon in the lower Deschutes subbasin. Although no specifics are proposed, an action item of this plan is to develop a cooperative harvest management agreement with CTWS.

MANAGEMENT CONSIDERATIONS

Spring chinook salmon are produced at two hatcheries in the subbasin. RBH has released 220,000 to 270,000 smolts annually to meet PGE's mitigation requirement of an average of 1,200 adult spring chinook salmon returning annually to Pelton trap. WSNFH releases approximately 700,000 smolts annually and has released over 1,000,000. The run size of hatchery spring chinook salmon in the subbasin averaged 3,427 fish from 1982 through 1994.

Wild spring chinook salmon are currently produced only in the Warm Springs River and Shitike Creek. The Warm Springs River above WSNFH and Shitike Creek are currently managed for wild fish only. Hatchery spring chinook salmon are not released in the Warm Springs River upstream from WSNFH or in Shitike Creek although hatchery spring chinook salmon were allowed to spawn in the Warm Springs River above WSNFH from 1982 to 1986 as some hatchery fish from there were not externally marked and could not be easily differentiated from wild fish. All hatchery origin juvenile spring chinook released into the subbasin have been externally fin marked since the 1982 releases and all have been adipose fin marked and coded wire tagged since 1993. Marking of all juvenile spring chinook salmon released from RBH and WSNFH is necessary to differentiate them from wild fish on return as adults to allow only wild fish to spawn above WSNFH.

The optimum escapement goal for the Warm Springs River above WSNFH is 1,300 adult spring chinook salmon with a minimum adult run size goal of 1,000. This optimum goal has been met in 12 of the last 17 years. The average run of wild adult spring chinook salmon to the mouth of the Deschutes River was 1,817 fish from 1977 through 1995.

No escapement goal is currently available for the Shitike Creek spring chinook population although it is recognized on ODFW's Provisional Wild Fish Population List as a separate population from the Warm Springs River population. Information will be collected to help answer this question and determine management direction for this stream. In the interim, managers believe that managing lower Deschutes River wild spring chinook for the optimum escapement of 1,300 adults to the barrier dam at WSNFH will also provide adequate escapement into Shitike Creek to protect genetic resources in that population. If an escapement goal for spring chinook in Shitike Creek is developed it will be incorporated into this plan.

One opportunity for potentially increasing the abundance of naturally produced spring chinook in the lower Deschutes River is the White River Falls Passage Project. Extensive studies were funded by the BPA from 1983 to 1984 to evaluate the potential of anadromous production above the impassable falls in that subbasin. Those studies resulted in a recommendation to introduce spring chinook and summer steelhead above the falls to increase anadromous production and help meet the Northwest Power Planning Council goal to double anadromous runs in the Columbia basin. Seven methods were used to estimate a potential production of 1,400 to 2,100 spring chinook adults in the White River subbasin (ODFW et al. 1985). Trap and haul technology was proposed to provide anadromous passage rather than ladder construction.

As discussed in the Summer Steelhead Section of this plan, passage of anadromous species into White River above the falls was included as an element of the Northwest Power Planning Council Subbasin Plan approved by the Commission in 1989 but passage above the falls was never carried out. The Subbasin Plan was reviewed by the Commission and approved in total but not coded as Oregon Administrative Rule. Individual plan elements, such as White River Falls passage, are not viewed as policy and can be revisited by the Commission as new information becomes available. Please refer to the Summer Steelhead Section of this plan for a detailed discussion of the White River Falls Passage Project and why this plan does not recommend that project as an action item for spring chinook.

A large recreational fishery and a tribal fishery for spring chinook salmon occurs in a 3-mile section from Sherars Falls downstream to the first railroad trestle from April to June most years. Harvest rates in these fisheries have historically been great enough to cause concern for the wild component of the spring chinook salmon run.

Recreational and tribal fisheries for spring chinook salmon were closed in 1981, 1984, and 1994 to protect the wild stock from over harvest and help insure adequate escapement to the spawning grounds. The spring chinook season was closed for recreational anglers in 1995 but tribal fishers were allowed an abbreviated season by CTWS Tribal Council. The hatchery programs at RBH and WSNFH were generally not returning more adults than required for brood stock during those years. Restrictions on the harvest of wild spring chinook salmon in the recreational fishery may be an option in the future if predicted returns of the wild stock are low. Differential recreational harvest of hatchery origin spring chinook would be possible because all hatchery origin spring chinook are marked with the easily visible adipose fin mark. Hooking mortality of wild spring chinook released in a differential harvest is unknown.

Hatchery production of spring chinook has increased by rearing additional smolts in Pelton ladder. The number of additional hatchery spring chinook smolts released into the Deschutes River will be limited to the production from one cell, about 62,000 fish. The remainder of the additional ladder production will be used in the Hood River. The actual number of smolts reared in the ladder will depend on a feasibility study to determine the capacity of the ladder and return rates that could be expected at higher production levels.

Several opportunities for increasing natural production of spring chinook salmon in the subbasin have been identified. Habitat enhancement projects in Shitike Creek and the Warm Springs River watershed are expected to benefit spring chinook salmon.

Passage of adult and juvenile spring chinook around the Pelton/Round Butte hydroelectric project may be possible in the future. Feasibility studies of Pelton/Round Butte passage projects would determine the actual increases in natural production that could result from implementing effective passage. Reintroduction of anadromous species above the hydroelectric project are being explored during PGE's efforts to relicense the project with the FERC (Ratliff et al. 1996). PGE's current operation license expires in December 31, 2001. The formal relicensing process will begin in 1996. PGE has already developed a draft plan that describes how fish passage might be reestablished (Ratliff et al. 1996).

Off-station juvenile acclimation and adult capture facilities may be a technique available to increase hatchery spring chinook utilization. A juvenile acclimation and adult capture facility site in lower White River appears to be the most suitable location but other sites may be available.

Fishing effort and harvest would likely increase in the subbasin as the spring chinook run size increases. Hatchery production should continue to be externally marked with an adipose fin mark so that differential harvest of hatchery fish can occur if wild populations require harvest protection. Hatchery populations can withstand higher harvest rates than wild populations because higher survival from egg to smolt in the hatchery requires fewer spawners to maintain production.

Wild and hatchery origin spring chinook are harvested in both ocean and Columbia River fisheries (Lindsay et al. 1989). It is, however, beyond the scope of this plan to make recommendations relative to out of basin harvest.

No hatchery spring chinook spawning has ever been documented in the mainstem lower Deschutes River or Shitike Creek. Very few hatchery origin spring chinook have been found spawning in the Warm Springs River below WSNFH. RBH and WSNFH produce spring chinook that return to their respective hatcheries with great affinity.

When considering any production increase in the subbasin, the impact on other fish species native to the subbasin must also be considered.

Critical Uncertainties

1. The ecological impact of increased hatchery production of spring chinook salmon is unknown.

2. Physical and biological factors limiting production of wild spring chinook salmon in the Warm Springs River and Shitike Creek system are unknown.

3. The actual increase in spring chinook salmon production in the Warm Springs River system and Shitike Creek as a result of riparian improvement and in-stream habitat projects is difficult to quantify.

4. It is unknown if spring chinook that spawn in Shitike Creek are a separate population or are genetically the same as the spring chinook that spawn in the Warm Springs River.

5. If spring chinook that spawn in Shitike Creek are genetically different from the Warm springs population, it is unknown if their genetic resources will be protected without a specific spawning escapement goal.

MANAGEMENT DIRECTION

Objectives and actions contained in the management direction will be used to set district work plans that form the basis for monitoring and evaluation programs. Completion of actions listed under an objective contribute to the meeting of that objective. Many actions cannot be accomplished under current levels of funding. If funding continues to be limited, ODFW will pursue completion of actions according to priorities as funds become available.

Policies

Policy I. *The lower Deschutes River subbasin shall be managed for wild and hatchery spring chinook salmon.*

Objective 1. Achieve a spawning escapement level between an optimum of 1,300 and a minimum of 1,000 adult wild spring chinook salmon above the barrier dam at Warm Springs National Fish Hatchery.

Assumptions and Rationale

1. The CTWS manage their fisheries consistent with conservation of indigenous species. The CTWS are co-managers in meeting subbasin management plan objectives and will be involved in fish management activities in the lower Deschutes River subbasin at all levels. All action items will be conducted in cooperation with CTWS as co-managers of the resource.
2. The lower Deschutes River subbasin supports wild spring chinook, although at significantly lower numbers than historic levels.
3. The genetic diversity, adaptiveness and abundance of the wild populations of Deschutes River spring chinook salmon will be adequately maintained by spawning escapement levels of 1,000 to 1,300 adult wild spring chinook in the Warm Springs River upstream from WSNFH. This level of escapement into Warm Springs River should also ensure adequate spawning escapement into Shitike Creek.
4. The principle spawning destination for wild spring chinook salmon in the Deschutes River subbasin is the Warm Springs River upstream from WSNFH and the genetic resources of the wild spring chinook will be adequately protected by not allowing hatchery origin spring chinook salmon above the barrier dam.
5. Counts of wild spring chinook salmon over the barrier dam, plus redd counts in the Warm Springs River below WSNFH represent true spawning escapement into the Warm Springs River. Escapement into Shitike Creek can be estimated by spawning ground counts.
6. Harvest in the Columbia River and ocean is believed to be minimal and will not prevent meeting this spawning escapement objective. Out of subbasin harvest objectives are beyond the scope of this plan.
7. Currently available spring chinook salmon habitat in the Warm Springs River and Shitike Creek will allow adequate production of wild spring chinook to meet spawning escapement goals.

8. Run to the river objectives for wild adult spring chinook salmon will be amended if passage and re-establishment of naturally producing spring chinook salmon are provided above the Pelton/Round Butte hydroelectric complex.
9. Hatchery origin spring chinook salmon released from Round Butte Hatchery return to the hatchery trap with great fidelity, do not spawn in the wild, and pose a very low threat to genetic diversity, adaptiveness or abundance of the wild populations of Deschutes River spring chinook salmon, particularly those spawning in Shitike Creek.
10. The current models used to predict run to the river on a given return year are sufficiently accurate to be used as a management tool.

__Actions__

Action 1.1. Monitor returns of wild and hatchery spring chinook adults in the lower Deschutes River subbasin through harvest census, trap capture at the Pelton trap and WSNFH, and redd counts on Shitike Creek and the Warm Springs River.

Action 1.2. Monitor pre-spawning mortality in spring chinook salmon passed upstream from WSNFH and determine ways to reduce that mortality.

Action 1.3. Approximately 300,000 hatchery spring chinook salmon smolts shall be released annually at Round Butte Hatchery to satisfy FERC mandated mitigation, with additional experimental groups released as needed. All spring chinook salmon smolts released from Round Butte Hatchery shall be externally marked to facilitate separation from naturally produced fish in Deschutes River fisheries and at the hatchery.

Action 1.4. Reconsidering inoculating all wild spring chinook adults returning to WSNFH to minimize prespawning mortality from BKD if run size on any year is predicted to be less than 500 to the mouth of the Deschutes River or if the ratio of wild fish per redd remains greater than 4.0 for more than two consecutive years. Work with CTWS to develop a inoculation trigger based on juveniles sampled for BKD at the Warm Springs juvenile trap.

Action 1.5. Calculate annual preseason run size estimates using the most accurate methods available.

Action 1.6. Continue to improve the accuracy of spawning escapement estimate procedures.

Action 1.7. Continue to improve the accuracy of pre-season run size estimates.

Action 1.8 Periodically capture and mark with coded wire tags sufficient numbers of wild spring chinook juveniles to estimate ocean and Columbia River harvest.

Action 1.9. Collect samples and perform genetic analysis to determine if the Warm Spring River and Shitike Creek spring chinook are separate populations.

Action 1.10. Collect samples and perform genetic analysis on RBH and WSNFH origin spring chinook to determine how similar they are to each other and to the wild population.

Action 1.11. Work with CTWS to collect information on juvenile and adult spring chinook in Shitike Creek.

Action 1.12 Cooperate with CTWS and USFWS to increase WSNFH smolt to adult survival while protecting the genetic diversity, adaptiveness and abundance of fish populations in the Warm Springs and Deschutes rivers.

Objective 2. Provide the opportunity to harvest wild spring chinook salmon when returns are greater than the optimum wild adult spawning escapement of 1,300 adults. Provide the opportunity to harvest Round Butte Hatchery and Warm Springs National Hatchery origin spring chinook salmon that are excess to brood stock needs.

<u>Assumptions and Rationale</u>

1. The CTWS manage their fisheries consistent with conservation of indigenous species. The CTWS are co-managers in meeting subbasin management plan objectives and will be involved in fish management activities in the lower Deschutes River subbasin at all levels. All action items will be conducted in cooperation with CTWS as co-managers of the resource.
2. Harvest in the Columbia River and ocean is believed to be minimal and will not prevent achieving this harvest opportunity goal. Out of subbasin harvest objectives are beyond the scope of this plan.
3. Subbasin harvest objectives will be amended if passage and re-establishment of naturally producing populations of spring chinook salmon are provided above the Pelton/Round Butte hydroelectric complex.
4. The current statistical harvest estimation procedure at Sherars Falls accurately measures harvest of wild and hatchery spring chinook salmon.
5. No significant harvest of spring chinook salmon takes place downstream from the Sherars Falls bait area (river mile 41 to river mile 44).
6. The operator of the Pelton/Round Butte hydroelectric complex will continue to provide hatchery mitigation for spring chinook.
7. A minimum of 500 adult and 50 jack spring chinook salmon are needed for brood stock at Round Butte Hatchery. They will provide an adequate number of Deschutes River stock spring chinook eggs to continue current and future production levels at that facility.
8. A minimum of 700 adult spring chinook salmon are needed for brood stock at WSNFH. They will provide an adequate number of Deschutes River stock spring chinook eggs to continue current and future production levels at that facility.
9. In-season harvest management adjustments can be made quickly, easily and effectively to ensure adequate spawning and brood stock escapement.
10. Continued adipose fin marking of all hatchery origin spring chinook salmon will make differential harvest of hatchery origin spring chinook possible in recreational fisheries. Differential harvest of fin marked hatchery origin spring chinook salmon is a potential harvest management strategy to increase wild spawning escapement and the utilization of hatchery origin spring chinook salmon in excess of brood stock needs.
11. Release of wild spring chinook by recreational anglers at Sherars Falls will produce some hooking mortality. Hooking mortality of wild spring chinook in the Sherars Falls recreational fishery will be acceptable if it does not jeopardize wild escapement goals and makes harvesting hatchery fish possible.
12. The current statistical estimation procedure for harvest at Sherars Falls accurately measures harvest. Run to the river is accurately estimated by summing harvest and spawning escapement.

13. WSNFH is capable of increasing hatchery origin smolt to adult return rates while protecting the genetic diversity, adaptiveness and abundance of fish populations in the Warm Springs and Deschutes rivers.
14. The CTWS and ODFW are willing to identify a process to develop a cooperative harvest management agreement.

Actions

Action 2.1 Annually calculate preseason run to the river and spawning escapement estimates for Deschutes River subbasin wild and hatchery origin spring chinook salmon. Determine the number of wild and hatchery origin spring chinook salmon available for subbasin harvest.

Action 2.2. Provide subbasin fishers harvest opportunities if more than 1,300 wild adult spring chinook are predicted to return to the lower Deschutes River and hatchery returns are predicted to be greater than hatchery broodstock needs. Develop seasons with appropriate length, terminal tackle and bag limit restrictions to meet but not exceed desired harvest.

Action 2.3 Consider fin marked hatchery origin spring chinook only recreational harvest in years when spawning escapement is predicted to be below the optimum goal of 1,300 adult wild spring chinook salmon needed to meet Objective 1.

Action 2.4 Determine hooking mortality of wild spring chinook in a wild release recreational fishery at Sherars Falls.

Action 2.5. Monitor the recreational spring chinook salmon fishery closely for regulation compliance and mortality of hooked and released wild spring chinook if differential harvest of hatchery origin spring chinook salmon is enacted.

Action 2.6. Monitor harvest of spring chinook salmon at Sherars Falls with the most appropriate statistical harvest monitoring procedure.

Action 2.7. Calculate final harvest, spawning escapement and run to the river estimates each year.

Action 2.8. Develop a mid-season run size prediction update procedure.

Action 2.9. Continue to improve the accuracy of harvest estimation procedures.

Action 2.10. Periodically conduct harvest estimates for areas other than the Sherars Falls reach to validate assumptions relative to harvest in these areas.

Action 2.11. Refine and improve run to the river and spawning escapement estimation procedures.

Action 2.12. Collect spring chinook salmon brood stock, take eggs and rear juveniles at Round Butte Hatchery to provide approximately 300,000 smolts for release annually. Additional experimental groups may also be released.

Action 2.13. Continue to rear a portion of Round Butte Hatchery spring chinook salmon production in the Pelton ladder.

Action 2.14. Operational guidelines to implement hatchery programs to accomplish management objectives of the hatchery program and be consistent with Oregon's Wild Fish Management Plan standards will be developed as required by OAR 635-07-541(3) and will be appended to this plan.

Action 2.15. Continue coded wire tagging all releases of hatchery origin spring chinook salmon in the lower Deschutes River subbasin. Additional distinctive fin marks may also be used.

Action 2.16. Develop operational guidelines to implement hatchery programs to accomplish management plan objectives as required by OAR 635-07-541(3). These guidelines will be consistent with Oregon's Wild Fish Management Plan standards and will be appended to this plan.

Action 2.17. Develop a cooperative harvest management agreement with CTWS.

Action 2.18. Develop an agreement with CTWS relative to providing them with spring chinook from Round Butte Hatchery for ceremonial and subsistence purposes.

Objective 3. Increase harvest opportunity of hatchery spring chinook salmon within existing hatchery production levels.

__Assumptions and Rationale__

1. The CTWS manage their fisheries consistent with conservation of indigenous species. The CTWS are co-managers in meeting subbasin management plan objectives and will be involved in fish management activities in the lower Deschutes River subbasin at all levels. All action items will be conducted in cooperation with CTWS as co-managers of the resource.
2. Acclimated off-station releases of hatchery spring chinook salmon juveniles will increase angler catch and utilization of these fish when the adults return due to a tendency for these adults to hold near the area of release.
3. Acclimated off-station releases of hatchery spring chinook juveniles will not contribute to the number of adult hatchery spring chinook salmon subsequently spawning in the wild if adult recapture facilities are properly designed, built, and operated at juvenile acclimation sites using water supplies other than Deschutes or Warm Springs rivers or Shitike Creek.
4. Acclimating a portion of current Round Butte Hatchery spring chinook salmon production at a site downstream from river mile 100 would decrease potential competition between hatchery and wild salmonids.
5. Capturing adult hatchery origin spring chinook salmon at a trap downstream from river mile 100 would make meaningful adult recycling through the Sherars Falls fisheries possible and increase utilization of hatchery origin spring chinook salmon.
6. Providing increased harvest opportunities will not jeopardize our ability to meet hatchery needs for brood stock.
7. The operator of the Pelton/Round Butte hydroelectric complex, FERC and other federal agencies will be agreeable to renegotiation of the FERC license mandated spring chinook salmon mitigation measurement.
8. Both sport and tribal fishing opportunity would be enhanced by this objective.

Actions

Action 3.1. Evaluate potential sites for juvenile acclimation/adult capture, assess cost, risks, and presumed benefits, and accept or reject this as a strategy for meeting plan objectives.

Action 3.2. If an acceptable strategy, negotiate modifications of the Pelton/Round Butte FERC license mitigation obligations, seek funding, and establish facility. Split hatchery production at that time between the current location at river mile 100 and the acclimation facility.

Action 3.3. Operate the facility on an experimental basis utilizing hatchery production existing at that time and evaluate its contribution to achieve plan objectives and facility benefits.

Action 3.4. If the experimental operation demonstrates that plan objectives are met, increase the numbers of juveniles acclimated at the facility to increase adult returns and subsequent benefits after seeking Oregon Fish and Wildlife Commission and CTWS Tribal Council concurrence.

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SECTION 5. SPRING CHINOOK

FIGURES AND TABLES

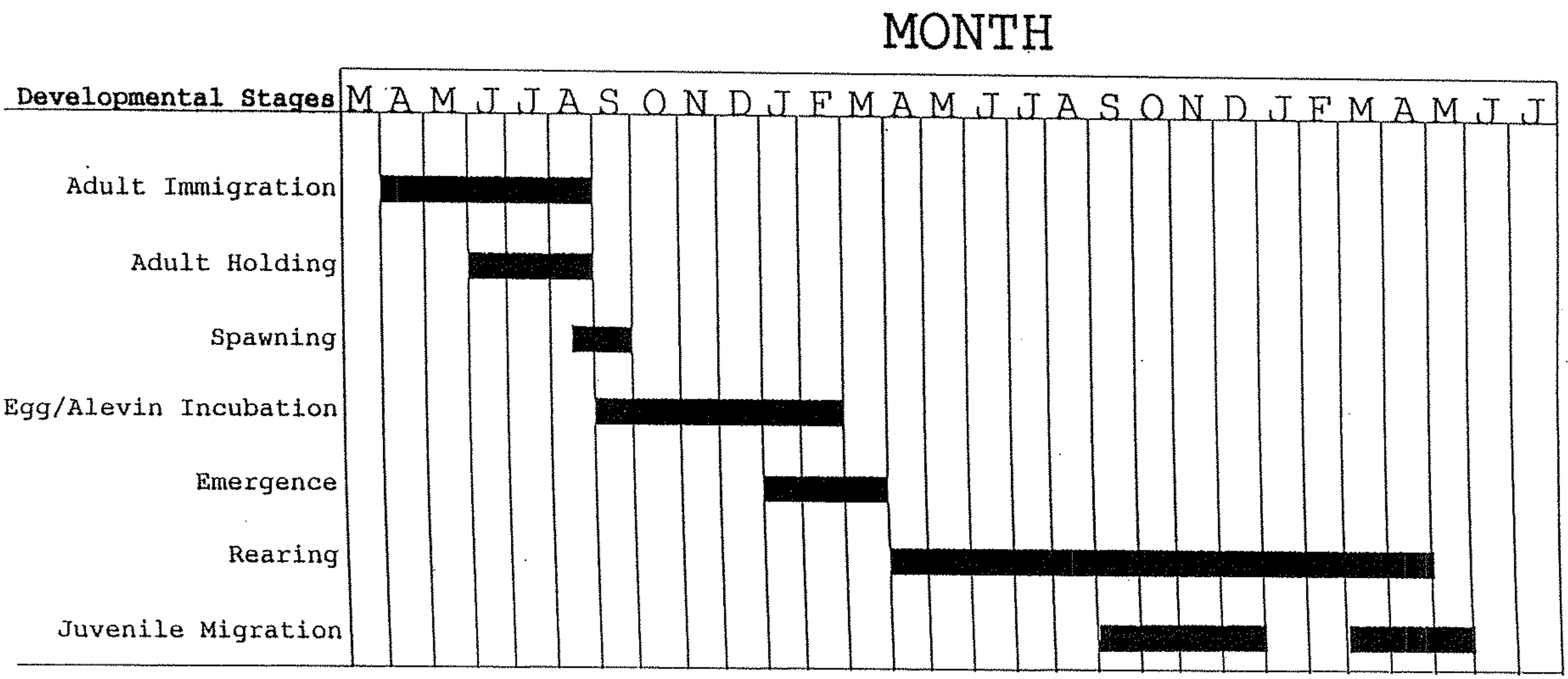

Table 5.1. Freshwater life history for spring chinook salmon in the lower Deschutes River. Developmental stage timing represents basin-wide average.

Table 5.2. Percent age composition from scale analysis of wild spring chinook salmon returning to Warm Springs National Fish Hatchery, 1974-90 brood years. From U. S. Fish and Wildlife Service.

Brood Year	Total Age 3	4	5	6
1974	5	81	15	0
1975	6	77	17	0
1976	7	67	27	0
1977	2	79	18	0
1978	4	82	14	0
1979	3	81	16	0
1980	2	86	13	0
1981	8	80	12	0
1982	3	80	17	0
1983	3	75	22	0
1984	6	76	18	0
1985	5	74	22	<1
1986	4	82	15	0
1987	6	63	31	0
1988	4	73	23	0
1989	4	78	18	0
1990	1	83	16	0
1991	N/A	N/A	N/A	N/A
Average	4	78	18	<1

Table 5.3. Run size of wild spring chinook salmon (adults and jacks) in the Deschutes River, 1977-95 run years.

Run Year	Harvest Tribal	Harvest Recreational	Brood Stock For RBH e/	Escapement to WSNFH	Total
1977	391	1,107	194	1,606a/	3,298
1978	173	512	115	2,660	3,460
1979	203	345	89	1,395	2,032
1980	113	337	60	1,002	1,512
1981b/	0	0	0	1,575	1,575
1982	201	502	0	1,454	2,157
1983	190	355	0	1,541	2,086
1984b/	0	0	0	1,290	1,290
1985	c/	704	0	1,155	N/A
1986	d/	d/	0	1,711	N/A
1987	408	501	0	1,783	2,692
1988	241	629	0	1,647	2,517
1989	265	519	0	1,409	2,193
1990	297	775	0	1,867	2,939
1991	111	485	0	817	1,413
1992	142	563	0	1,065	1,770
1993	126	251	0	538	915
1994	0	0	0	435	435
1995	4	0	0	237	241

line needs to be left justified

a/ An estimated 603 fish (201 redds X 3 fish/redd) that spawned below Warm Springs National Hatchery due to very low flow are not included in the total.
b/ Fishery closed.
c/ No tribal harvest estimate. Tribal harvest and run size unknown.
d/ No harvest estimate. Harvest and run size unknown.
e/ Adult spring chinook taken from the Sherars Trap for brood stock at Round Butte Hatchery.

Table 5.4. Number of wild juvenile spring chinook that migrated from the Warm Springs River, 1975-94 brood years (CTWS unpublished data).

Brood Year	Time of Migration: Fall	Time of Migration: Spring	Total
1975	25,795	43,250	69,045
1976	47,041	26,043	73,084
1977	25,125	25,204	50,329
1978	74,727	57,216	131,943
1979	24,930	25,628	50,558
1980	20,579	14,656	35,235
1981	29,238	14,647	43,885
1982	67,719	30,594	98,313
1983	89,396	31,101	120,497
1984	61,970	34,827	96,797
1985	35,991	38,333	74,326
1986	47,125	35,651	82,776
1987	59,195	27,508	86,703
1988	56,007	40,365	96,372
1989	42,720	33,154	75,874
1990	51,340	47,914	99,254
1991	14,576	14,056	28,632
1992	25,471	29,332	54,803
1993	14,196	13,842	28,038
1994	51,085	N/A	N/A

Table 5.5. Abundance and survival estimates of wild spring chinook salmon at various life stages in the Warm Springs River, 1975-95 brood years. These numbers represent fish surviving to spawn in the Warm Springs River and their recruitment back to the Deschutes River.

Brood Year	Females (redds)[a/]	Males	Millions of eggs	Survival (%) Migrants	Adult Returns	Egg to Migrants	Migrant to adult
1975	808	539 b/	2.669	69,045	1,891	2.6	2.7
1976	1,066	653 b/	3.521	73,084	1,547	2.1	2.1
1977	699	428 b/	2.309	50,329	1,691	2.2	3.4
1978	796	467	2.671	131,943	2,009	4.9	1.5
1979	359	220	1.309	50,558	2,077	3.0	4.1
1980	117	63	0.403	35,235	1,162	8.7	3.3
1981	157	114	0.539	43,885	1,807	8.1	4.1
1982	433	233	1.430	---	2,770	6.9	---
1983	438	304	1.447	120,497	2,743	8.3	2.3
1984	429	274	1.417	96,797	2,344	6.8	2.4
1985	398	254	1.315	74,326	2,274	5.7	3.1
1986	428	395	1.414	82,776	2,938	5.9	3.5
1987	484	447	1.599	86,703	1,372	5.4	1.6
1988	401	290	1.325	96,372	1,830	7.3	1.9
1989	415	277	1.133 c/	75,874	564	6.7	0.7
1990	547	321	1.462 c/	99,254	453	6.8	0.5
1991	246	210	0.632 c/	28,632	---	---	---
1992	163	199	0.432 c/	54,803	---	---	---
1993	147	106	0.399 c/	28,038	---	---	---
1994	166	111	0.474 c/	---	---	---	---
1995	65	94	0.173	---	---	---	---

Centered above these 2 columns

a/ Number of redds includes those counted in Warm Springs River below Warm Springs National Fish Hatchery.
b/ Number of males based on average percentages of males (0.38) in 1977-1985 runs.
c/ Number of eggs based on average eggs per female for all fish spawned at Warm Springs National Fish Hatchery.

Table 5.6. Major habitat constraints to spring chinook salmon production in the lower Deschutes River Subbasin. From Lower Deschutes Subbasin Plan.

Location	Habitat constraints [a/]
Warm Springs River	TEM, SED, GQL, SBD, GRA, CVR
Beaver Creek and Tributaries	TEM, SED, GQL, SBD, FLO, CVR, CHN
Mill Creek and tributaries	GQN, GRA, PSI, DIV, CVR, FLO
Badger Creek	FLO, GQN, PSI
Warm Springs River, South Fork	FLO, GQN
Shitike Creek	CHN, TEM, SBD, FLD, PSI
Tygh Creek	TEM

a/ CHN=channelization
CVR=instream cover
DIV=unscreened or poorly operating diversion
FLD=flash flooding
FLO=low flow
GQL= gravel quality
GQN=gravel quantity
GRA=gradient
PSI=passage impeded
SBD=stream bank degradation
SED=sedimentation
TEM=high temperature

Table 5.7. Juvenile spring chinook salmon released from Round Butte Hatchery into the Deschutes River, 1972-93 broods.

Brood Year	Release sites(s)	Total Number
1972	Pelton Ladder, Lake Simtustus, Rereg. Reservoir, Rereg. Dam	443,297
1973	Pelton Ladder, Lake Simtustus, Lake Billy Chinook, Rereg. Dam, Rereg. Reservoir	520,697
1974	Rereg. Dam	38,865
1975	Rereg. Reservoir	39,630
1976	Rereg. Dam	134,340
1977	Rereg. Dam	218,148
1978	Rereg. Dam, Pelton Ladder	162,495
1979	Rereg. Dam, Pelton Ladder	136,640
1980	Rereg. Dam, Pelton Ladder	129,674
1981	Rereg. Dam, Pelton Ladder	222,338
1982	Rereg. Dam, Pelton Ladder	273,338
1983	Rereg. Dam, Pelton Ladder	270,410
1984	Rereg. Dam, Pelton Ladder	275,850
1985	Rereg. Dam, Pelton Ladder	265,863
1986	Rereg. Dam, Pelton Ladder	264,219
1987	Rereg. Dam, Pelton Ladder	272,914
1988	Rereg. Dam, Pelton Ladder	259,447
1989	Rereg. Dam, Pelton Ladder	270,892
1990	Rereg. Dam, Pelton Ladder	270,779
1991	Rereg. Dam, Pelton Ladder	235,906
1992	Rereg. Dam, Pelton Ladder	237,533
1993	Rereg. Dam, Pelton Ladder	239,219

Table 5.8. Spring chinook salmon provided to Confederated Tribes of Warm Springs Reservation of Oregon from fish returning to Pelton trap, 1984-95 run years.

Run Year	Adults	Jacks
1984	0	216
1985	858	196
1986	1,117	250
1987	717	231
1988	669	278
1989	1,275	542
1990	1,567	130
1991	967	288
1992	1,344	83
1993	944	28
1994	39	5
1995	0	95

Table 5.9. Percent age composition of all recoveries coast wide of coded wire tagged Round Butte Hatchery spring chinook salmon, 1977-90 brood years. From PSMFC coast wide recoveries.

	Total Age		
Brood Year	3	4	5
1977	29	71	0
1978	24	75	1
1979	28	71	1
1980	31	67	2
1981	14	84	2
1982	33	64	3
1983	32	64	4
1984	26	70	4
1985	21	77	1
1986	30	68	2
1987	12	80	7
1988	19	74	7
1989	9	88	3
1990	N/A	N/A	N/A
Average	24	73	3

Table 5.10. Number of spring chinook juveniles released, total (adult and jack) returns to the mouth of the Deschutes River and the percent smolt to total return (adult plus jack) for Warm Springs National Hatchery and Round butte Hatchery, by brood year.

	Warm Springs National Hatchery			Round Butte Hatchery		
Brood Year	Number Released	Number Returning	Percent Return	Number Released	Number Returning	Percent Return
1978	178,890	1,510	0.84	162,495	497	0.31
1979	412,805	371	0.09	136,640	1,067	0.78
1980	208,187	874	0.42	129,674	373	0.29
1981	318,328	1,782	0.56	222,338	2,292	1.03
Average			0.48			0.65
1982	687,859	196	0.03	270,338	1,813	0.67
1983	806,325	1,031	0.13	270,410	2,010	0.74
1984	746,187	912	0.12	275,850	2,391	0.87
1985	720,328	3,871	0.54	265,863	2,634	0.99
Average			0.21			0.82
1986	700,255	1,974	0.28	264,219	3,804	1.44
1987	661,019	847	0.13	272,918	2,985	1.09
1988	731,959	1,330	0.18	259,447	3,757	1.45
1989	1,070,933	196	0.02	270,892	1,804	0.67
Average			0.15			1.16

Table 5.11. Juvenile spring chinook salmon released from Warm Springs National Fish Hatchery into the Warm Springs River, 1978-93 broods.

Brood year	Release site(s)	Total Number
1978	Warm Springs River	178,890
1979	Warm Springs River	323,835
1980	Warm Springs River	208,187
1981	Warm Springs River	318,328
1982	Warm Springs River	687,859
1983	Warm Springs River	806,325
1984	Warm Springs River	746,187
1985	Warm Springs River	720,328
1986	Warm Springs River	665,018
1987	Warm Springs River	661,136
1988	Warm Springs River	703,034
1989	Warm Springs River	1,101,103
1990	Warm Springs River	659,507
1991	Warm Springs River	557,114
1992	Warm Springs River	521,414
1993	Warm Springs River	398,142

Table 5.12. Adult spring chinook salmon collected for brood stock (wild and hatchery origin stock) at Warm Springs National Fish Hatchery or passed upstream, by return year, 1977 to 1995. From US Fish and Wildlife Service.

Return Year	Wild		Hatchery	
	Kept	Upstream	Kept	Upstream
1977	0	1,505	0	0
1978	549	2,015	0	0
1979	416	906	0	0
1980	317	651	0	0
1981	512	1,013	0	0
1982	91	1,317	625	270
1983	442	1,081	185	170
1984	389	803	265	519
1985	322	777	573	487
1986	470	1,186	112	25
1987	147	1,550	489	0
1988	319	1,259	434	0
1989	90	1,254	886	0
1990	84	1,721	794	0
1991	0	777	577	0
1992	91	953	757	0
1993	0	528	307	0
1994	0	425	44	0
1995	0	160	94	0

Table 5.13. Percent age composition of Warm Springs National Fish Hatchery spring chinook salmon returning to the Deschutes River, 1978-90 brood years.

Brood Year	Total Age 3	4	5
1978	6	86	8
1979	7	88	5
1980	4	88	8
1981	11	85	4
1982	5	74	21
1983	26	66	9
1984	33	57	10
1985	12	84	4
1986	10	83	7
1987	11	80	9
1988	7	81	12
1989	7	85	8
1990	13	87	0
1991	N/A	N/A	N/A
Average	12	80	8

Table 5.14. Run size of hatchery spring chinook salmon (adults and jacks) returning to the Deschutes River, 1977-95 run years.

Run Year	Harvest		Return to		Total
	Tribal	Recreational	RBH	WSNFH	
1977	0	0	27	0	27
1978	0	0	14	0	14
1979	0	0	26	0	26
1980	0	60	84	0	144
1981 a/	0	0	407	85	492
1982	138	535	438	916	2,027
1983	125	293	614	371	1,403
1984 a/	0	0	583	992	1,573
1985	b/	928	1,542	1,109	b/
1986	c/	c/	1,820	349	c/
1987	553	759	1,348	742	3,402
1988	345	1,311	1,472	824	3,952
1989	489	1,596	2,241	2,538	6,864
1990	425	1,281	2,211	1,311	5,228
1991	285	1,593	1,895	644	4,417
1992	380	1,552	2,024	791	4,746
1993	195	620	1,398	309	2,472
1994 a/	0	0	603	52	655
1995 d/	35	0	878	240	1,153

a/ Fishery closed.
b/ No tribal harvest estimate. Tribal harvest and run size unknown.
c/ No harvest estimate. Harvest and run size unknown.
d/ Sport fishery closed.

Table 5.15. Spring chinook salmon recycled through the fishery at Sherars Falls, 1985-88 run years.

Run Year	Adults	Jacks	Harvest rate %
1985	313	3	14
1986	430	31	2
1987	318	35	9
1988	107	19	15

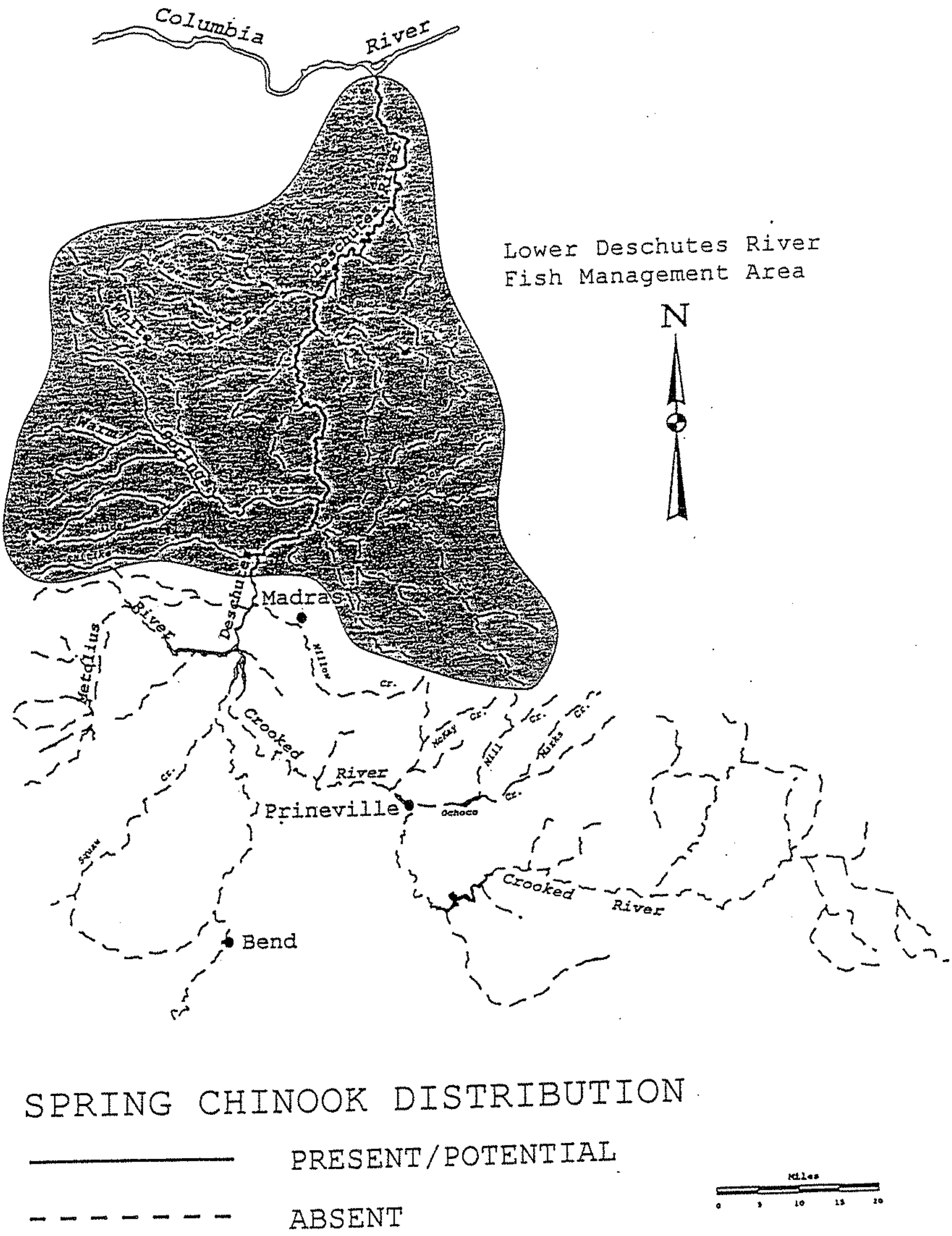

Figure 5.1. Spring chinook salmon distribution in the lower Deschutes River subbasin.

APPENDIX A

SPRING CHINOOK RELEASES FROM ROUND BUTTE HATCHERY

Appendix A. Juvenile spring chinook salmon released from Round Butte Hatchery into the Deschutes River, 1972-93 broods. [a/]

Brood year	Release date	Release site	Number	Fish/lb	Mark or tag code
1972	04/27/73	Pelton Ladder	50,122	76.6	DLP
1972	04/27/73	Lake Simtustus	182,283	63.7	LP
1972	06/05/73	Rereg. Reservoir	65,678	50.6	LP
1972	03/04,05/74	Rereg. Dam	145,214	6.7-7.2	ADLP
1973	04/10,16/74	Lake Simtustus	81,110	65.0	LV
1973	04/19/74	Lake Simtustus	65,635	61.0	No Mark
1973	04/23/74	Rereg. Reservoir	81,704	63.0	RV
1973	04/23/74	Rereg. Reservoir	86,775	65.0	No Mark
1973	04/23/74	Rereg. Reservoir	1,320	60.0	AN
1973	05/10/74	Pelton Ladder	23,964	55.0	AN
1973	06/03/74	Rereg. Dam	61,560	26.2	DRP
1973	06/11/74	Lake Billy Chinook	15,000	75.0	No Mark
1973	02/14,18/75	Rereg. Dam	103,629	5.5	LVLM
1974	06/03/75	Rereg. Dam	20,150	30.0	DLP
1974	10/20/75	Rereg. Dam	4,267	5.6	DLV
1974	12/19/74	Rereg. Dam	14,448	13.0	DLV
1975	10/05/76	Rereg. Reservoir	27,579	9.3	09 04 06
1975	10/05/76	Rereg. Reservoir	12,051	9.3	09 04 07
1976	05/02/77	Rereg. Dam	62,040	44.5	09 16 01 & 02
1976	06/03/77	Rereg. Dam	36,675	29.1	09 16 03
1976	06/03/77	Rereg. Dam	35,625	29.1	09 16 04
1977	05/31/78	Rereg. Dam	47,802	28.4	07 16 11
1977	05/31/78	Rereg. Dam	47,598	32.3	07 16 12
1977	05/31/78	Rereg. Dam	26,394	23.7	07 16 15
1977	10/04/78	Rereg. Dam	26,640	13.0	07 16 54
1977	10/04/78	Rereg. Dam	27,714	13.2	07 16 55
1977	04/09/79	Rereg. Dam	42,000	9.1	07 16 53

(continued)

Appendix A. (continued) Juvenile spring chinook salmon released from Round Butte Hatchery into the Deschutes River, 1972-93 broods. [a/]

Brood year	Release date	Release site	Number	Fish/lb	Mark or tag code
1978	05/10/79	Pelton Ladder [b/]	14,579	91.0	07 18 24
1978	05/30/79	Rereg. Dam	54,300	22.0	07 18 25
1978	04/14/80	Rereg. Dam	32,865	8.0	07 19 49
1978	04/14/80	Rereg. Dam	30,758	8.8	07 19 50
1978	04/14/80	Rereg. Dam	29,993	8.0	07 19 51
1979	05/12/80	Pelton Ladder [b/]	22,280	101.1 [c/]	07 21 53
1979	10/06/80	Rereg. Dam	29,264	5.9	07 21 54
1979	03/10/81	Rereg. Dam	30,450	6.6	07 23 10
1979	04/24/81	Rereg. Dam	29,200	5.0	07 23 09
1979	03/02/81	Pelton Ladder [d/]	25,446	8.8	07 23 11
1980	10/05/81	Rereg. Dam	46,578	5.7	07 23 47
1980	10/05/81	Rereg. Dam	29,430	11.4	07 23 49
1980	03/02/82	Pelton Ladder [d/]	28,656	7.00	7 23 48
1980	03/23/82	Rereg. Dam	25,010	5.0	07 23 50
1981	10/11/82	Rereg. Dam	28,538	6.4	07 25 20
1981	10/11/82	Rereg. Dam	59,118	22.8	07 27 15
1981	03/21/83	Rereg. Dam	57,340	9.3	07 27 14
1981	03/02/83	Pelton Ladder [d/]	48,495	12.2	07 27 16
1981	03/21/83	Pelton Ladder [d/]	28,847	12.2	07 27 17
1982	05/24/83	Rereg. Dam	28,920	19.2	07 28 36
1982	10/05/83	Rereg. Dam	53,550	16.3	07 28 43
1982	10/06/83	Rereg. Dam	28,200	5.6	07 28 37
1982	04/16/84	Rereg. Dam	28,790	5.2	07 28 39
1982	04/16/84	Rereg. Dam	28,991	5.2	07 28 40
1982	03/05/84	Pelton Ladder [d/]	53,941	9.5	07 28 42
1982	04/15/84	Pelton Ladder [d/]	50,946	8.4	07 28 41

(continued)

Appendix A. (continued) Juvenile spring chinook salmon released from Round Butte Hatchery into the Deschutes River, 1972-93 broods. [a]

Brood year	Release date	Release site	Number	Fish/lb	Mark or tag code
1983	10/08/84	Rereg. Dam	60,797	12.4	07 31 31
1983	10/09/84	Rereg. Dam	30,394	6.5	07 31 32
1983	04/02/85	Rereg. Dam	57,748	5.8	07 31 28
1983	03/09/85	Pelton Ladder [d]	60,712	7.6	07 31 29
1983	04/01/85	Pelton Ladder [d]	60,759	7.6	07 31 30
1984	03/12/86	Rereg. Dam	32,000	5.7	07 33 20
1984	03/13/86	Rereg. Dam	30,952	5.7	07 33 20
1984	06/03/86	Pelton Ladder [d]	62,994	7.7	07 33 21
1984	06/05/86	Pelton Ladder [d]	74,744	7.7	LV LM
1984	06/05/86	Pelton Ladder [d]	75,160	7.7	LP
1985	04/13/87	Rereg. Dam	54,863	5.5	07 39 28
1985	05/27/87	Pelton Ladder [d]	75,000	7.5	RP
1985	05/27/87	Pelton Ladder [d]	62,000	7.5	07 39 29
1985	05/27/87	Pelton Ladder [d]	74,000	7.5	RM
1986	04/11/88	Rereg. Dam	54,221	6.9	07 44 61
1986	04/11/88	Pelton Ladder [d]	55,147	8.5	07 44 62
1986	04/22/88	Pelton Ladder [d]	66,593	8.5	LV LM
1986	04/22/88	Pelton Ladder [d]	66,5948.5	LP	
1986	05/25/88	Pelton Ladder [d]	6,123	8.2	07 44 62
1986	05/25/88	Pelton Ladder [d]	7,771	8.5	LV LM
1986	05/25/88	Pelton Ladder [d]	7,770	8.5	LP
1987	04/17/89	Rereg. Dam	57,714	6.4	07 46 22
1987	04/18/89	Pelton Ladder [d]	61,332	9.8	07 46 23
1987	04/18/89	Pelton Ladder [d]	153,868	9.8	RM
1988	04/19/90	Rereg. Dam	28,608	6.0	07 50 62
1988	05/17/90	Pelton Ladder [d]	24,107	10.7	07 50 58
1988	05/17/90	Pelton Ladder [d]	20,967	9.7	07 50 59
1988	04/20/90	Rereg. Dam	29,590	6.5	07 50 61

(continued)

Appendix A. (continued) Juvenile spring chinook salmon released from Round Butte Hatchery into the Deschutes River, 1972-93 broods. [a/]

Brood year	Release date	Release site	Number	Fish/lb	Mark or tag code
1988	05/17/90	Pelton Ladder [d/]	21,328	8.8	97 50 60
1988	05/17/90	Pelton Ladder [d/]	134,847	10.7	LM
1989	04/22/91	Rereg. Dam	29,959	6.1	07 53 61
1989	04/23/91	Rereg. Dam	29,959	6.1	07 53 62
1989	05/14/91	Pelton Ladder [d/]	21,236	9.5	07 53 63
1989	05/14/91	Pelton Ladder [d/]	21,232	9.5	07 54 01
1989	05/14/91	Pelton Ladder [d/]	21,521	10.5	07 54 02
1989	05/14/91	Pelton Ladder [d/]	146,985	9.8	RM
1990	04/28/92	Rereg. Dam	28,575	6.5	07 56 48
1990	04/28/92	Rereg. Dam	28,575	6.5	07 56 49
1990	05/21/92	Pelton Ladder [d/]	21,148	9.8	07 56 45
1990	05/20/92	Pelton Ladder [d/]	21,540	9.8	07 56 46
1990	05/21/92	Pelton Ladder [d/]	21,393	9.8	07 56 47
1990	05/21/92	Pelton Ladder [d/]	149,548	9.8	LM
1991	04/07/93	Rereg. Dam	24,735	6.1	07 50 08r2
1991	04/05/93	Pelton Ladder [d/]	21,122	8.7	07 59 40
1991	04/05/93	Pelton Ladder [d/]	47,713	8.7	07 59 49
1991	04/06/93	Pelton Ladder [d/]	22,020	10.0	07 59 39
1991	04/06/93	Pelton Ladder [d/]	49,600	10.0	07 59 48
1991	04/07/93	Pelton Ladder [d/]	49,127	9.8	07 59 47
1991	04/07/93	Pelton Ladder [d/]	21,589	9.8	07 59 38
1992	04/18/94	Rereg. Dam	26,580	6.0	07 02 30
1992	05/06/94	Pelton Ladder [d/]	70,995	8.6	07 02 27
1992	05/06/94	Pelton Ladder [d/]	70,960	9.3	07 02 28
1992	05/06/94	Pelton Ladder [d/]	68,998	8.9	07 02 29

(continued)

Appendix A. (continued) Juvenile spring chinook salmon released from Round Butte Hatchery into the Deschutes River, 1972-93 broods. a/

Brood year	Release date	Release site	Number	Fish/lb	Mark or tag code
1992	04/18/94	Rereg. Dam	26,580	6.0	07 02 30
1992	05/06/94	Pelton Ladder d/	70,995	8.6	07 02 27
1992	05/06/94	Pelton Ladder d/	70,960	9.3	07 02 28
1992	05/06/94	Pelton Ladder d/	68,998	8.9	07 02 29
1993	04/17/95	Rereg. Dam	69,446	5.8	07 05 26
1993	04/19/95	Pelton Ladder d/	70,042	8.7	07 05 27
1993	04/18/95	Pelton Ladder d/	70,413	8.7	07 05 28
1993	04/17/95	Pelton Ladder d/	29,318	8.1	08 05 29

a/ Experimental releases totaling 70,013 were made into Pelton ladder from 1975 to 1979 (1974-1977 broods) to determine migration timing, but were not included in this table.
b/ Fish were transferred from the hatchery to Pelton ladder in March and allowed to migrate of their own volition beginning on the release date.
c/ Weight at time of transfer to the ladder March 5, 1980.
d/ Fish were transferred from the hatchery to Pelton ladder in late October or early November and allowed to migrate of their own volition

APPENDIX B

HATCHERY SPRING CHINOOK RELEASES FROM WARM SPRINGS NATIONAL HATCHERY

Appendix B. Juvenile spring chinook salmon released from Warm Springs National Fish Hatchery into the Warm Springs River, 1978-93 broods.

Brood Year	Date Released	Number	Size (fish/lb)	Mark or Tag Code
1978	04/7,14/80	168,000	19	AD
1978	04/1,14/80	10,890	19	AD
1979	11/06/80	26,852	9	AD
1979	11/06/80	27,816	9	AD
1979	04/02/81	66,700	18	AD
1979	04/09,16/81	170,167	18	AD
1979	04/02/81	32,300	8	AD
1980	11/16,12-18/81 [a/]	65,303	12	No Mark
1980	03/29/82	142,884	12	No Mark
1981	10/05/82	68,557	10	OTC [b/]
1981	10/05/82	13,965	10	RV; OTC
1981 [c/]	10/05/82	25,950	6	LV; OTC
1981	04/12/83	154,954	15	2-OTC
1981 [c/]	04/12/83	27,645	15	LV; 2-OTC
1981	04/12/83	27,257	15	RV; 2-OTC
1982	10/24/83	61,864	9	LV; OTC
1982	04/13/84	625,995	18	LV
1983	10/16/84	345,544	9	RV; OTC
1983 [c/]	10/16/84	77,937	10	LV; OTC
1983	04/09/85	321,194	19	RV
1983 [c/]	04/09/85	61,650	17	LV
1984 [d/]	10/01/85	46,822	9	RV
1984	10/01/85	279,001	9	LV
1984	04/09/86	62,011	17	RV; OTC
1984	04/09/86	358,353	17	LV; OTC
1985	10/01/86	80,698	8	RV
1985	10/01/86	79,490	9	LV
1985	04/09/87	340,832	17	RV; OTC
1985	04/09/87	219,308	17	LV; OTC

(continued)

Appendix B. Juvenile spring chinook salmon released from Warm Springs National Fish Hatchery into the Warm Springs River, 1978-93 broods.

Brood Year	Date Released	Number	Size (fish/lb)	Mark or Tag Code
1986	10/01/87	35,237	9	LV
1986	10/01/87	307,556	9	RV
1986	04/08/88	31,418	16	LV
1986	04/08/88	326,044	16	RV
1987	05/06/88	5,762	66	AD
1987	05/06/88	5,762	66	LV
1987	05/06/88	40,086	66	AD
1987	09/30/88	13,328	11	AD
1987	09/30/88	11,325	11	AD
1987	09/30/88	18,387	11	AD
1987	09/30/88	11,338	11	RV
1987	09/30/88	20,902	11	AD
1987	09/30/88	7,473	9	AD
1987	09/30/88	5,405	11	AD
1987	09/30/88	16,485	10	AD
1987	09/30/88	869	11	AD
1987	09/30/88	7,492	9	LV
1987	09/30/88	14,765	11	AD
1987	09/30/88	12,095	12	AD
1987	09/30/88	871	11	AD
1987	09/30/88	12,130	12	LV
1987	09/30/88	237	11	AD
1987	09/30/88	13,339	11	RV
1987	09/30/88	22,418	11	AD
1987	09/30/88	16,545	11	AD
1987	04/05/89	38,045	14	AD; OTC
1987	04/05/89	17,481	9	AD; OTC
1987	04/05/89	21,972	14	AD; OTC
1987	04/05/89	613	14	AD; OTC
1987	04/05/89	31,624	15	AD
1987	04/05/89	12,460	15	AD; OTC
1987	04/05/89	20,089	9	AD; OTC
1987	04/05/89	2,238	14	AD; OTC
1987	04/05/89	12,482	15	LV; OTC
1987	04/05/89	13,503	16	AD; OTC

(continued)

Appendix B. Juvenile spring chinook salmon released from Warm Springs National Fish Hatchery into the Warm Springs River, 1978-93 broods.

Brood Year	Date Released	Number	Size (fish/lb)	Mark or Tag Code
1987	04/05/89	6,459	14	AD; OTC
1987	04/05/89	14,469	15	AD; OTC
1987	04/05/89	34,996	14	AD; OTC
1987	04/05/89	14,603	15	RV; OTC
1987	04/05/89	12,471	15	RV; OTC
1987	04/05/89	12,463	15	AD; OTC
1987	04/05/89	13,542	16	LV; OTC
1987	04/05/89	29,325	17	AD
1987	04/05/89	34,623	15	AD; OTC
1987	04/05/89	2,246	14	AD; OTC
1987	04/05/89	30,253	16	AD; OTC
1987	04/05/89	28,165	15	AD; OTC
1988	09/27/98	18,740	10	AD
1988	09/27/89	13,949	9	AD
1988	09/27/89	10,302	9	LV
1988	09/27/89	7,650	10	RV
1988	09/27/89	19,067	10	AD
1988	09/27/89	7,035	8	AD
1988	09/27/89	9,987	8	AD
1988	09/27/89	7,655	10	AD
1988	09/27/89	2,439	8	AD
1988	09/27/98	6,267	8	AD
1988	09/27/89	6,273	8	RV
1988	09/27/89	7,373	8	LV
1988	09/27/89	11,461	8	AD
1988	09/27/89	2,518	8	AD
1988	09/27/89	10,240	9	AD
1988 a/	11/15/89	5,000	9	AD
1988	04/11/90	19,320	21	RV; OTC
1988	04/11/90	27,315	19	AD
1988	04/11/90	33,622	19	AD; OTC
1988	04/11/90	30,639	18	AD; OTC
1988	04/11/90	25,286	9	AD; OTC
1988	04/11/90	18,001	21	RV; OTC
1988	04/11/90	8,012	18	AD; OTC

(continued)

Appendix B. Juvenile spring chinook salmon released from Warm Springs National Fish Hatchery into the Warm Springs River, 1978-93 broods.

Brood Year	Date Released	Number	Size (fish/lb)	Mark or Tag Code
1988	04/11/90	32,034	18	AD; OTC
1988	04/11/90	27,024	20	AD
1988	04/11/90	14,774	21	AD; OTC
1988	04/11/90	35,818	21	AD; OTC
1988	04/11/90	24,892	11	AD; OTC
1988	04/11/90	17,983	21	AD; OTC
1988	04/11/90	28,526	21	AD; OTC
1988	04/11/90	40,597	20	AD; OTC
1988	04/11/90	14,893	21	LV; OTC
1988	04/11/90	7,760	18	AD; OTC
1988	04/11/90	19,297	21	AD; OTC
1988	04/11/90	19,456	21	LV; OTC
1988	04/11/90	19,326	21	AD; OTC
1988 a/	04/16/90	46,942	15	AD
1988 a/	04/16/90	52,064	15	AD
1989	09/26/90	6,613	10	RV
1989	09/26/90	46,191	9	AD
1989	09/26/90	7,259	12	AD
1989	09/26/90	9,935	12	AD
1989	09/26/90	9,875	12	AD
1989	09/26/90	11,492	9	AD
1989	09/26/90	8,631	12	AD
1989	09/26/90	18,263	11	AD
1989	09/26/90	7,348	9	AD
1989	09/26/90	9,842	8	AD
1989	09/26/90	14,811	9	AD
1989	09/26/90	24,751	9	AD
1989	09/26/90	8,009	12	AD
1989	09/26/90	4,430	11	RV
1989	09/26/90	8,097	8	LV
1989	09/26/90	4,302	11	AD
1989	09/26/90	8,047	8	AD
1989	09/26/90	9,792	8	LV
1989	09/26/90	6,590	10	AD
1989 a/	11/01/90	34,004	14	AD

(continued)

Appendix B. Juvenile spring chinook salmon released from Warm Springs National Fish Hatchery into the Warm Springs River, 1978-93 broods.

Brood Year	Date Released	Number	Size (fish/lb)	Mark or Tag Code
1989 a/	11/01/90	26,331	12	AD
1989	04/17/91	39,914	13	AD
1989	04/17/91	8,108	13	AD
1989	04/17/91	20,349	18	AD
1989	04/17/91	26,541	18	ADOTC
1989	04/17/91	18,138	17	ADOTC
1989	04/17/91	20,718	16	ADOTC
1989	04/17/91	71,305	16	ADOTC
1989	04/17/91	21,362	16	RVOTC
1989	04/17/91	7,895	10	AD
1989	04/17/91	17,231	17	ADOTC
1989	04/17/91	16,098	16	ADOTC
1989	04/17/91	18,260	15	ADOTC
1989	04/17/91	15,894	16	ADOTC
1989	04/17/91	10,007	13	AD
1989	04/17/91	12,950	13	AD
1989	04/17/91	4,781	8	ADOTC
1989	04/17/91	40,054	13	AD
1989	04/17/91	20,340	18	AD
1989	04/17/91	8,958	10	AD
1989	04/17/91	15,420	18	LVOTC
1989	04/17/91	15,250	18	ADOTC
1989	04/17/91	10,882	7	ADOTC
1989	04/17/91	18,454	15	RVOTC
1989	04/17/91	9,274	13	AD
1989	04/17/91	17,123	17	LVOTC
1989	04/17/91	40,125	14	AD
1989	04/17/91	16,978	17	ADOTC
1989	04/17/91	4,781	8	ADOTC
1989	04/17/91	34,968	16	ADOTC
1989	04/17/91	40,169	19	AD
1989	04/17/91	40,306	12	AD
1989	04/17/91	43,312	16	ADOTC
1989	04/17/91	9,158	10	AD
1989	04/17/91	15,799	16	ADOTC
1989	04/17/91	36,614	18	ADOTC

(continued)

Appendix B. Juvenile spring chinook salmon released from Warm Springs National Fish Hatchery into the Warm Springs River, 1978-93 broods.

Brood Year	Date Released	Number	Size (fish/lb)	Mark or Tag Code
1989 [a/]	04/17/91	20,489	12	AD
1989 [a/]	04/17/91	28,415	12	AD
1990 [a/]	11/04/91	6,018	4	AD
1990 [a/]	11/04/91	2,503	8	AD
1990	04/22/92	8,283	12	AD
1990	04/22/92	10,279	11	AD
1990	04/22/92	42,682	14	AD
1990	04/22/92	10,694	13	AD
1990	04/22/92	9,100	11	AD
1990	04/22/92	10,627	12	AD
1990	04/22/92	24,532	13	AD
1990	04/22/92	3,850	13	AD
1990	04/22/92	3,600	12	AD
1990 [a/]	04/22/92	45,191	12	AD
1990	04/22/92	11,534	13	AD
1990	04/22/92	32,338	13	AD
1990	04/22/92	47,406	12	AD
1990	04/22/92	10,741	12	AD
1990	04/22/92	37,319	12	AD
1990	04/22/92	34,051	12	AD
1990	04/22/92	37,942	12	AD
1990	04/22/92	34,807	13	AD
1990 [a/]	04/22/92	48,497	12	AD
1990	04/22/92	17,470	12	AD
1990	04/22/92	13,771	10	AD
1990	04/22/92	37,709	13	AD
1990	04/22/92	38,188	12	AD
1990	04/22/92	23,896	11	AD
1990	04/22/92	18,193	13	AD
1990	04/22/92	38,286	12	AD
1991	10/01/92	6,488	22	AD
1991	10/01/92	6,379	22	AD
1991	10/01/92	6,172	22	AD
1991	10/01/92	4,736	22	AD

(continued)

Appendix B. Juvenile spring chinook salmon released from Warm Springs National Fish Hatchery into the Warm Springs River, 1978-93 broods.

Brood Year	Date Released	Number	Size (fish/lb)	Mark or Tag Code
1991	11/16/92	2,116	19	AD
1991	11/16/92	4,060	22	AD
1991 a/	11/16/92	4,107	22	AD
1991 a/	11/16/92	1,045	21	AD
1991 a/	11/16/92	2,063	19	AD
1991 a/	11/16/92	3,142	19	AD
1991 a/	11/16/92	2,217	19	AD
1991 a/	11/16/92	3,707	49	AD
1991 a/	11/16/92	1,045	21	AD
1991	04/22/93	47,047	16	AD
1991	04/22/93	36,860	17	AD
1991	04/22/93	11,253	18	AD
1991	04/22/93	37,900	18	AD
1991	04/22/93	37,379	15	AD
1991	04/22/93	14,370	15	AD
1991 a/	04/22/93	10,731	18	AD
1991 a/	04/22/93	10,732	18	AD
1991 a/	04/22/93	47,514	13	AD
1991	04/22/93	32,262	19	AD
1991 a/	04/22/93	25,347	18	AD
1991	04/22/93	29,958	18	AD
1991 a/	04/22/93	39,517	18	AD
1991 a/	04/22/93	25,348	18	AD
1991 a/	04/22/93	11,563	18	AD
1991	04/22/93	33,905	18	AD
1991	04/22/93	33,906	18	AD
1991	04/22/93	24,145	16	AD
1992	11/15/93	3,142	19	AD
1992	11/15/93	837	23	AD
1992	11/15/93	3,139	21	AD
1992	11/15/93	3,139	21	AD
1992	11/15/93	3,139	21	AD
1992	11/15/93	5,233	20	AD
1992	11/15/93	3,139	21	AD
1992	11/15/93	1,331	23	AD

(continued)

Appendix B. Juvenile spring chinook salmon released from Warm Springs National Fish Hatchery into the Warm Springs River, 1978-93 broods.

Brood Year	Date Released	Number	Size (fish/lb)	Mark or Tag Code
1992	04/20/94	48,700	19	AD
1992	04/20/94	26,231	15	AD
1992	04/20/94	43,909	15	AD
1992	04/20/94	39,460	14	AD
1992	04/20/94	24,639	15	AD
1992	04/20/94	35,753	14	AD
1992	04/20/94	37,273	18	AD
1992	04/20/94	24,738	14	AD
1992	04/20/94	21,696	15	AD
1992	04/20/94	25,569	14	AD
1992	04/20/94	23,928	15	AD
1992	04/20/94	34,248	20	AD
1992	04/20/94	24,927	15	AD
1992	04/20/94	22,709	15	AD
1992	04/20/94	24,180	16	AD
1992	04/20/94	40,355	20	AD
1993	11/16/94	1,255	15	AD
1993	11/16/94	1,937	13	AD
1993	11/16/94	2,580	16	AD
1993	11/16/94	1,937	12	AD
1993	11/16/94	917	15	AD
1993	11/16/94	1,998	12	AD
1993	11/16/94	1,998	13	AD
1993	11/16/94	1,934	13	AD
1993	11/16/94	1,941	13	AD
1993	03/31/95	30,021	9	AD
1993	03/31/95	30,065	8	AD
1993	03/31/95	28,925	10	AD
1993	03/31/95	28,904	12	AD
1993	03/31/95	18,788	14	AD
1993	03/31/95	38,500	13	AD
1993	03/31/95	29,841	12	AD
1993	03/31/95	29,811	11	AD
1993	03/31/95	30,827	12	AD
1993	03/31/95	29,515	10	AD

(continued)

Appendix B. Juvenile spring chinook salmon released from Warm Springs National Fish Hatchery into the Warm Springs River, 1978-93 broods.

Brood Year	Date Released	Number	Size (fish/lb)	Mark or Tag Code
1993	03/31/95	29,122	9	AD
1993	03/31/95	28,647	11	AD
1993	03/31/95	28,679	12	AD

a/ Volitional release.

b/ Oxytetracycline mark, 2 = two feedings.

c/ Fish obtained from Round Butte Hatchery.

d/ In 1984, fish with low levels of bacterial kidney disease (BKD) were given an LV fin clip and those with moderate levels, an RV fin clip.

LOWER DESCHUTES RIVER SUBBASIN FISH MANAGEMENT PLAN
SECTION 6. FALL CHINOOK SALMON

Table of Contents

FALL CHINOOK SALMON

BACKGROUND AND STATUS

Origin

Fall chinook salmon, *Oncorhynchus tshawytscha*, occur throughout the mainstem Deschutes River below Pelton Reregulating Dam. All production of fall chinook salmon in the subbasin is from wild stock. Summer and fall flows in the lower Deschutes River may have historically limited distribution of fall chinook salmon to 44 miles of river downstream from Sherars Falls before a fish ladder was built at the falls in the 1930's (Figure 6.1). Construction of Pelton and Round Butte hydroelectric dams in 1958 and 1964, respectively, inundated spawning areas above river mile 100. Upstream passage was possible around the hydroelectric complex but downstream passage facilities at the dams proved insufficient to sustain wild runs above the dams.

Schreck et al. (1986) classified populations of Columbia River chinook salmon (wild and hatchery; spring, summer, and fall) into several broad groups of similar populations by cluster analysis of characteristics associated with body shape, meristics, biochemistry, and life history. Wild fall chinook salmon from the Deschutes River were similar to eight hatchery and wild fall chinook salmon populations that occur in the Columbia River basin from the Cowlitz River to the Hanford Reach and were also similar to two hatchery spring chinook salmon populations from the lower Columbia River. Deschutes River fall chinook salmon were not genetically similar to summer chinook salmon from the upper Columbia River or from the Salmon River. Details of the gene frequencies, meristic characters, and body shape characters of Deschutes River fall chinook salmon can be found in Schreck et al. (1986).

The fall spawning chinook stock enters the subbasin from late June to October (Table 6.1). It is unknown if this stock is composed of both summer and fall runs or a single run with a protracted time of entry into the subbasin. The available information suggests, however, that if a summer race of chinook was present, it appears to be functionally extinct today.

Information has been compiled and presented in this plan under the assumption that this is one race of chinook salmon but an escapement goal for adult fall chinook migrating upstream from Sherars Falls is recognized to manage for the biological diversity these fish are thought to represent.

The run size of fall chinook salmon (adult and jack) into the lower Deschutes River subbasin from 1977 through 1995 averaged 9,465 fish annually, ranging from 4,061 fish to 19,808 fish (Table 6.2). Annual spawning escapement of jacks and adults averaged 3,482 fish and 4,107 fish, respectively, in this period (Tables 6.3 and 6.4).

Life History and Population Characteristics

It is uncertain if the lower Deschutes River fall chinook run is composed of one population spawning throughout the lower 100 miles of the Deschutes or two populations; one spawning above Sherars Falls and one spawning below Sherars Falls. Beaty (1995) examined this question in detail but could not reach a definitive conclusion on the existence two populations.

Evidence that supports both the one population concept and the two population concept exists.

Evidence supporting the one population concept is that prior to construction of a fish ladder at Sherars Falls in the 1930's, true fall chinook probably had difficulty negotiating the falls during normal late summer and fall flows and the majority of spawning was below Sherars Falls. It is possible that portions of the population spawning below Sherars Falls took advantage of spawning and rearing habitat above Sherars Falls made available by ladder construction and the number of adult fall chinook passing Sherars Falls increased through time. The period of time from construction of the ladder at Sherars Falls to present is, however, too brief to expect population specific life history characteristics such as run timing to become established. Additionally, temporal and spatial reproductive isolation necessary to maintain population specific differences between fall chinook that pass Sherars Falls early in the fall run and later in the fall run cannot be demonstrated (Jonasson and Lindsay 1988). Nehlsen (1995) mentions that a large increase in fall chinook numbers above Sherars Falls took place after John Day Dam was completed in 1968, likely in response to flooding mainstem Columbia River spawning areas (Figure 6.2). This would suggest that the current lower Deschutes River fall chinook population is a mixture of stocks that historically spawned in the Columbia River and Deschutes River below Sherars Falls and currently utilizes the lower 100 miles of the Deschutes River. Jonasson and Lindsay (1988) concluded that only one population of fall chinook currently exists in the lower Deschutes River subbasin. Oregon's Provisional Wild Fish Population List recognizes one population or race of fall chinook salmon in the lower Deschutes River subbasin.

Evidence exists that two populations were historically present and may continue to exist. Galbreath (1966) reported several instances of chinook tagged at Bonneville Dam during the summer chinook migration (June 1 to July 31 at Bonneville Dam) being recovered later in the Deschutes River subbasin. Three of these tags were recovered in the Metolius River prior to the time anadromous runs were blocked by dams on the Deschutes River, suggesting that a portion of the Deschutes River chinook population, potentially summer chinook, spawned in the Metolius River and maintained spatial reproductive and hence racial separation. Additionally, a jack chinook radio tagged by the US Army Corps of Engineers at Bonneville Dam in early June (summer chinook run timing) was recovered in the lower Deschutes River in October, 1984 (Jonasson and Lindsay 1988).

Trapping at Sherars Falls shows two peaks in migration timing of the non-spring chinook - one in June through August and one in late September and early October (Figure 6.3). Fish from the earlier migration peak tend to migrate further up the system and be captured at the Pelton Trap at a higher rate than the later migrating group. During run years 1977 through 1986, 28% of the fall chinook that passes Sherars Falls did so prior to September 1. However, of the adults caught in the Pelton Trap for those run years, 48% were caught by September 1 (Jonasson and Lindsay 1988). Prior to construction of the ladder at Sherars Falls, it is likely that June and July migrating chinook could pass Sherars Falls more readily than chinook attempting passage in September and October due to generally greater flows earlier in the summer.

In recent years, population trends of chinook spawning above and below Sherars Falls have not been the same, suggesting the two groups may be separate and subject to different environmental conditions and mortality factors within and outside the subbasin.

Nehlsen (1995) tends to discount the presence of summer chinook in the Deschutes River subbasin based on a lack of zero-aged juvenile migrants captured during Pelton Dam evaluations. Recent evidence shows that summer chinook do not exclusively exhibit a zero-aged migrant life history and yearling migrants classified as spring chinook during Pelton Dam evaluations could have, in fact, been misclassified summer chinook juveniles (Chapman et al. 1994). Additionally, the skimmer traps used to sample juveniles in the impoundment created by Pelton Dam may have selected against summer or fall chinook juvenile capture. Gessel et al. (1989) found that juvenile fall chinook migrate deeper in the water column and are not as effectively guided into trap and bypass facilities as spring chinook.

Possible reasons for the decline in the earlier migrating Deschutes River chinook are many. Spawning and rearing areas were undoubtedly lost due to construction of the Pelton/ Round Butte hydroelectric complex. Reproductive isolation needed to maintain populations above and below Sherars Falls was lost first by providing passage at Sherars Falls with the fish ladder in the 1930's and second by the dam complex truncating available spawning area. Since the earlier returning group of chinook appear to have migrated upstream past Sherars Falls, they were subjected to greater selective harvest pressure by tribal and recreational fishers there than the chinook which spawned below Sherars Falls. Population declines in the earlier returning group of lower Deschutes River chinook may have been masked during the mid-1980's by higher than normal ocean survival and subsequent adult returns that many coastal and Columbia River chinook stocks exhibited (Beaty 1995).

The average age class structure of lower Deschutes River fall chinook during 1977 through 1986 brood years was 34% age-2 fish, 30% age-3 fish, 31% age-4, 5% age- 5, and less than 1% age-6 fish. Approximately 96% of the returns during the same brood years had entered the ocean at age 0, and 4% had entered the ocean at age 1 (Jonasson and Lindsay 1988).

Mean lengths of the four most common ages at return are shown in Table 6.5. In the lower Deschutes River subbasin, 21.3 inches is the length criterion to differentiate between jacks and adults for inventory purposes. Only 2% of age-2 fish are larger than 21.3 inches, and only 15% of age-3 fish are smaller than 21.3 inches (Jonasson and Lindsay 1988).

Information is not available regarding sex ratio, fecundity, or adult length-weight relationship.

Spawning of fall chinook begins in late September, reaches a peak in November, and is completed in December (Table 6.1; (Jonasson and Lindsay 1988). Researchers have observed carcasses of spawned out fall chinook salmon from late September to late December with the peak number of carcasses noted during the last half of November. Ripe males and females have, however, been captured in Pelton trap in early December.

Emergence of fry from the gravel begins in January or February and is completed in April or May (Table 6.1; Jonasson and Lindsay 1988).

Fall chinook salmon spawn throughout the lower Deschutes River from the river mouth to Pelton Reregulating Dam. The upper six miles of the lower Deschutes River (Dry Creek to Pelton Reregulating Dam) were heavily utilized for spawning in the 1970's and early 1980's. During the period 1972 through 1986, 46% of all redds counted were counted in four sample areas above Dry Creek. These four areas represent only 16% of the area surveyed for redds from the river mouth to the dam (Jonasson and Lindsay 1988). Huntington (1985) found approximately 55% of the suitable spawning gravel for chinook salmon in the upper three miles of the river, from Shitike Creek to Pelton Reregulating Dam.

Redd counts during years 1988 to 1995 suggest that a change in historic spawning distribution may be occurring and a higher percentage of all spawning is taking place downstream from Sherars Falls (Table 6.6). During the years 1972 to 1987, an average of 76% of the fall chinook redds counted in the lower 100 miles of the Deschutes River were counted upstream from Sherars Falls. During year 1988 to 1995, an average of 30% of all redds counted were upstream from Sherars Falls. Reasons for this shift in historic spawning distribution are unknown but may include deterioration in spawning gravel quality or quantity above Sherars Falls, increased egg to smolt survival below Sherars Falls resulting from riparian habitat enhancement in this reach, passage problems associated with the Sherars Falls fish ladder, intensive water contact recreation above Sherars Falls, and over harvest of the portion of the run destined to spawn above Sherars Falls.

This change in spawning distribution as measured both by the number of redds counted upstream from Sherars Falls and the estimated number of adult and jack fall chinook migrating upstream from Sherars Falls has management implications in the subbasin. An important recreational and one of the last remaining tribal dipnet fisheries in the region takes place in the Sherars Falls area and both are dependent on fall chinook that migrate upstream from Sherars Falls. The estimated number of both adult and jack fall chinook migrating upstream from Sherars Falls has generally declined since 1988 (Table 6.7). Trends in abundance of adult and jack fall chinook upstream from Sherars Falls appears to be independent of abundance of adult and jack fall chinook spawning downstream from Sherars Falls (Table 6.7)

The shift in spawning distribution from above to below Sherars Falls has driven harvest regulations to protect the low number of spawning fall chinook above Sherars Falls since 1991.

From 1978 through 1980, the abundance of juvenile fall chinook salmon was highest in the area from Dry Creek to Pelton Reregulating Dam and progressively decreased downriver and distribution of juveniles generally corresponded to distribution of spawning (Jonasson and Lindsay 1988). While specific information on juvenile abundance in recent years is lacking, it is possible that the apparent shift in fall chinook spawning distribution from above Sherars Falls to below Sherars Falls has resulted in increased abundance of juveniles below Sherars Falls.

Most juvenile fall chinook salmon leave the lower Deschutes River from May to July at age 0 (Table 6.1). In 1979 and 1980, the peak of migration occurred earliest from the river mouth to Sherars Falls and progressively later in upriver sections. Emigration through the Columbia River occurs from April to August, with the median passage in June and July. A small percentage of the juvenile fall chinook remain in the lower Deschutes River over winter and emigrate in spring at age 1.

Information on survival rates for fall chinook salmon in the lower Deschutes River subbasin is not available.

Lower Deschutes River fall chinook are susceptible to ceratomyxosis, the disease caused by the myxosporean *Ceratomyxa shasta*. Juvenile fall chinook salmon seined from the lower Deschutes River before May 4 in 1978 and June 8 in 1979 were not infected with *C. shasta*. Infection rates increased for groups of fish seined from the river until July 7 of 1978 (56% infected) and July 16 of 1979 (90% infected), and then steadily decreased to low infection rates in September of both years (Ratliff 1981). It is possible that most juvenile fall chinook salmon avoid contracting ceratomyxosis by emigrating to the ocean before July when high numbers of infective units of *C. shasta* are present in the river. Beaty (1995) examined the question of ceratomyxosis and concluded that the importance of *C. shasta* as a mortality factor in juvenile lower Deschutes River fall chinook is unknown.

Fish Production Constraints

Major habitat constraints to production of fall chinook salmon in the lower Deschutes River are listed in Table 6.8. Spawning gravel quality and quantity are the major constraints identified. The Pelton/Round Butte hydroelectric project has prevented the natural transportation of gravel by the stream channel from areas upstream of the dams. Riparian areas throughout the subbasin likely contain less large woody material to potentially contribute to the lower Deschutes River than was present historically and the many dams in the basin have prevented the recruitment of large woody debris to the lower Deschutes River. Large woody material in many river systems facilitates island and gravel bar formation and provides in-channel diversity. Even though the Pelton/Round Butte hydroelectric complex has not historically been managed for flood control, the cumulative amount of water storage in the Deschutes basin may have resulted in an altered flow regime in the lower Deschutes River. This may be affecting both gravel quantity and quality in the lower Deschutes River. All fall chinook spawning in the lower Deschutes River occurs in the mainstem and the availability of quality gravel is of extreme importance. There is currently a study of the fluvial geomorphology of the lower Deschutes River which will help determine how sediment, including spawning gravels, are transported and deposited within the lower Deschutes River (Grant et al. 1996).

Stream bank degradation, primarily caused by livestock and recreational use, may also limit production by providing a chronic source of sedimentation and decreasing available juvenile rearing habitat by inhibiting growth of riparian plant communities.

Disease, specifically ceratomyxosis, may impact fall chinook salmon production by killing some of the late emigrating smolts.

Adult fall chinook migrating above Sherars Falls may delay their migration for a period of time immediately below the falls and be subject to excessive harvest by both recreational and tribal fishers during years when a fishery occurs.

Harvest of lower Deschutes River fall chinook in the ocean and Columbia River may constrain managers abilities to meet subbasin production goals. Jonasson and Lindsay (1988) found, using coded wire tag recoveries from fall chinook juveniles that were coded wire tagged during the 1977 through 1979 broods, that 74% of lower Deschutes River fall chinook harvest took place out of the subbasin. Ocean fisheries accounted for 64% of the total harvest and Columbia River fisheries accounted for 10% of the total harvest. In the absence of more recent ocean harvest data specific to the lower Deschutes stock, Beaty (1995) used another fall chinook stock, the Lewis River (Washington) fall chinook, as an indicator stock to draw conclusions relative to more recent ocean harvest of the lower Deschutes River stock. He concluded that ocean exploitation of lower Deschutes River fall chinook has likely changed little from that measured during the 1977 through 1979 broods. The Pacific Marine Fisheries Council, the group that regulates ocean fisheries in United States coastal waters, has greatly reduced ocean chinook salmon harvest in recent years due to concerns for federally listed chinook stocks. Because of this reduction, Deschutes River fall chinook may now be harvested out of the subbasin at a lower rate than earlier estimated.

HATCHERY PRODUCTION

Fisheries managers out-planted hatchery populations of Little White Salmon River fall chinook salmon in the Warm Springs River without success in 1958, 1967, and 1968 (Table 6.9). There was some experimental production of fall chinook salmon at Round Butte Hatchery in the late 1970's. This project was discontinued because of poor returns, possibly due to ceratomyxosis (Ratliff 1981). No future supplementation of fall chinook salmon in the lower Deschutes River subbasin is anticipated.

ANGLING AND HARVEST

Harvest of fall chinook salmon in the lower Deschutes River occurs primarily in a 3-mile section from Sherars Falls downstream to the first railroad trestle. This section of river is the only area of the lower Deschutes River where the use of bait by recreational anglers is permitted. A popular recreational fishery and one of the last tribal subsistence fisheries for fall chinook salmon in the region typically occurs from early July, when the first fish arrive at Sherars Falls, to late October. During years when recreational harvest of fall chinook was allowed, 88% of the recreational harvest of adult fall chinook downstream from Sherars Falls took place in the Sherars Falls reach; the remaining 12% were caught throughout the river as incidental captures in the recreational fishery for summer steelhead. No target recreational fall chinook fisheries have been documented by managers outside of the Sherars Falls reach.

No method currently exists to predict either preseason or mid-season fall chinook run strength. Previous modeling efforts have yielded less than desirable results. This has made it necessary for managers to regulate subbasin harvest using trends in run to the river and estimated escapement over Sherars Falls as indicators of population health. This is a less desirable management option than is available for spring chinook management where data exists to make a preseason run strength estimate and regulate subbasin harvest to provide the desired spawner escapement. Scale samples required to assign brood year and facilitate modeling the population are routinely collected at the Sherars Falls trap and are currently being analyzed. This data will be used to refine modeling and preseason prediction efforts.

The apparent shift in spawning distribution from above to below Sherars Falls has driven harvest regulations to protect the low number of fall chinook spawning above Sherars Falls since 1991.

Recreational and tribal harvests of fall chinook salmon in the lower Deschutes River are shown in Tables 6.2, 6.3, and 6.4. Concerns for low numbers passing over Sherars Falls resulted in season length and harvest restrictions from 1991 to 1995.

Recreational harvest averaged 320 adult fall chinook and tribal harvest averaged 1,297 adult fall chinook from 1977 to 1990, years when season length and harvest restrictions were not in place. During the same time period, recreational harvest averaged 693 jack fall chinook and tribal harvest averaged 372 jack fall chinook. Of the fall chinook salmon that entered the lower Deschutes River from 1977 through 1990, 31% of the adults and 29% of the jacks were harvested in recreational and tribal fisheries. Fall chinook salmon and summer steelhead provide an average of 4,200 angler days and 21,500 angler hours annually in the recreational fishery at Sherars Falls and 4,900 fishing hours annually in the tribal subsistence fishery during years of unrestricted fishing.

No specific harvest management goals or treaty and non-treaty harvest allocation agreements exist for fall chinook salmon in the lower Deschutes River subbasin. Although no specifics are proposed, an action item of this plan is to develop a cooperative harvest management agreement with the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS).

The Oregon Fish and Wildlife Commission sets harvest regulations for recreational fisheries in the subbasin. During years when harvest regulations were not needed to meet escapement goals, the salmon season has been April 1 to October 31 below Sherars Falls, and the fourth Saturday in April to October 31 above Sherars Falls. Fall chinook angling was allowed October 1 to October 31 during 1991 but has been closed in the lower Deschutes River from

1992 through 1995. Additionally, the one mile reach from Sherars Falls downstream to Buck Hollow Creek has been closed to all angling during those years. Throughout the lower 100 miles, the recreational fishery has been restricted to use of barbless flies and lures only since 1979, except in the 3-mile section from the first railroad trestle downstream from Sherars Falls up to Sherars Falls where anglers may use bait with barbless hooks. The catch limit for salmon and steelhead has been two adults per day in any combination, six adults per week, and 10 jack salmon per day, 20 per week. Oregon State Police and the Warm Springs Tribal Police enforce fishing regulations in the subbasin.

The CTWS regulate all on-reservation fishing by both tribal members and non-members and also regulates off-reservation fishing by tribal members. CTWS regulations for the on-reservation recreational fishery on the lower Deschutes River bordering the reservation are consistent with Oregon Department of Fish and Wildlife regulations. The CTWS Tribal Council regulates the off-reservation treaty fishery through time and area closures, depending on stock and run-size status. In recognition of low run sizes in 1991 through 1995, CTWS Tribal Council has placed harvest and season length restrictions on tribal fall chinook fishers (Table 6.2).

Harvest of fall chinook at Sherars Falls has been monitored with a statistical harvest survey of the recreational and tribal fisheries. For specific information on harvest survey methodology, see Jonasson and Lindsay (1988).

Juvenile fall chinook from the lower Deschutes River were coded wire tagged during the 1977 through 1979 brood years to monitor out of subbasin harvest. Seventy-four percent of lower Deschutes River fall chinook harvest occurred in the ocean, 10% in the Columbia River, and 26% in the lower Deschutes River subbasin (Jonasson and Lindsay 1988). Ocean harvest occurred from California to Alaska but 85% was north of the Columbia River, principally off British Columbia. Current ocean harvest rates, particularly in ocean waters governed by the United States - Canada harvest treaty, are believed to be similar to those measured for the 1977 to 1979 brood years. Chinook harvest in United States coastal waters governed by the Pacific Fisheries Management Council may be less than those measured earlier. Out of subbasin harvest rates may constrain managers ability to allow increased fall chinook harvest in the subbasin.

The CTWS have raised concerns relative to the harvest of fall chinook potentially destined for the lower Deschutes River in a sport fishery in the Columbia River just downstream from the mouth of the Deschutes River. The CTWS speculate that chinook destined for the lower Deschutes River use the cold water plume at the Deschutes River/Columbia River confluence as a refuge from warmer Columbia River water and as a transition area to move from the Columbia River into the lower Deschutes River. The CTWS are concerned that fall chinook destined for the lower Deschutes River are being harvested at an unacceptable rate in this area. ODFW acknowledges but does not share this concern.

This plan sets no objectives for out of subbasin harvest. Out of subbasin objectives are beyond the scope and purview of this plan.

MANAGEMENT CONSIDERATIONS

Fall chinook salmon in the subbasin are currently managed for wild fish only; no hatchery fall chinook salmon are released in the subbasin.

This stock, which enters the subbasin from late June to October, may be composed of both summer and fall runs or a single run with a protracted time of entry into the subbasin. It is unknown if the lower Deschutes River fall chinook run is composed of a single group that spawns throughout the lower 100 miles of the river or two groups that spawn discretely above or below Sherars Falls. Given the importance of the group that spawns upstream from Sherars Falls to subbasin fisheries, particularly tribal subsistence fishers, this plan recognizes an escapement goal for adult fall chinook passing Sherars Falls to protect the biological diversity this group represents.

The run size of adult fall chinook salmon into the lower Deschutes River subbasin from 1977 through 1995 averaged 5,323 fish and ranged from 2,813 to 8,250 annually. Annual spawning escapement of adult fall chinook averaged 4,107 during the same period and ranged from 2,224 to 8,239. Annual spawning escapement of adult fall chinook upstream from Sherars Falls averaged 2,771 for the period 1977 through 1988 and 932 for the period 1989 through 1995. Annual spawning escapement of adult fall chinook from the mouth of the Deschutes River up to Sherars Falls averaged 2,155 for the period 1977 through 1988 and 4,009 for the period 1989 through 1995.

Assuming out of subbasin harvest rates remain similar to those measured by Jonasson and Lindsay (1988), the stock appears capable of maintaining total production with an average adult spawning escapement of approximately 4,000 adults to the Deschutes River. Spawning escapement of this level should provide for an average annual harvest in the subbasin of approximately 1,300 adult fall chinook. Jack production in the subbasin would be expected to continue at historic levels with these adult escapement and harvest levels.

The shift in fall chinook spawning distribution from upstream of Sherars Falls to downstream of Sherars Falls has complicated management in the subbasin. The group of fall chinook that spawns upstream from Sherars Falls appears to require an adult spawning escapement of approximately 2,000 fish to maintain adequate production. Fall chinook jack production in the area upstream of Sherars Falls would be expected to continue at historic levels with these adult escapement and harvest levels.

An accurate stock recruitment model similar to that used to predict adult spring chinook returns to the subbasin does not exist for fall chinook but is currently being investigated. This lack of a preseason prediction of adult returns has made it necessary to conduct subbasin harvest management based on population trends rather than on yearly predicted population strength.

Lower Deschutes River fall chinook salmon support important recreational and CTWS subsistence fisheries in the subbasin and contribute to ocean and Columbia River fisheries. In years prior to conservation driven harvest restrictions, approximately 20% of the in-subbasin harvest was taken by recreational fishermen and 80% by tribal fishers. In-subbasin harvest rates in the recreational and tribal fisheries from 1977 to 1990, years of historic season length, have averaged 31% for adults and 29% for jacks entering the lower Deschutes River.

All fall chinook salmon production in the subbasin occurs in the mainstem lower Deschutes River. During the 1970's and early 1980's the reach of river immediately below the Pelton/Round Butte hydroelectric complex was believed to be the principal production area for fall chinook. Spawning distribution appears to have shifted since 1988 from above Sherars Falls to below Sherars Falls.

Habitat factors believed to limit production in the subbasin are the quantity and quality of spawning gravel throughout the lower Deschutes River. There have been two studies done assessing the condition of spawning gravel in the mainstem lower Deschutes River, one in the mid-1960's (Aney et al. 1967) and another in the early 1980's (Huntington 1985). The Pelton/Round Butte hydroelectric complex has interrupted the recruitment of gravel into downstream areas, particularly affecting the three mile reach immediately downstream from the dams. Recruitment of large woody material into the lower Deschutes River has been lessened by a variety of factors. Sediment accumulating in the gravel is another concern relative to fall chinook spawning success.

Ways to benefit fall chinook production in the subbasin include reducing the amount of fine sediment input into the aquatic environment through riparian habitat enhancement and the discharge of flushing flows from the Pelton/Round Butte hydroelectric project to help clean gravel bars in the mainstem lower Deschutes River. A study is currently underway to help identify the fluvial geomorphology of the lower Deschutes River which will help determine how sediment, including spawning gravels are transported and deposited within the lower Deschutes River (Grant et al. 1996). The addition of large woody debris may aid in island and gravel bar formation and provide additional inchannel diversity. Riparian habitat enhancement will also increase available habitat and habitat effectiveness for juvenile fall chinook. Periodic introductions of suitable spawning gravel would reduce the net loss of gravel from the river below the dams and may benefit fall chinook production.

Critical Uncertainties

1. The lower Deschutes River fall chinook stock may be a single stock with a protracted run timing. If this is the case, it is uncertain if the stock is a single population that spawns throughout the river or two stocks that spawn in discrete areas above and below Sherars Falls. The lower Deschutes River fall chinook stock may also be distinct summer and fall runs.
2. Factors limiting production of fall chinook salmon in the lower Deschutes River are unknown.
3. The number of fall chinook salmon smolts produced in the lower Deschutes River is unknown.
4. Smolt-to-adult survival rate of fall chinook salmon in the lower Deschutes River is unknown.
5. A stock recruitment model for fall chinook salmon in the lower Deschutes River is not currently available but is being investigated.
6. Increases in fall chinook salmon production as a result of riparian habitat improvement and enhancement of spawning gravel are difficult to quantify.
7. Ocean and Columbia River fisheries accounted for 74% of the total harvest of lower Deschutes River fall chinook from the 1977 through 1979 broods. Current out of basin harvest rates are unknown but are believed to be similar to those measured for the 1977 to 1979 broods.
8. Causes for the shift in fall chinook salmon production from above Sherars Falls to below are unknown.

MANAGEMENT DIRECTION

Management direction places the highest priority on wild fall chinook and precludes the release of hatchery fall chinook in the lower Deschutes River and its tributaries. Efforts will be made to restore and protect the wild fall chinook populations in the lower Deschutes River subbasin. Low subbasin harvest rates may be needed some years to meet escapement goals.

Objectives and actions contained in the adopted alternative will be used to set district work plans that form the basis for monitoring and evaluation programs. Completion of actions listed under an objective contribute to the meeting of that objective. Many actions cannot be accomplished under current levels of funding. If funding continues to be limited, ODFW will pursue completion of actions according to priorities as funds become available.

Policies

Policy 1. *No hatchery fall chinook salmon shall be released into the lower Deschutes River and its tributaries.*

Objective 1. Achieve a minimum annual spawning escapement of 4,000 adult fall chinook in the lower Deschutes River with a minimum annual spawning escapement of 2,000 adult fall chinook upstream of Sherars Falls.

Assumptions and Rationale

1. The CTWS manage their fisheries consistent with conservation of indigenous species. The CTWS are co-managers in meeting subbasin management plan objectives and will be involved in fish management activities in the lower Deschutes River subbasin at all levels. All action items will be conducted in cooperation with CTWS as co-managers of the resource.
2. The genetic diversity, adaptiveness, and abundance of wild lower Deschutes River fall chinook will be adequately maintained by an average spawning escapement of 4,000 adult fall chinook. Jack production would be expected to continue at historic levels given this adult escapement.
3. The genetic diversity, adaptiveness, and abundance of the wild lower Deschutes River fall chinook that spawn upstream of Sherars Falls will be adequately maintained by an average spawning escapement of 2,000 adult fall chinook. Jack production would be expected to continue at historic levels given this adult escapement.
4. Out of subbasin harvest will not prevent this escapement objective.
5. Monitoring the distribution and abundance of wild fall chinook salmon in the lower Deschutes River will provide an indication of their health and adaptiveness.
6. It is uncertain if there is a single population of fall chinook in the subbasin that has a protracted run timing or two populations, one spawning above Sherars Falls and the other spawning below Sherars Falls.

Actions

Action 1.1. Monitor escapement of wild fall chinook into the lower Deschutes River and escapement upstream of Sherars Falls.

Action 1.2. Determine life history and genetic characteristics of the June to July and August to October segments of the chinook salmon run.

Action 1.3. Investigate the cause of the shift in historic spawning distribution and determine if discrete groups of fall chinook spawn upstream and downstream of Sherars Falls.

Action 1.4. If a distinct group of fall chinook exists upstream or downstream from Sherars Falls, determine the status of those groups. Different management actions may be appropriate for the two groups.

Action 1.6. Mark wild fall chinook juveniles in the lower Deschutes River subbasin with coded wire tags to document location and rate of out of subbasin harvest.

Action 1.7. Investigate the importance of *Ceratomyxa shasta* in mortality of adult and juvenile fall chinook upstream and downstream from Sherars Falls.

Objective 2. Provide the opportunity to harvest wild fall chinook when returns are greater than the spawning escapement objectives of 4,000 adults to the river and 2,000 adults escaping upstream from Sherars Falls.

Assumptions and Rationale

1. The CTWS manage their fisheries consistent with conservation of indigenous species. The CTWS are co-managers in meeting subbasin management plan objectives and will be involved in fish management activities in the lower Deschutes River subbasin at all levels. All action items will be conducted in cooperation with CTWS as co-managers of the resource.
2. Spawning escapements of 4,000 adults in the lower Deschutes River and 2,000 adults upstream of Sherars Falls are sufficient to allow the population to retain its genetic characteristics and capacity to evolve.
3. Harvest may need to be severely constrained to meet the spawning escapement objective upstream of Sherars Falls.
4. Angling regulations in place to conserve other species present in the lower Deschutes River may constrain recreational harvest opportunities for fall chinook.
5. The CTWS and ODFW are willing to identify a process to develop a cooperative harvest management agreement.

Actions

Action 2.1. Develop a model to predict pre-season run strength of fall chinook to the mouth of the Deschutes River and escaping upstream of Sherars Falls.

Action 2.2. Develop a model to predict run strength of fall chinook in the lower Deschutes River and upstream of Sherars Falls at a mid-point in the run timing.

Action 2.3. Absent the use of a predictive model, allow recreational harvest of fall chinook in the lower Deschutes River subbasin when the spawning escapement goals of 4,000 adults to the river and 2,000 adults upstream of Sherars Falls has been met two out of three consecutive years.

Action 2.4 If spawning escapement to the river on any one year is less than 2,000 adult fall chinook, enact regulations to protect fall chinook until escapement goals are met.

Action 2.5. Conduct statistical harvest sampling at an intensity and frequency sufficient to accurately measure harvest.

Action 2.6. Develop a cooperative harvest management agreement with CTWS.

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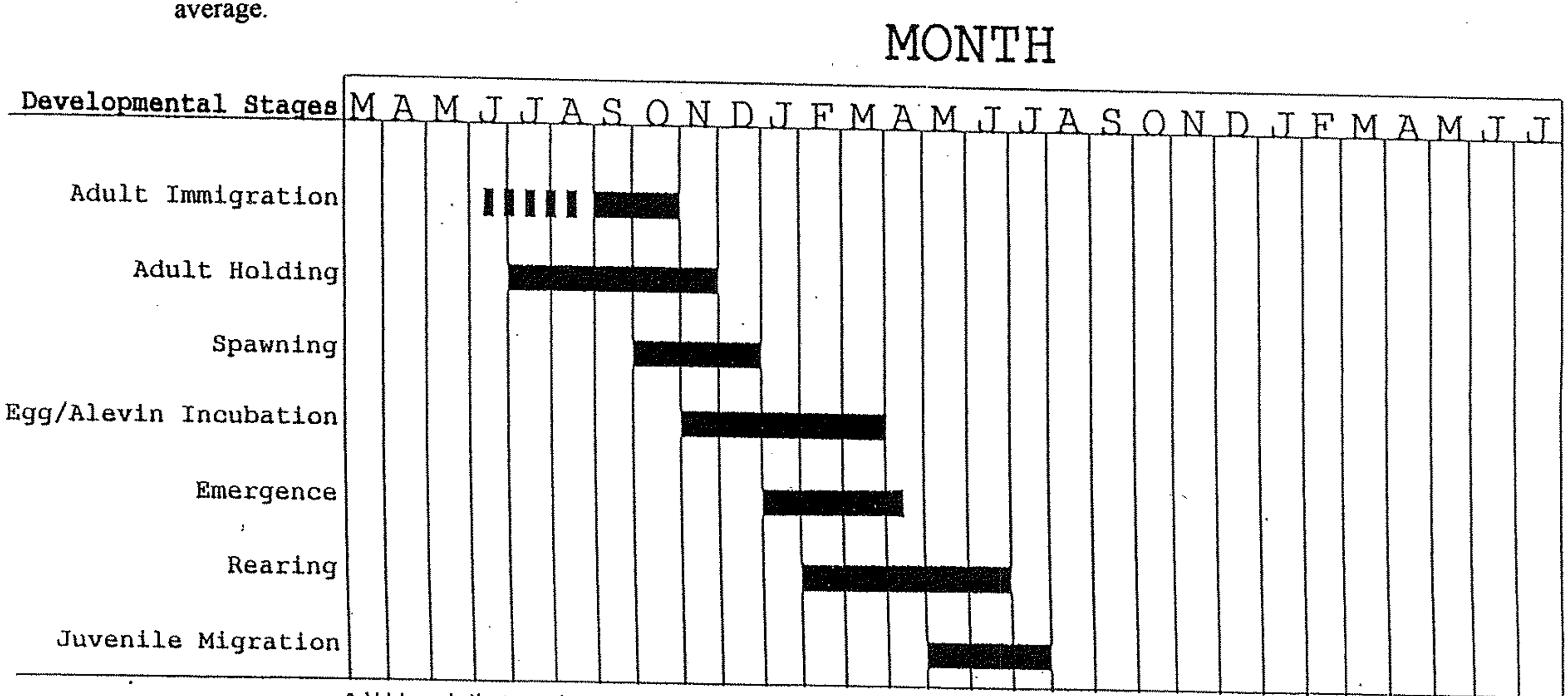
SECTION 6. FALL CHINOOK

FIGURES AND TABLES

Table 6.1. Freshwater life history for fall chinook in the lower Deschutes River. Developmental stage timing represents basin-wide average.



Solid bars indicate periods of heaviest adult immigration, spawning and juvenile emigration.

Table 6.2. Run size of wild fall chinook salmon (adults and jacks) in the lower Deschutes River, 1977-95.

Year	Harvest: Tribal [a/]	Harvest: Recreational	Escapement	Run Size
1977	2,280	1,253	7,756	11,289
1978	2,037	1,531	6,862	10,430
1979	1,991	1,601	7,629	11,221
1980	2,133	1,325	4,446	7,904
1981	1,786	1,345	6,911	10,042
1982	1,826	1,696	8,250	11,772
1983	1,549	625	4,528	6,702
1984	1,184	773	3,262	5,219
1985	1,449	812	8,029	10,290
1986	1,282	1,299	9,673	12,254
1987	1,676	621	5,612	7,911
1988	1,884	590	5,379	7,853
1989	1,446	419	6,199	8,064
1990	827	283	2,951	4,061
1991 [b/]	95	118	5,278	5,491
1992 [c/]	41	0	5,259	5,300
1993 [d/]	11	0	***NO ESTIMATE OF JACKS***	
1994 [e/]	77	0	19,731	19,808
1995 f/	53	0	14,709	14,762

a/ Combined dipnet and hook and line fisheries at Sherars Falls. Does not include left before 0700 sample in 1988 and 1989. Does not include tribal snagging harvest in 1987.

b/ Recreational and tribal fishery closed to chinook salmon until October 1.

c/ Recreational fishery closed to salmon after June 16. Tribal fishery restricted to a 49 adult salmon harvest cap. Harvest windows: July 1 - 11, October 15 - 18, October 30 - 31.

d/ Recreational fishery closed to salmon after June 18. Tribal fishery restricted to a 45 adult salmon harvest cap. Harvest windows: 6 AM Friday to 12 PM Sunday, July 9 to October 31.

e/ Recreational fishery closed to salmon after April 1. Tribal fishery not restricted June 16 to August 7. Tribal fishery closed August 7 to September 23. Tribal fishery restricted to 60 adult salmon harvest cap. Harvest windows: 6 AM Friday to 12 PM Sunday, September 23 to October 30.

f/ Recreational fishery closed to salmon after April 1. Tribal harvest allowed July 17 through July 29 and 6 AM to 9 PM Monday through Saturday, October 2 to December 31, 1995. Tribal harvest restricted to a 63 adult salmon harvest cap.

Table 6.3. Run size of wild jack fall chinook salmon in the lower Deschutes River, 1977-95.

Year	Harvest		Escapement	Run Size
	Tribal a/	Recreational		
1977	723	949	2,125	3,797
1978	518	1,079	2,708	4,305
1979	616	1,384	4,338	6,338
1980	510	997	1,904	3,411
1981	366	928	3,728	5,022
1982	366	1,140	3,360	4,866
1983	369	309	859	1,537
1984	393	594	1,237	2,224
1985	789	665	5,384	6,838
1986	344	1,084	5,872	7,300
1987	56	186	1,515	1,757
1988	62	183	1,859	2,104
1989	63	87	1,429	1,579
1990	29	111	727	867
1991 b/	7	52	1,746	1,805
1992 c/	4	0	2,483	2,487
1993 d/e/	0	0	******NO ESTIMATE*****	
1994 f/	8	0	14,276	14,284
1995 g/	17	0	7,121	7,138

a/ Combined dipnet and hook and line fisheries at Sherars Falls. Does not include left before 0700 sample in 1988 and 1989. Does not include tribal snagging harvest in 1987.

b/ Recreational and tribal fishery closed to chinook salmon until October 1.

c/ Recreational fishery closed to salmon after June 16. Tribal fishery restricted to a 49 adult salmon harvest cap. Harvest windows: July 1 - 11, October 15 - 18, October 30 - 31.

d/ Recreational fishery closed to salmon after June 18. Tribal fishery restricted to a 45 adult salmon harvest cap. Harvest windows: 6 AM Friday to 12 PM Sunday, July 9 to October 31.

e/ Estimated escapement and run of jack fall chinook salmon could not be calculated due to insufficient tag recoveries.

f/ Recreational fishery closed to salmon after April 1. Tribal fishery closed August 7 to September 23. Tribal fishery restricted to 60 adult salmon harvest cap. Harvest windows: 6 AM Friday to 12 PM Sunday, September 23 to October 30.

g/ Recreational fishery closed to salmon after April 1. Tribal harvest allowed July 17 through July 29 and 6 AM to 9 PM Monday through Saturday, October 2 to December 31, 1995. Tribal harvest restricted to a 63 adult salmon harvest cap.

Table 6.4. Run size of wild adult fall chinook salmon in the lower Deschutes River, 1977-95.

Year	Harvest: Tribal [a/]	Harvest: Recreational	Escapement	Run Size
1977	1,557	304	5,631	7,492
1978	1,519	452	4,154	6,125
1979	1,375	217	3,291	4,883
1980	1,623	328	2,542	4,493
1981	1,420	417	3,183	5,020
1982	1,460	556	4,890	6,906
1983	1,180	316	3,669	5,165
1984	791	179	2,025	2,995
1985	660	147	2,645	3,452
1986	938	215	3,801	4,954
1987	1,622	435	4,097	6,154
1988	1,824	407	3,520	5,751
1989	1,377	332	4,770	6,500
1990	798	172	2,224	3,194
1991 b/	88	66	3,532	3,686
1992 c/	37	0	2,776	2,813
1993 d/	11	0	8,239	8,250
1994 e/	69	0	5,455	5,524
1995 f/	36	0	7,588	7,624

a/ Combined dipnet and hook and line fisheries at Sherars Falls. Does not include left before 0700 sample in 1988 and 1989. Does not include tribal snagging harvest in 1987.

b/ Recreational and tribal fishery closed to chinook salmon until October 1.

c/ Recreational fishery closed to salmon after June 16. Tribal fishery restricted to a 49 adult salmon harvest cap. Harvest windows: July 1 - 11, October 15 - 18, October 30 - 31.

d/ Recreational fishery closed to salmon after June 18. Tribal fishery restricted to a 45 adult chinook harvest cap. Harvest windows: 6 AM Friday to 12 PM Sunday, July 9 to October 31.

e/ Recreational fishery closed to salmon after April 1. Tribal fishery closed August 7 to September 23. Tribal fishery restricted to 60 adult salmon harvest cap. Harvest windows: 6 AM Friday to 12 PM Sunday, September 23 to October 30.

f/ Recreational fishery closed to salmon after April 1. Tribal harvest allowed July 17 through July 29 and 6 AM to 9 PM Monday through Saturday, October 2 to December 31, 1995. Tribal harvest restricted to a 63 adult salmon harvest cap.

Table 6.5. Age-specific lengths of fall chinook salmon sampled at Sherars Falls, 1978-83. From Jonasson and Lindsay, 1988.

Age a/	N	Length (inches)		
		Mean	95 % CI b/	Range
2	866	17.3	+0.1	8-23
3	644	24.3	+0.4	13-35
4	852	33.7	+0.2	24-43
5	153	36.6	+0.4	29-43

a/ Age was determined by scale analysis.
b/ CI = confidence interval.

Table 6.6. Percentage of fall chinook salmon redds in random, random-index, and index areas above and below Sherars Falls, 1972 to 1995.

Year	Percent Above Sherars Falls	Percent Below Sherars Falls
1972	71.3	28.7
1974	71.8	28.2
1975	93.6	6.4
1976	76.1	23.9
1977	65.0	35.0
1978	87.4	12.6
1979	69.8	30.2
1980	78.8	21.2
1981	75.7	24.3
1983	83.4	16.6
1985	51.6	48.4
1986	72.9	27.1
1988	48.7	51.3
1989	40.7	59.3
1990	61.1	38.9
1991	38.8	61.2
1992	25.6	74.4
1993	18.1	81.9
1994	11.9	88.1
1995	19.9	80.1

Table 6.7. Estimated spawning escapement of adult and jack fall chinook upstream and downstream of Sherars Falls, 1977-1995.

Year	Upstream of Sherars Falls		Downstream of Sherars Falls	
	Adult	Jack	Adult	Jack
1977	3,927	1,482	3,565	643
1978	3,564	2,323	2,561	1,982
1979	2,308	3,042	2,575	1,296
1980	2,009	1,505	2,484	399
1981	2,495	2,922	2,525	806
1982	3,820	2,625	3,086	735
1983	3,152	738	2,013	121
1984	1,582	966	1,413	271
1985	1,576	3,208	1,876	2,176
1986	3,137	4,846	1,817	1,026
1987	3,201	1,184	896	331
1988	2,477	1,305	1,043	554
1989	1,252	375	3,518	1,054
1990	1,101	360	1,123	367
1991	983	486	2,549	1,260
1992	670	599	2,106	1,884
1993	1,035	N/A	7,204	N/A
1994	410	1,073	5,045	13,203
1995	1,072	1,006	6,516	6,115

Table 6.8. Major habitat constraints to fall chinook salmon production in the lower Deschutes River subbasin. From ODFW and CTWS, 1990.

Location	Habitat Constraints [a/]
Deschutes River, mouth to White River	GQL, GQN, SED, SBD, CVR
Deschutes River, White River to Rereg. Dam	GQL, GQN, SBD, PTR, CVR

a/ CVR = in-stream cover
GQL = gravel quality
GQN = gravel quantity
PTR = pool-to-riffle ratio
SBD = streambank degradation
SED = sedimentation

Table 6.9. Releases of hatchery fall chinook salmon in the lower Deschutes River subbasin.

Release Year	Hatchery and Stock	Number	Size	Location
1958	Spring Creek	300,000	Eggs	Warm Springs R.
1967	Little White Salmon	502,500	1,139/lb	Warm Springs R.
1968	Little White Salmon	1,000,000	856/lb	Warm Springs R.

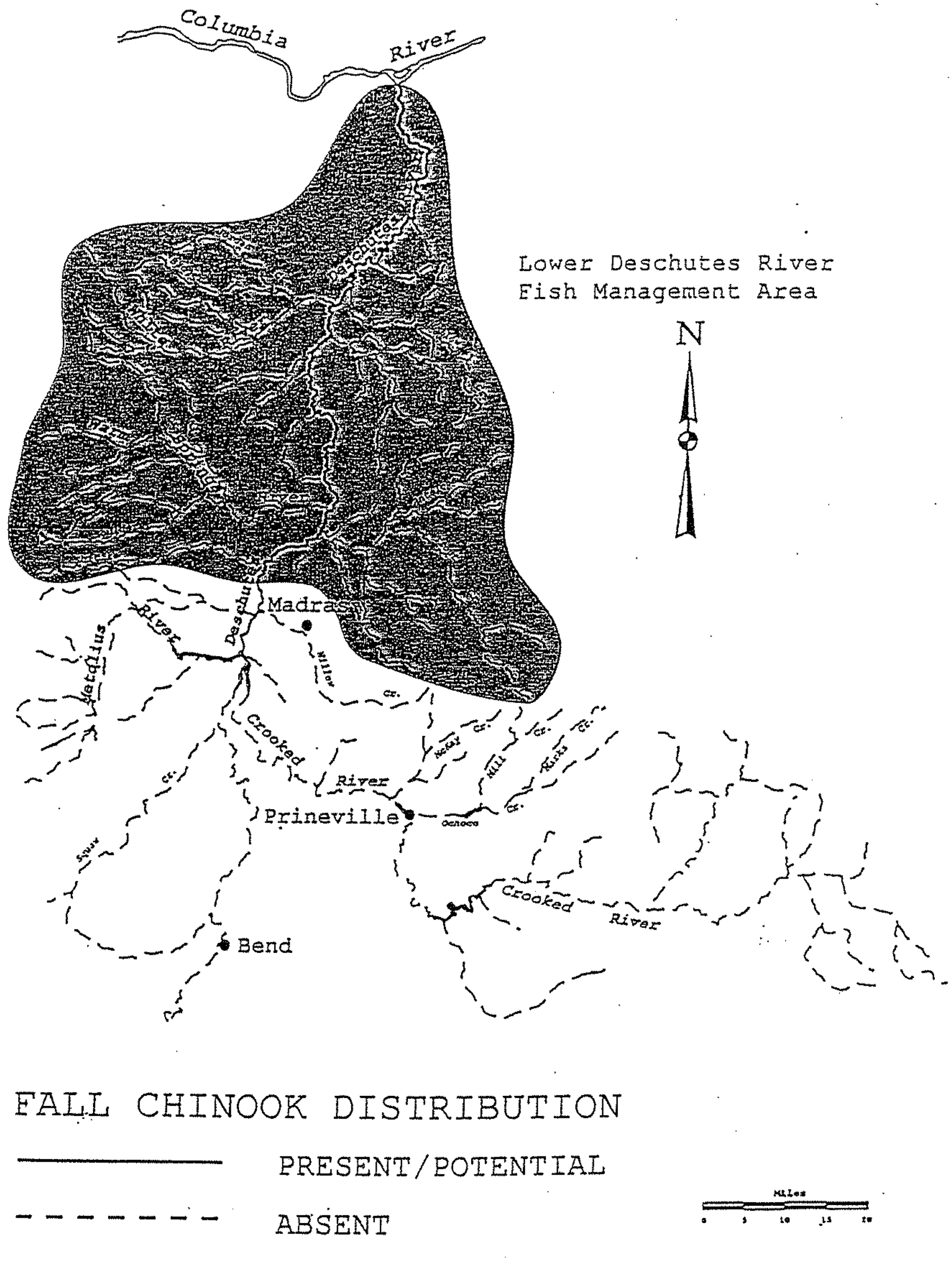


Figure 6.1. Fall chinook salmon distribution in the lower Deschutes River subbasin.

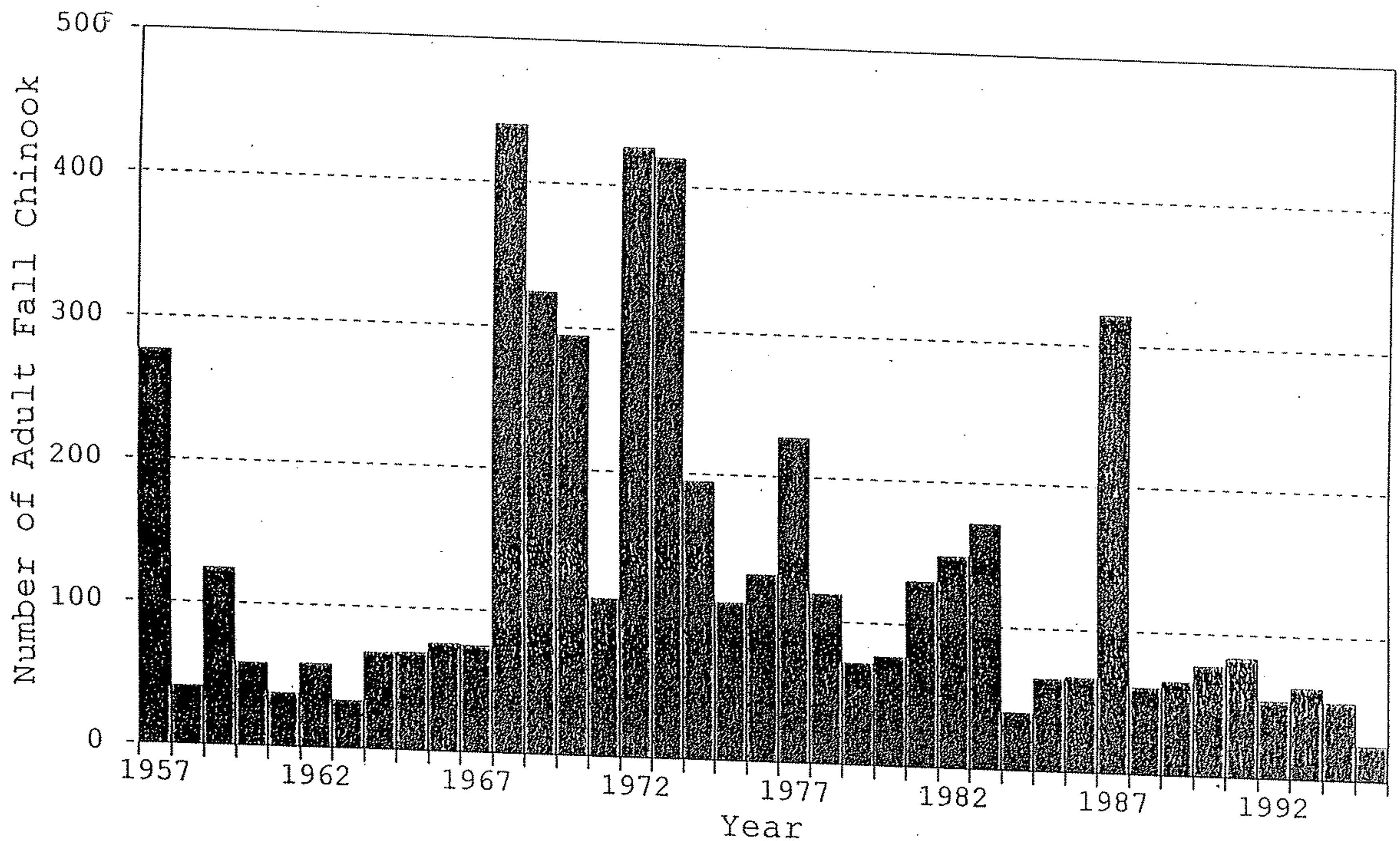


Figure 6.2. Adult fall chinook captured at the Pelton trap, 1957-1995.

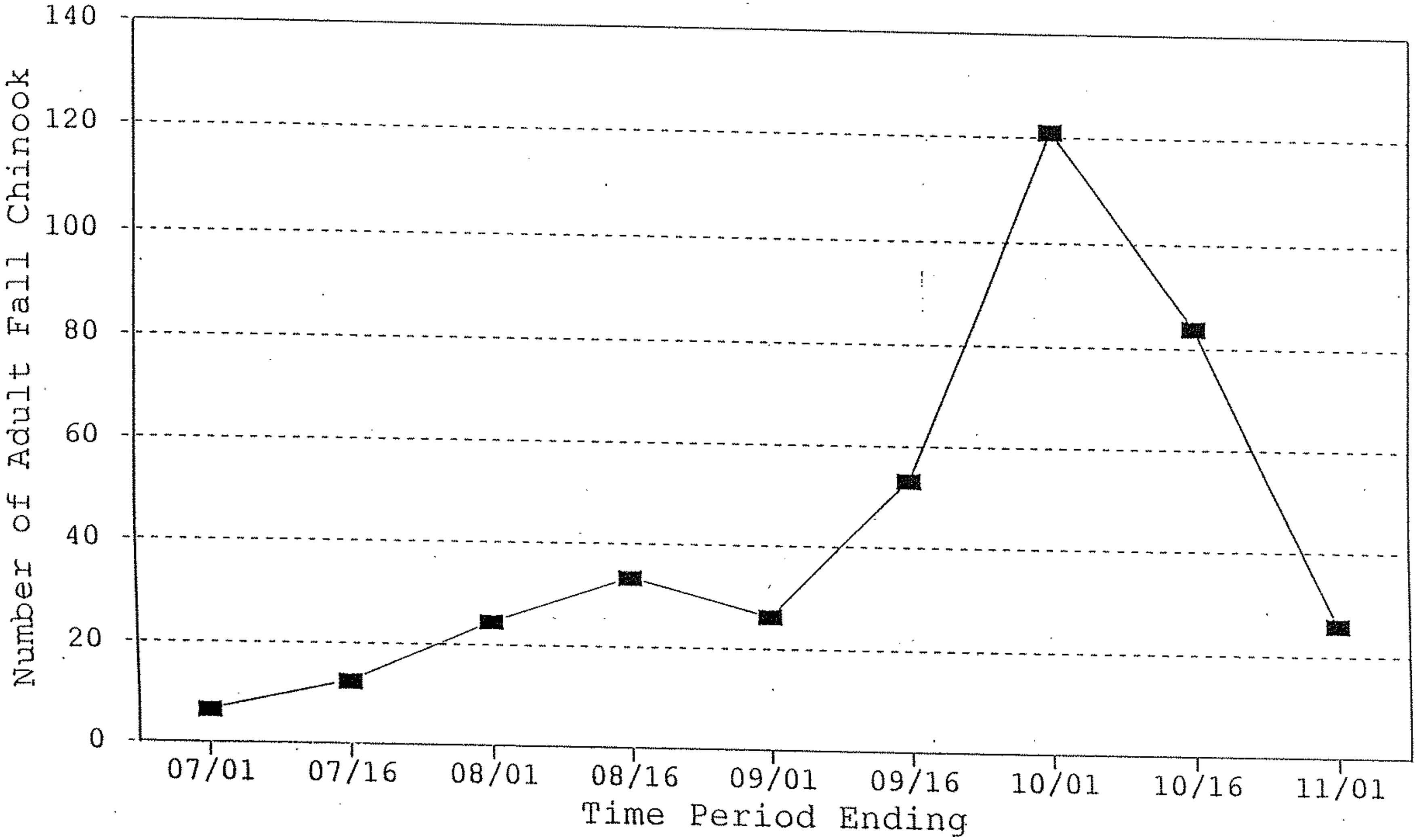


Figure 6.3. Average number of adult fall chinook salmon captured by two week period at the Sherars Falls trap on years of sampling from June 16 to October 31, 1977-81, 1988-93, and 1995.

LOWER DESCHUTES RIVER SUBBASIN FISH MANAGEMENT PLAN
SECTION 7. WARMWATER GAMEFISH IN STANDING WATERS

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WARMWATER GAMEFISH IN STANDING WATERS

BACKGROUND AND STATUS

The warm climate of the lower Deschutes River subbasin makes the area generally suitable for a variety of warmwater gamefish, none of which are native to the area. Most warmwater gamefish populations in the lower Deschutes River subbasin are the result of unauthorized introductions by the public.

Warmwater species known to exist in the basin are brown bullhead, *Ictaluras nebulosus*, bluegill, *Lepomis machrochirus*, green sunfish, *Lepomis cyanellus*, largemouth bass, *Micropterus salmoides*, and smallmouth bass, *Micropterus dolomieui*. The species of warm-water gamefish and the waters they inhabit are listed in the Table 7.1.

Largemouth bass are the most widely distributed warmwater species in the subbasin and are found in most low elevation reservoirs and ponds in the subbasin. Most farm ponds scattered throughout the Juniper Flat farming area west of Maupin have illegally introduced populations.

Bluegill are also common in many of the lower elevation ponds and reservoirs and have been stocked in some waters in combination with largemouth bass to provide a forage species for the bass. In general, if both species in a small pond are not subjected to intensive management they have a tendency to overpopulate resulting in a stunted population. Unfortunately low harvest and good escape cover for young of the year and yearlings usually combine to result in stunted populations of both species.

Populations of stunted brown bullhead are also found in most low elevation reservoirs and ponds.

Green sunfish were illegally released into Pine Hollow Reservoir, apparently in the 1980's. They seldom reach a desirable size and will not be stocked by the Oregon Department of Fish and Wildlife (ODFW) in the subbasin.

Smallmouth bass have been observed in small numbers in the lower Deschutes River and may have resulted from illegal introductions, escapement from private farm ponds, or recruitment from the Columbia River.

The current management strategy emphasizes providing diverse angling opportunities and maximizing harvest of warm water gamefish. The current ODFW warmwater gamefish stocking program in the subbasin is on an irregular schedule and involves small shallow ponds that are generally unsuitable for cold water fish, but do support warmwater species. This management strategy provides warmwater gamefish angling opportunities in a number of small ponds and reservoirs scattered over a wide geographic area.

MANAGEMENT CONSIDERATIONS

Unauthorized introduction of warmwater gamefish, salmonids, and nongame fish species is a serious management concern within the lower Deschutes River subbasin. Most of the existing warmwater fish populations in the subbasin have been established through illegal transfers by members of the public. Introduced warmwater gamefish may compete with salmonid species for food and space resulting in reduced abundance, size, and distribution of native salmonids. Fish brought in from other areas may carry disease or parasites that could infect resident salmonid species. Unauthorized introductions jeopardize valuable anadromous fisheries, impact highly desirable resident species fisheries, and reduce management options available for desired warmwater fisheries. Unauthorized introductions may require costly chemical rehabilitation in order to reestablish desirable species.

ODFW does not have an active stocking program for warmwater fish in the lower Deschutes River subbasin.

Permits to introduce fish are issued to individuals that wish to stock ponds on private property are reviewed and issued by ODFW. Individuals are allowed to obtain fish for introduction by angling or purchase authorized species from private suppliers approved by ODFW. Because of past problems with illegally introduced undesirable fish, it is illegal to transport live fish without a permit from ODFW (ORS 498.222).

Largemouth bass have been illegally introduced into almost every low elevation public and private reservoir and pond in the subbasin. Other unauthorized introductions include brown bullhead and green sunfish into Pine Hollow Reservoir, brown bullhead into Rock Creek Reservoir, and brown bullhead into Baker Pond.

Projects to eliminate illegally introduced fish have cost the state millions of dollars in the past, and, in many cases, total eradication is impossible. Illegal introductions decrease ODFW's options for managing the waters of the subbasin, and decrease the diversity of sizes and kinds of desirable fish.

Historically, most undesirable populations of warmwater gamefish were controlled with rotenone. However, due to the increased popularity of warmwater gamefishes, environmental concerns, and the high cost of the chemical and the treatment programs, ODFW rarely conducts large chemical rehabilitation projects. A history of rotenone treatment projects in the subbasin and target fish species is listed in Table 2.2.

Bass populations in the subbasin could reduce salmonid populations in the reservoirs, the White River system and the lower Deschutes River. Low water temperatures in flowing waters of the subbasin generally limit bass distribution. Water temperatures in the upper 50's are required for spawning (Wydoski and Whitney, 1979). Bass are generally inactive when water temperatures drop below 50 degrees.

ODFW recognizes the value of well managed warmwater fisheries in areas where indigenous fish populations are not impacted. The goal of this plan is to provide the greatest diversity of angling opportunities with fish species currently in the subbasin by providing direction on how warmwater species will be managed for the present and future generations of Oregon anglers while maintaining indigenous fish populations.

MANAGEMENT DIRECTION

Objectives and actions contained in the management direction will be used to set district work plans that form the basis for monitoring and evaluation programs. Completion of actions listed under an objective contribute to the meeting of that objective. Many actions cannot be accomplished under current levels of funding. If funding continues to be limited, ODFW will pursue completion of actions according to priorities as funds become available.

Policies

Policy 1. *Warmwater fish in the lower Deschutes River subbasin shall be managed for natural production consistent with the Basin Yield Management Alternative for warmwater fish (OAR 635-500-055 (1(d)).*

Policy 2. *Largemouth bass, bluegill and black crappie are the only species of warmwater fish that will be considered for introductions in small ponds within the subbasin.*

Policy 3. *To protect native species and desired introductions, such as largemouth bass, bluegill and black crappie, other species of exotic fish, including but not limited to smallmouth bass, spotted bass, yellow perch, channel catfish and all other members of the catfish family, walleye, northern pike, striped bass, muskellunge, hybrid bass, koi and grass carp shall not be approved for new introductions in public or private ponds in the lower Deschutes River subbasin.*

Objective 1. Promote warmwater fisheries as a recreational alternative in isolated waters in the lower Deschutes River subbasin in locations that do not harm indigenous species.

Assumptions and Rationale

1. ODFW must educate the public about existing warmwater fisheries, management objectives, and management concerns if ODFW wishes the public to support and become involved in its warmwater programs.
2. There are a limited number of waters in the subbasin suitable for warmwater fisheries that pose little or no threat to indigenous species.
3. There may be more pressure to diversify existing warmwater angling opportunities or provide new warmwater angling experiences.
4. The general public is probably not aware of the warmwater fishing opportunities in the subbasin.

Actions

Action 1.1. Develop a guide that describes warmwater fishing areas in the subbasin, including information on currently underutilized angling opportunities.

Action 1.2. Periodically survey angler use and preference, where possible, so that warmwater angling opportunities can be tailored to the desires of the angling public.

Action 1.3. Develop new warmwater fishing opportunities only in isolated locations that do not jeopardize indigenous species.

Objective 2. Minimize illegal introductions of undesirable warmwater species into the lower Deschutes River subbasin.

<u>Assumptions and Rationale</u>

1. People with diverse backgrounds coming from around the state, as well as different parts of the country, possess different values with respect to fish species. They are not aware of problems that may result from bringing new fish species into the subbasin.
2. Currently it is illegal to transport live fish, except aquaria fish, without a permit from ODFW, but there are no regulations preventing the possession of undesirable fish species.
3. The physical boundaries of the lower Deschutes River subbasin and natural fish passage barriers are often the only barriers that naturally prevent the spread of potentially devastating fish diseases. Transfer permittees are often unaware that native fishes are susceptible to introduced diseases and parasites.

<u>Actions</u>

Action 2.1. Educate the public as to which species are undesirable and what impacts they will have on desirable species.

Action 2.2. Develop guidelines and educational programs to ensure that commercially raised warmwater fish are not released in subbasin waters without ODFW approval and permits.

Action 2.3. Include in the ODFW Fish Transportation Permit process all transfers of warmwater fish brought into the subbasin.

Objective 3. Regularly inventory public water bodies that support warmwater fish.

<u>Assumptions and Rationale</u>

1. Warmwater fish populations can vary naturally from year to year.
2. Fish size and species composition may change depending upon harvest or natural mortality.

<u>Actions</u>

Action 3.1. Regularly interview anglers to determine numbers, size and species of warmwater fish captured.

Action 3.2. Periodically conduct biological inventory using seines, electrofishing or other appropriate means to assess species composition, condition, abundance and size of warmwater gamefish in public water bodies.

Objective 4. Maintain or develop access at water bodies managed for warmwater fisheries.

Assumptions and Rationale

1. Better angler access will encourage use of warmwater fisheries.
2. There is an increasing angler demand for warmwater angling opportunities.
3. Over-harvest is generally not of concern for warmwater fish management.

Actions

Action 4.1. Inventory existing access sites and condition.

Action 4.2. Develop an access improvement plan that prioritizes potential sites and explores potential funding sources.

Action 4.3. Develop access and recreation facilities for the handicapped.

Action 4.4. Explore the opportunities for developing additional warmwater fishery impoundments.

LITERATURE CITED

Basic Yield Management Alternative for Warmwater Gamefish. 1987. Oregon Administrative Rule 635-500-055(1(d)), Oregon Department of Fish and Wildlife, Portland, Oregon.

Wydoski, R.S. and R.R. Whitney. 1979. Inland fishes of Washington. University of Washington Press, Seattle and London.

SECTION 7. WARMWATER GAMEFISH IN STANDING WATERS.

FIGURES AND TABLES

Table 7.1. Warmwater game fish populations in the lower Deschutes River subbasin.

Water	Species	Stocking Origin	
Baker Pond	Brown Bullhead	Illegal Introduction	
Big Boulder Pond	Largemouth Bass	Cody Pond #5	6/21/1977
	Bluegill	?	?
CK Pond	Largemouth Bass	Cody Pond #5	6/21/1977
Cody Pond #1	Largemouth Bass	OSGC (St. Paul)	9/14/1966
Cody Pond #3	Largemouth Bass	OSGC (St. Paul)	9/14/1966
	Bluegill	?	?
Cody Pond #4	Largemouth Bass	OSGC (St. Paul)	9/14/1966
	Bluegill	?	?
Cody Pond #5	Largemouth Bass	OSGC (St. Paul)	9/14/1966
	Bluegill	?	?
Deschutes River	Smallmouth Bass	? Illegal Introduction	
Gobbler Pond	Largemouth Bass	Cody Pond #5	6/21/1977
	Bluegill	?	?
Happy Ridge Pond	Largemouth Bass	Cody Pond #5	7/6/1979
Misc. Private Ponds	Largemouth Bass	?	
	Bluegill	?	
	Brown Bullhead	Illegal Introduction	
Pine Hollow Res.	Largemouth Bass	Illegal Introduction	
	Brown Bullhead	Illegal Introduction	
	Green Sunfish	Illegal Introduction	
Rock Creek	Largemouth Bass	Rock Creek Reservoir	
Rock Creek Res.	Largemouth Bass	Illegal Introduction	
	Bluegill	Illegal Introduction	
	Brown Bullhead	Illegal Introduction	
Smock Prairie Pond	Largemouth Bass	Cody Pond #5	7/6/1979

LOWER DESCHUTES RIVER SUBBASIN FISH MANAGEMENT PLAN
SECTION 8. ACCESS

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ACCESS

BACKGROUND AND STATUS

Public access to waters in the lower Deschutes subbasin varies depending on individual waters. Access to the lower Deschutes River is limited by four factors including the rough topography of the canyon, privately owned lands, lands within the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS), and limitations of the existing road and trail systems. Public access to the river on privately owned lands is often restricted or prohibited. There are approximately 11 miles of paved all-weather road, 26.5 miles of gravel road, 2 miles of dirt road and 46 miles of trail open to the public along the lower Deschutes River.

The CTWS prohibit public access and angling on all streams within or bordering the reservation except for a seven mile section of lower Deschutes River between the mouth of Dry Creek and the Wasco County line (river mile 87 - 94), and approximately two miles of the Warm Springs River downstream from the Kah-nee-ta Resort. Public angling in designated stream reaches bordering or within the CTWS reservation is restricted to permit entry only (river mile 87 - 94). The CTWS also allow public angling at several high Cascade lakes by permit. These lakes are located solely within the reservation boundary.

Public access to several of the larger off-reservation tributaries is restricted by extensive private land ownership. The lower seven miles of White River downstream from Tygh Valley, and Bakeoven, Buck Hollow and Trout creeks flow predominately through private lands. White River, between Tygh Valley (river mile 6) and the Mount Hood National Forest boundary (river mile 26) is located within a deep canyon that contains considerable land managed by the Bureau of Land Management (BLM). These BLM holdings are often interspersed with or land-locked by private holdings.

Lakes, reservoirs, and streams located within the Mount Hood National Forest have good public access via an extensive system of roads and/or trails. Access to some ponds, reservoirs, and streams within the White River Wildlife Area is restricted to foot traffic only because of an aggressive road closure program designed to minimize wildlife disturbance and provide a quality hunting experience.

ACCESS OPPORTUNITIES

Improvements to existing dirt and gravel roads could result in improved public access along the lower Deschutes River. The interagency Lower Deschutes River Management Plan, completed in 1993 (LDRMP 1993), specifically directs the BLM to upgrade the road from Maupin (river mile 52) upstream to the Deschutes Club Gate (river mile 59) to meet minimum safety standards, including widening and oiling the road between Maupin and Harpham Flat (river mile 55.5). BLM will attempt to acquire a legal public easement for foot traffic only from the Deschutes Club Gate and the Two Springs Ranch (river mile 69). BLM will also develop a trail from the Criterian Summit (US Highway 197) to the river at approximately river mile 65.

Any further access improvement along the lower Deschutes River may be restricted by river use limits established in the Lower Deschutes River Management Plan.

MANAGEMENT DIRECTION

Objectives and actions contained in the management direction will be used to set district work plans that form the basis for monitoring and evaluation programs. Completion of actions listed under an objective contribute to the meeting of that objective. Many actions cannot be accomplished under current levels of funding. If funding continues to be limited, ODFW will pursue completion of actions according to priorities as funds become available.

Policies

Policy 1. *The Oregon Department of Fish and Wildlife (ODFW) will recognize other resource and recreation plans in affect in the lower Deschutes subbasin. ODFW will work cooperatively with other agencies to maintain or increase boat access and shoreline angler access that will satisfy public need for a variety of angling opportunities and a dispersion of angling effort throughout the subbasin.*

Policy 2. *Acquisition and development of angler access sites will be consistent with the guidelines and objectives for management of fish and their habitat.*

Policy 3. *ODFW will attempt to maintain public access at all existing public access sites in the White River system.*

Policy 4. *ODFW will pursue possible easements or land purchases to create new public access at key sites throughout the planning area, on a willing seller-willing buyer basis.*

Objective 1. Improve the distribution of people angling on the lower Deschutes River by supporting other agencies in the development of new parking areas and the improvement of designated launch sites and foot trails.

Assumptions and Rationale

1. Access to angling sites, in some areas, is limited by the lack of parking areas or pull-outs along the lower Deschutes River.
2. Rough secondary roads limit the types of vehicles that can safely travel on them, subsequently limiting access.
3. Some boat launch sites are unimproved or primitive and require four-wheel drive vehicles to access them.
4. Improving foot trails would allow more anglers to use them and would help to disperse anglers over more areas.

Actions

Action 1.1. Encourage the BLM to construct new parking lots and improve existing ones at various locations identified in the LDRMP.

Action 1.2. Existing access roads and trails should be retained in at least their present condition.

Action 1.3. Lower Deschutes River boat launch sites should be maintained or improved as identified in the LDRMP. Some unimproved launch sites may be closed in order to protect or restore shoreline riparian habitat.

Action 1.4. Trails totaling 37 miles should be improved and/or developed along two segments of the river.

Objective 2. ODFW will continue to work with other agencies and landowners to both maintain existing public access sites and to develop new ones.

__Assumptions and Rationale__

1. Landowners will continue to allow use of public access sites already established on private land.
2. There is a small fishery in the upper White River system for wild rainbow trout on public lands.
3. There is a limited fishery in miscellaneous tributaries within the planning area.
4. Anglers will utilize waters with good access.

__Actions__

Action 2.1. Work with private landowners to maintain existing public access sites on private land.

Action 2.2. Acquire additional angler access to areas where hatchery trout are, or could be stocked through easements or purchase of private lands, on a willing seller willing buyer basis.

Action 2.3. Encourage public land managers to maintain roads and trails that provide angling access.

Objective 3. ODFW will not pursue increased public angling access to Buck Hollow, Bakeoven, or Trout creeks.

__Assumptions and Rationale__

1. Landowners will continue to restrict public access to streams on private lands.
2. These streams are important spawning and rearing areas for wild summer steelhead.
3. Any trout fishery would impact wild steelhead smolt production.

__Actions__

Action 3.1. Work with private landowners to protect wild steelhead production.

Action 3.2. Monitor and comment on any proposals to improve public vehicle access to these streams.

Objective 4. ODFW will work with other agencies and private landowners to develop new reservoirs or ponds, or access to existing reservoirs and ponds for additional public angling opportunity.

<u>Assumptions and Rationale</u>

1. There are numerous privately owned ponds and reservoirs within the planning area containing a variety of fish species that are not open to public use.
2. There are suitable sites within the planning area for the development of small ponds and reservoirs.
3. There is constant angler demand for new angling opportunities.

<u>Actions</u>

Action 4.1. Acquire public access to private ponds and reservoirs through the purchase or lease of easements on a willing buyer - willing seller basis.

Action 4.2. Work with private and public land managers to develop new ponds or reservoirs for creation of new angling opportunities.

LITERATURE CITED

Lower Deschutes River Management Plan and Environmental Impact Statement. Volume 1. 1993. A joint river management plan developed by: Bureau of Land Management, Bureau of Indian Affairs, Confederated Tribes of the Warm Springs Reservation, Oregon State Parks and Recreation Department, Oregon Department of Fish and Wildlife, Oregon State Marine Board, Oregon State Police, Deschutes River Management Committee, Wasco, Sherman, and Jefferson counties, and the City of Maupin. Bureau of Land Management, Prinevile, Oregon.

GLOSSARY

Acclimated - Physiological adjustment by an organism to environmental change.

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

Alevins - Newly hatched salmonids with the yolk sac still attached.

Ambient - Of the surrounding environment.

Anadromous - A fish life history where juveniles are born and rear for a period of time in freshwater, move to the ocean to rear to maturity and return to freshwater to spawn. Moving from the sea to freshwater for reproduction.

Aquatic invertebrate - Aquatic or water living insects and other organisms without a vertebral column.

Coded wire - A type of fish tag consisting of a very small piece of stainless steel wire with a binary code on it. The wire is generally implanted in a fish's snout.

Cohort analysis - Analysis of a fish population by considering age at return.

Differential harvest - Harvest of a specific group of fish when others are also present.

Endemic - Native to a particular region.

Ephemeral - Lasting only a short time.

Erythromycin - A broad-spectrum antibiotic.

Fecundity - The number of eggs a female fish produces.

Fluvial - Living in flowing water.

Genotype - All or part of the genetic makeup of an individual or group or organisms.

Hybridize - Two animals or plants of different species that breed to produce a hybrid.

Hydrologic - Circulation of water on the surface of the land, in the soil and underlying rocks.

Indigenous - Native to a particular region.

Insectivorous - Depending on insects for food.

Inter-specific - Existing or arising between species.

Introgression - The introduction of a gene from one gene complex into another.

Intra-specific - Occurring within a species or involving members of one species.

Jack - An anadromous fish, usually a male, that returns to freshwater prematurely to reproduce.

Loess - Fine, wind blown soil.

Matrix pairing - A fish spawning procedure used to maximize the amount of genetic material available by dividing the available eggs and sperm into smaller units.

Meristic - Number or geometrical relation of body parts.

Mitigate - Lessen the impact of activities or events that cause a loss.

Morphological - The form or structure of an organism or its parts.

Morphometric - Measurement of external form.

Oligotrophic - Deficient in nutrients.

Orifices - An opening through something can pass.

Perennial - Present at all seasons of the year.

Phenotypic - The visible properties of an organism that are produced by the interaction of the genotype and the environment.

Piscivorous - Feeding on fishes.

Prophylactic - Guarding from or preventing disease.

Pyloric caeca - Blind guts or caeca associated with a fishes stomach.

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

Reproductive isolation - A group of organisms that is separated by space or time from reproducing with others.

Riffles - A shallow stretch of water extending across a stream bed and causing broken water.

Riparian - Relating to or living or located on the bank of a natural watercourse.

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

Smolt - A juvenile salmonid that has completed the physiological process that allows it to make the change from a freshwater environment to a saltwater environment.

Spatial - Relating to, occupying, or having the character of space.

Stock-recruitment model - A mathematical model used to predict adult return for a brood year.

Subbasin - A discrete part of a larger drainage basin.

Substrate - The base on which an organism lives.

Sympatrically - Existing or operating through an affinity, interdependence, or mutual association.

Temporal - Relating to time.

Truncating - To shorten or bypass.

Volitionally - Making a choice.

Winter kill - to kill fish by exposure to winter conditions, commonly by a lack of dissolved oxygen.