Draft

Deschutes River Subbasin Summary

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Northwest Power Planning Council

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Deschutes River Subbasin Summary

Subbasin Description

Introduction

The Deschutes River originates on the east slope of the Cascade Mountains southwest of Bend. The river flows north through Central Oregon and enters the Columbia River 205 miles from the Pacific Ocean (Appendix I, Figure 1). The subbasin includes approximately 10,500 square miles and is 170 air miles long by 125 air miles wide, greatest dimensions (OWRD 1961). The Deschutes River subbasin is second in size only to the Willamette River subbasin in Oregon.

The Deschutes River subbasin is bounded on the west by the Cascade Mountains, on the south by high elevation pine forest, on the east by the high desert plateau between the John Day and Deschutes subbasins, and on the north by the Columbia River.

This document encompasses the entire Deschutes River subbasin and its tributaries from the headwaters to the confluence with the Columbia River. The subbasin is separated into upper and lower sections, the dividing point between the sections being the Pelton/Round Butte Project located at RM 100. The upper Deschutes River subbasin is further divided into the upper Deschutes, Crooked, and Metolius Rivers, and the Pelton/Round Butte Project reservoirs (Lakes Billy Chinook and Simtustus).

General Description - Lower Deschutes River

Subbasin Location

The lower Deschutes River subbasin is that portion of the subbasin from the Pelton Reregulating Dam (RM 100) to the confluence with the Columbia River 205 miles from the Pacific Ocean (Appendix I, Figure 1).

Drainage Area

The lower Deschutes River subbasin covers approximately 2,700 square miles and has 760 miles of perennial streams and 1,440 miles of intermittent streams. Major tributaries to the lower Deschutes River include the Warm Springs and White rivers and Shitike, Trout, Bakeoven, and Buck Hollow creeks. Nineteen high mountain lakes, six lower elevation lakes and small reservoirs, and numerous man-made or natural small ponds are also found within the lower Deschutes River subbasin but will not be addressed in this document.

Climate

The climate in the lower Deschutes River subbasin ranges from transitional in the westside tributary headwaters to semiarid in the main stem canyon and eastside uplands, with average precipitation from as high as 100 inches, in the Cascade Mountains, to as low as 9 to 14 inches in the Deschutes canyon and eastern plateaus. Approximately 25 percent of the annual precipitation falls between May and September.

Topography

The lower Deschutes River flows through a desert canyon from 700 to 2,000 feet in depth. The elevation of the river drops from 1,393 feet at Pelton Reregulating Dam (RM 100) to

160 feet at the confluence with the Columbia River (RM 205). There are two major drops in the lower Deschutes River, at Sherars Falls, RM 44, with a vertical drop of 15 feet and Whitehorse Rapids, RM 75, with a drop of 35 feet in one mile.

Geology

The lower Deschutes River subbasin lies in the southern portion of the Columbia Basin physiographic province (Franklin and Dyrness 1973). Major geologic formations in the subbasin 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 eroded from the uplands and deposited along streams.

Hydrology

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

Regulation of waters in the upper Deschutes River and tributaries alters the flow patterns of the river from what would have occurred naturally. Lower Deschutes River flows are controlled by discharge from Portland General Electric's (PGE) Pelton/Round Butte Project, located at RM 100. The Pelton/Round Butte Project 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.

Major west side tributaries to the lower Deschutes River are Shitike Creek and the Warm Springs and White rivers. Shitike Creek drains approximately 76 square miles and enters the Deschutes River at RM 97. The Warm Springs River drains approximately 526 square miles and enters the Deschutes River at RM 84. White River flow originates from a drainage area of 368 square miles, it enters the Deschutes River at RM 46.

Trout, Bakeoven and Buck Hollow creeks are the major east side tributaries to the lower Deschutes River. They enter the Deschutes River at RM 88, RM 52 and RM 42, respectively.

Many of the lower Deschutes River tributaries are characterized by intermittent or low flows. This is often related to consumptive water withdrawals and degraded stream corridors. These low flows can occur on some streams by early spring.

Soils

The soils of the lower Deschutes River subbasin are primarily silt loam, 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).

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 (Appendix I, Figure 2). 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 grand fir. Western 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 cheatgrass, Kentucky bluegrass and medusahead wildrye has altered the native plant communities, as have cultivation, livestock grazing and other human activities (USBR 1981).

Riparian vegetation along low elevation 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 dominated by a mix of vine maple, alder, and cottonwood.

Land Uses

The entire lower Deschutes River subbasin is located within the boundary of lands ceded to the United States government by the seven bands of Wasco- and Sahaptin-speaking Indians whose representatives and head men were signatories to the Treaty with the Tribes of Middle Oregon of June 25, 1855. The Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) are the legal successor to the Indian signatories to the treaty. The CTWS reservation and off-reservation lands comprise approximately 21 percent of the land areas of the lower Deschutes River subbasin. Tribal lands are managed primarily for timber production, livestock grazing, and residential uses (Appendix I, Figure 3).

The US Forest Service manages 235 square miles in the White River subbasin, or approximately 11 percent of the lower Deschutes River subbasin. The Bureau of Land Management manages approximately four percent of the subbasin, mostly in the lower Deschutes River canyon. Major land uses on federal lands are timber management and recreation.

The State of Oregon manages approximately two percent of the lower Deschutes River subbasin. State lands are managed for recreation and fish and wildlife needs. Private lands make up 62 percent of the subbasin and are largely agricultural, much of it for livestock production.

Dry land and irrigated farming are predominant in the lower Deschutes River subbasin. Dry land farming is generally confined to the northern portion of the watershed and is associated with grain production, principally wheat and barley. Irrigated agriculture is 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. Livestock grazing is common in the lower Deschutes River canyon and tributaries.

Impoundments and Irrigation Projects

Pelton Dam (RM 103), forming Lake Simtustus and the Reregulating Dam (RM 100), forming the Reregulating Reservoir, were both completed in 1958. Round Butte Dam (RM 110), forming Lake Billy Chinook, was completed in 1964. This three-dam complex, operated by Portland General Electric and Warm Springs Power Enterprises, is collectively referred to as the Pelton/Round Butte Project.

Municipal water use in the lower Deschutes River subbasin 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 relies on a large spring located within the city limits.

Industrial water use from the lower Deschutes River is confined to the large pump diversion supplying water to the Warm Springs Forest Products mill at Warm Springs.

The Oregon Water Resources Department 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 River up to RM 100 for domestic, livestock, lawn or noncommercial garden irrigation, fish enhancement, recreation, and fish and wildlife uses (OAR 690-505-006). Rules adopted in 1994 prohibit issuance of new commercial 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). Existing consumptive water rights have been over appropriated on a number of streams in the subbasin, including Trout, Badger, Tygh, Boulder, and Lost creeks.

Protected Areas

In 1970, the lower 100 miles of the Deschutes River were designated a component of the Oregon State Scenic Waterways system. This program is designed to protect and enhance the scenic, aesthetic, natural, recreation, and fish and wildlife values along scenic waterways.

In 1988, U.S. Congress designated the lower 100 miles of the Deschutes River as a recreational component of the National Wild and Scenic Rivers System.

General Description - Pelton/Round Butte Project Area

Subbasin Location

Lake Billy Chinook

Lake Billy Chinook was created in 1964 by the completion of Round Butte Dam at RM 110 on the Deschutes River. It is located approximately eight miles southwest of the Central Oregon town of Madras in Jefferson County. The dam is part of the Pelton/Round Butte Project operated by PGE and CTWS. The reservoir is a locally and regionally popular recreation area. Swimming, boating, angling, and water skiing are the primary recreational activities.

Lake Billy Chinook lies at the junctions of the Crooked, Deschutes and Metolius rivers. This area is characterized by flat plateaus bisected by deep river canyons. Uplands along the Crooked and Deschutes river arms are dominated by semiarid rangelands, with irrigated farmlands and rural residential development to the east (Appendix I, Figure 2). Native vegetation consists largely of bunch grass, big sagebrush, and juniper. The Metolius River arm extends to the west with juniper, big sage, bunch grass, bitterbrush, and rabbit brush in the lower elevations, yielding to a steeper, mountainous terrain dominated by ponderosa pine, red cedar and mixed conifer forests at the upper end of the arm.

Round Butte Dam is an earth filled structure with a height of 440 feet, a crest length of 1,380 feet, and a present storage capacity of 535,000 acre feet. The reservoir extends 12, 8.5 and 6 miles up the Metolius, Deschutes and Crooked River canyons, respectively. The drainage area for the reservoir is 7,490 square miles. Lake Billy Chinook has a maximum depth of 415 feet. Much of the shoreline is basalt cliffs and steep talus slopes.

Over 60% of the reservoir has a depth greater than 100 feet (Mullarkey 1967) and only 6% of the reservoir is less than 10 feet deep. Elevation at full pool is 1,945 feet above mean sea level, and the maximum surface area is 4,000 acres. Total shoreline of the reservoir is approximately 62 miles.

Lake Simtustus

Below Lake Billy Chinook is Lake Simtustus. Lake Simtustus was created by the completion of Pelton Dam in 1958 at RM 103 on the Deschutes River, approximately 10 miles northwest of Madras in Jefferson County. The dam is part of the Pelton/Round Butte Project operated by PGE and the CTWS. The reservoir has a surface area of 611 acres and is 7.5 miles long. Water enters the reservoir from three sources: the Round Butte Dam draft tubes or spillway, and Seekseequa and Willow creeks.

Lake Simtustus lies just downstream from the junction of the Deschutes and Metolius rivers, and six miles upstream from the community of Warm Springs. The area is characterized by flat plateaus bisected by deep river canyons. Native vegetation consists largely of juniper, big sage, bunch grass, bitterbrush, and rabbitbrush (Appendix I, Figure 2).

Pelton Dam is a variable-radius, thin-arch concrete dam with a structural height of 204 feet, a crest length of 965 feet, and a present storage capacity of 37,300 acre feet. Lake Simtustus has a maximum depth of 200 feet. Elevation at full pool is 1,580 feet above mean sea level, and the maximum surface area is 611 acres. Total shoreline of the reservoir is approximately 20 miles. Much of the shoreline is basalt cliffs and steep talus slopes. About 12% of Lake Simtustus is less than 10 feet deep. The reservoir usually becomes thermally stratified during May each year, with the thermocline near a depth of 16 feet, and becomes homothermal again in late September or early October.

Hydrology

Lake Billy Chinook is generally kept near full pool from Memorial Day through Thanksgiving. Both recreation days and hydroelectric production are maximized when the reservoir is near full pool. The FERC license allows the reservoir to be drawn down 85 feet during the winter. Portland General Electric prefers to maintain the reservoir as close to full pool as possible. As a result, the reservoir generally is drawn down no more than 10 feet from Thanksgiving to Memorial Day each year, during this period of highest electricity demand. Because of the large surface area of the reservoir, daily fluctuations in the reservoir level are 6 inches to 1 foot per day.

Land Uses

The Lake Billy Chinook shoreline is owned by a multitude of interests (Appendix I, Figure 3). The entire north shore of the Metolius River arm, down to the middle of the old river channel, is owned by the CTWS. Large portions of the Crooked and Deschutes River arms are publicly owned and managed by the USFS and BLM. The State of Oregon owns and operates Cove Palisades State Park, and administers a portion of the federal land surrounding the park. Much of the south side of Metolius River arm up to Fly Creek is privately owned, with the USFS owning most of the remainder.

The entire western shoreline of Lake Simtustus (to the old river channel) is owned by the CTWS. The eastern shoreline is owned by the USFS, BLM, PGE, with a few isolated parcels of private land in Willow Creek cove.

General Description - Metolius River

Subbasin Location

The Metolius River covers approximately 31 square miles. The river originates from three springs at the base of the north side of Black Butte, near the community of Sisters, and flows south and east approximately 29 miles to its confluence with the Deschutes River in Lake Billy Chinook (Appendix I, Figure 1). Its major tributary, Lake Creek, originates at Suttle Lake and flows 5.2 RM in an east-northeast direction to its confluence with the Metolius River at RM 39.4 just south of the community of Camp Sherman.

Suttle Lake is located in the Deschutes National Forest approximately 40 miles northwest of Bend. Suttle Lake was glacially formed during the Pleistocene Epoch and filled when the glacier retreated. It is approximately 253 acres in size and the maximum depth is 75 feet. The average depth is 44 feet and the lake has a volume of 11,200 acre feet. The shoreline is 3.6 miles in length and approximately 10 percent of the lake is classified as shoal area.

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

Lake Creek, the outlet of Suttle Lake, is located at the east end. Upon leaving Suttle Lake, it flows northeast 6.5 miles and enters the Metolius River at a point two miles downstream of the headwaters.

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

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

Climate

The climate is characteristic of a transitional zone between the Cascade Mountains and the High Desert. Precipitation ranges between 10 and 50 inches per year, mostly in the form of snowfall, and temperatures range from -30°F in the winter to 80°F in the summer (USDA Forest Service 1996).

Topography

Elevation in the subbasin ranges from 10,497 (Mt. Jefferson) to 1,940 (at Lake Billy Chinook) feet above sea level. Geologic features include the Cascade Mountains, Black

Butte, and Green Ridge. The subbasin drains approximately 315 square miles of Deschutes and Jefferson counties. The Metolius River subbasin is bounded on the west by the Cascade Mountains, on the south and east by the upper Deschutes River subbasin, and on the north by Shitike Creek.

Hydrology

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

The Metolius has been withdrawn from further out-of-stream water appropriations (OWRD 1967). There is an instream water right for fish on Lake Creek and ODFW has applied for these rights on nearly every stream in the Deschutes River subbasin. Domestic and irrigation water rights are minor in the Metolius River subbasin.

Vegetation

The flora of the Metolius River subbasin ranges from forests of pine, fir, and cedar, and grassy meadows in the upper river section, to juniper and sagebrush downstream (Appendix I, Figure 2). Wet meadows are found in the upper portion with an association of alder, willows and various grasses.

Land Uses

The entire Metolius River subbasin is located within the boundary of lands ceded to the United States government by the seven bands of Wasco- and Sahaptin-speaking Indians whose representatives and head men were signatories to the Treaty with the Tribes of Middle Oregon of June 25, 1855. The Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) are the legal successor to the Indian signatories to the treaty (Appendix I, Figure 3).

The U.S. Forest Service manages approximately 68 percent of the subbasin, 28 percent is contained within the CTWS, and four percent is in private ownership (Deschutes NF recreation map 1981). Primary land uses in the subbasin include recreation, timber, farming, and residential.

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

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

The majority of the other lands within the subbasin are administered by the Deschutes National Forest.

Impoundments

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

Protected Areas

In 1988, U.S. Congress designated 28.6 miles of the Metolius River as a component of the National Wild and Scenic River System. The reach of river from Metolius Springs to Bridge 99 is classed as recreational (RM 41-29.1), the reach from Bridge 99 to Lake Billy Chinook is classed as scenic (RM 29.1-12). Management of the Wild and Scenic sections is a cooperative effort between tribal, state and federal agencies.

National Forest land surrounding the Metolius River has been established as the Metolius Conservation Area. This area is divided into ten management areas each with its own standards and guidelines. The goals of the management areas are generally not forest product oriented but emphasize resource protection and enhancement. Some resource extraction is allowed in most management areas. The Deschutes National Forest Land and Resource Management Plan (USDA Forest Service 1990a) is the primary management document; however, it was amended by the President's Plan (April 1994), the interim eastside screen and inland fish standards and guidelines put in place during the Interior Columbia Basin Ecosystem Management Project (ICBEMP) process and is scheduled to be amended again as part of the ICBEMP decision in 2001.

General Description - Crooked River

Subbasin Location

The Crooked River is the eastern most major tributary to the upper Deschutes River (Appendix I, Figure 1). Situated in Central Oregon, the majority of the subbasin is located in Crook County with smaller portions in Jefferson, Wheeler, Grant, Deschutes and Harney counties.

Drainage Area

The total drainage area of the Crooked River is approximately 4,300 square miles. Total length from headwaters on the North Fork Crooked River to the mouth at Lake Billy Chinook is approximately 155 miles.

Climate

The climate in the subbasin is semiarid, characterized by hot, dry summers and cold winters. Summer temperatures may exceed 100° F and winter temperatures occasionally drop below -30° F. Annual precipitation averages 8-10 inches per year at lower elevations, and up to 30-40 inches at higher elevations, most of which falls in the form of snow during winter. Occasional high intensity thunderstorms drop significant amounts of rainfall on local areas and may contribute to erosion.

Topography

The highest point in the Crooked River subbasin is Lookout Mountain, elevation 6,926 ft, located in the Ochoco Mountains. Elevation drops to 1,900 ft at Lake Billy Chinook where the Crooked River joins the Deschutes River.

Geology

The Crooked River is located along the southern edge of the Columbia Basin Plateau and at the northern margin of the High Desert. Portions of the North Fork, South Fork, and mainstem Crooked River carve canyons through the Central Oregon desert, although much of the drainage is characterized by rolling hills. The Ochoco Mountains are the major mountain range in the subbasin, and are a western extension of the Blue Mountains of Eastern Oregon. The Maury Mountains to the south of the Ochoco Mountains are entirely drained by tributaries of the Crooked River.

Soils

Soils in the Crooked River subbasin are derived from the mid-Tertiary Columbia Plateau geology, the early Tertiary clayey tuffaceous sedimentary John Day and Clarno formations, and much older Cretaceous to Paleozoic marine sedimentary formations in the Suplee-Izee area (Silvernale et al. 1976). Some soil associations are on flood plains, terraces, low benches, and alluvial fans and are formed mainly of sediments deposited by streams (USDA 1966). Other soil associations occurring on the basalt plateau consist of soils with hardpan, formed from pumiceous material, and are shallow and stony. Soils formed on forested highlands are derived from volcanic ash and soft tuffaceous rocks, and are very stony soils over basalt. Soils on uplands and buttes are derived from rhyolite rock and tuff, or basalt. Most of the north facing slopes and drainages are covered with Mount Mazama ash giving rise to higher productivity (Jim David, Ochoco National Forest Soil Scientist, personal communication). Soils in low elevation areas often have calcic horizons and a higher pH than mountain soils. Vegetative cover is 30-40% over much of this area.

Vegetation

Low elevation terraces, flood plains and lower subbasin valleys are occupied by irrigated croplands (Appendix I, Figure 2). Transition uplands are primarily sagebrush and western juniper, while upland and high elevation communities are comprised of ponderosa pine, lodgepole pine, and mixed conifer forests. Streamside vegetation communities with deciduous overstory consist of quaking aspen, mountain alder, black cottonwood, or willow.

Land Uses

Land ownership in the Crooked River subbasin is split about evenly between public and private interests (Appendix I, Figure 3). Public lands are administered primarily by the USFS Ochoco National Forest and the Prineville District of the BLM.

Land use in the Crooked River watershed is approximately 73% range, with grazing as the primary use, 21% forest, and 4% irrigated agriculture (OWRD 1978). The land around the Crooked River subbasin is sparsely populated. Low elevation river valleys from Beaver Creek downstream to 50 miles below Prineville on the Crooked River are now devoted to intensive agriculture. Livestock production dominates with irrigated lands primarily used for growing hay and forage crops. Other irrigated crops in the lower Crooked River valley include mint, potatoes, wheat, and onions. Mining for cinnabar was productive until the early 1970's; small mines are still worked for thunder eggs, while some exploration continues for gold and silver. Logging and wood products manufacturing first began in the county in the 1890's. By 1920, much of the upland timber area came under logging, and wood products continue as a major commodity in the subbasin.

The city of Prineville, the county seat for Crook County, is located at RM 50 of the Crooked River. Prineville began as a community supported by the livestock grazing and timber harvest activities in the region. Incorporated in 1880, it is the oldest town in Central Oregon. Prineville is a growing community with an economy based on timber, agriculture, manufacturing, and tourism. Unincorporated communities in the subbasin are Post, Paulina, Terrebonne, Brothers, Millican, Hampton, and O'Neil.

Deschutes, Jefferson, and Crook counties are projected for exceptionally large increases in the human population during the next 20 years, well ahead of the statewide average (Portland State University 1993).

Crook County's natural resources, including forests, range lands, lakes and streams, and wildlife contribute substantially to recreation and tourism in the region. A significant amount of the Crooked River subbasin is under public management and is managed by either the BLM or the USFS, including the Crooked River National Grasslands.

Much of the mainstem Crooked River and lower portions of the major tributaries including the North and South forks and Beaver Creek are in private ownership and inaccessible to the public. Approximately 10 miles of the mainstem Crooked River below Bowman Dam and another 10 miles below Highway 97 are in public ownership, either as BLM lands or Crooked River National Grasslands.

Most of the large impoundments, including lakes Billy Chinook and Simtustus, which are hydroelectric reservoirs, and Haystack and Prineville reservoirs, built for irrigation storage, have a majority or all of the shoreline in public ownership. Ochoco Reservoir, a private irrigation impoundment, has some public access for boating and shoreline use at the state park.

Impoundments and Irrigation Projects

The Crooked River flows east to west from headwaters in the North Fork, South Fork and Beaver Creek systems to Prineville Reservoir (RM 70) which was formed by Bowman Dam. The river flows out of the reservoir and joins the Deschutes River at Lake Billy Chinook, formed by Round Butte Dam at RM 111 on the Deschutes River. Downstream of Prineville Reservoir are Ochoco and McKay creeks that meet the Crooked River at RM 46 and 45, respectively. Another major impoundment in the subbasin is Ochoco Reservoir, impounded by Ochoco Dam at RM 10 on Ochoco Creek. Other smaller, public, reservoirs include Allen Creek Reservoir, Antelope Flat Reservoir, Walton Lake, Haystack Reservoir, and Reynolds Pond.

Prineville Reservoir

Prineville Reservoir is a US Bureau of Reclamation (USBR) multi-purpose reservoir on the Crooked River. The project was authorized by Congress in 1956 for irrigation, flood control, and minimum downstream flows of 10 cfs for fish and wildlife purposes. Water impounding began December 12, 1960 and the reservoir became operational during the winter of 1960-61. Fish passage facilities were not provided.

Prineville Reservoir was formed by the construction of Bowman Dam on the mainstem Crooked River at RM 70. The reservoir is located in Crook County, approximately 17 miles south of Prineville. This area is characterized by rolling hills and flat plateaus bisected by broad river valleys. Vegetation consists primarily of western juniper intermixed with big sagebrush, bitterbrush, rabbitbrush and a variety of other shrub,

grass and forb species. Grass species include native Idaho fescue, bluebunch wheatgrass, and wildrye, and exotic species include crested wheatgrass and cheatgrass.

Bowman Dam is an earth filled structure with a height of 245 feet. Prineville Reservoir has a maximum surface area of 3,030 acres and a present storage capacity of 148,633 acre feet. Maximum depth is 230 feet with an average annual drawdown of 25 to 30 feet. The elevation at full pool is 3,235 feet above mean sea level. There are 36.0 miles of shoreline, of which 34.5 are in public ownership. Public lands are administered by the USBR.

Irrigation and flood control functions drive the operation of the dam. Irrigation water is released from April 15 to October 15, and the reservoir level is lowered according to demand. The reservoir must be at or below 93,000 acre feet from November 15 to February 15 for flood control purposes. If the reservoir exceeds that level, water is released to lower the level. After February 15, a majority of the inflow is stored for irrigation needs. During drought years, when water levels are below 93,000 acre feet during the winter storage period, a majority of the inflow is stored to bring the reservoir up to the minimum flood control level.

In addition to irrigation and flood control releases, minimum flows of 10 cfs are authorized for fish and wildlife purposes in the Crooked River below the reservoir. Since 1990, Ochoco Irrigation District has administratively released from 30 to 75 cfs of water in the Crooked River during winter, depending on flood and snowpack conditions, to improve flows in the river below.

Ochoco Reservoir

Ochoco Reservoir was formed by the construction of Ochoco Dam, completed in 1921, on Ochoco Creek at approximately RM 10. Ochoco Dam is an earth filled dam with a height of 125 feet, a crest length of 1,000 feet, and a storage capacity of 44,500 acre feet. The USBR reconstructed and enlarged Ochoco Dam in 1949-1950. Ochoco Dam was also reconstructed in 1994 to fix internal seepage and erosion of the foundation and embankment, and repair of the outlet works. Additional repairs were made again in 1995 to correct internal seepage.

Ochoco Reservoir is located in Crook County, six miles east of the town of Prineville. Ochoco Reservoir lies on the west slope of the Ochoco Mountains in Central Oregon, occupying a relatively narrow valley. Below the dam, semiarid irrigated farmlands dominate, while rolling hills with juniper-sage-grassland communities dominate the surrounding uplands. The elevation at full pool is 3,130 feet above mean sea level. Maximum surface area of the reservoir at full pool is 1,090 acres and minimum surface area at dead storage is approximately 100 acres. The length of the reservoir is 3.5 miles, with a maximum width of 0.5 miles.

Irrigation demand drives the operation of the dam and consequent drawdown of the reservoir water level. The entire active capacity is allocated for the exclusive use of irrigation. Irrigation releases generally begin around April 1 and extend until early to mid-October.

Drainage area for the reservoir comes from three main tributaries, Mill, Marks, and Ochoco creeks, with a total drainage of 295 square miles.

Protected Areas

Portions of the North Fork Crooked River and the mainstem Crooked River below Bowman Dam were added to the federal Wild and Scenic Rivers System in 1988. The South Fork Crooked River has been designated for further study as a Wild and Scenic River from near its headwater to its confluence with the Crooked River**.** It is presently designated as a Wilderness Study Area.

General Description- Upper Deschutes River

Subbasin Location

The upper Deschutes River subbasin encompasses the upper 132 river miles of the Deschutes River (Appendix I, Figure 1). Situated in Central Oregon, the majority of the subbasin is located in Deschutes County with smaller portions in Jefferson, Lake and Klamath counties. The total drainage area is approximately 2,200 square miles. The average annual discharge of the Deschutes River at Benham Falls (RM 181) is 1,024,700 acre-feet. The highest point in the subbasin is South Sister Mountain, elevation 10,358 ft, located in the central Cascade Mountains. Elevation drops to 1,900 ft where the Deschutes River enters Lake Billy Chinook.

Fall River

Fall River is approximately 25 miles southwest of Bend. It enters the Deschutes River on the west bank at RM 205. The stream is approximately 11.0 miles long and stream bank ownership is approximately 59% federal (Forest Service), 38% private, and 3% state (State Parks).

Little Deschutes River

The Little Deschutes River headwaters in Klamath County and flows 97 miles north to its confluence with the Deschutes River near Sunriver (RM 193) in Deschutes County. It drains an area of 1,020 square miles. The Crescent Creek drainage, a tributary to the Little Deschutes River, comprises about 12 percent of the Little Deschutes subbasin area. Crescent Creek is about 30 miles in length. Land ownership along the Little Deschutes River is 29% private and 70% federal (USFS, BLM). The majority of federal lands (USFS) are located from the headwaters (RM 97) downstream to near Crescent Junction (RM 65).

Tumalo Creek

Tumalo Creek originates on the northeast side of Tumalo Mountain and the east side of Broken Top mountain, approximately 20 miles west of Bend. It enters the Deschutes River at RM 160 just north of the City of Bend. The mainstem of Tumalo Creek is approximately 16 miles long and four tributaries; North Fork, South Fork, Middle Fork and Bridge Creek contribute approximately 20 additional stream miles to the subbasin. Land ownership in the subbasin is approximately 67% federal (Forest Service), 24% private, 8% city (Bend), 1% county (Deschutes) and >1% state (Parks). Primary land uses are recreation, timber, farming, residential, mining, and water withdrawal.

Bridge Creek, a major tributary to Tumalo Creek, is a principal source of water for the City of Bend which maintains a diversion facility near RM 15 (Tumalo Creek). Approximately 2.6 miles of Tumalo Creek flows through Shevlin Park, owned and operated by Bend Metro Park and Recreation District. Tumalo Irrigation District diverts water from Tumalo Creek at the Tumalo Feed Canal (RM 2.5).

Squaw Creek

Squaw Creek headwaters in the Bend Glacier of Broken Top mountain, then flows 39 miles in a northeasterly direction, through the City of Sisters and enters the Deschutes River at RM 123.1, approximately five miles downstream of Steelhead Falls. Park Creek, Soap Creek, Snow Creek, North Fork Squaw Creek and South Fork Squaw Creek are headwater tributaries to Squaw Creek originating from the Three Sisters Wilderness Area. Elevations in the subbasin range from about 2,100 feet at the mouth to more than 9,000 feet on the three glacier covered peaks in the Three Sisters Wilderness.

The Squaw Creek subbasin encompasses approximately 234 square miles. Land ownership is approximately 82% federal (Forest Service, BLM, Crooked River National Grassland), 17% private, and <1% state.

Climate

The climate in the subbasin is continental, the moderating affects of the Pacific Ocean are not entirely shut off by the Cascade Mountains. Average annual precipitation is as high as 100 inches in some areas in the Cascade Range, but drops to between 9 and 14 inches in the Deschutes valley and on the eastern plateaus. Most precipitation falls in the form of snow during winter. Temperatures are characterized by moderate days and cool nights. Bend averages about 10 days per year with temperatures above 90°F. Lows in the winter average between 20 and 30°F. Extreme temperatures can range from 100°F to minus 30°F.

Hydrology

The Deschutes River flows north from its headwaters at Little Lava Lake to Crane Prairie Reservoir (RM 239), south and east through Wickiup Reservoir (RM 226), and then north again to its confluence with Lake Billy Chinook (RM 120). The major tributaries above Crane Prairie Dam are Snow, Cultus, and Deer creeks, and Cultus and Quinn rivers. Tributaries between Crane Prairie and Wickiup are Browns, Davis and Sheep Springs creeks. The principal tributaries between Wickiup Dam and Bend are the Little Deschutes, Fall, and Spring rivers. Squaw and Tumalo creeks are the principal tributaries to the Deschutes River from Bend to Lake Billy Chinook.

The principal natural lakes in the subbasin are Odell, Crescent, Davis, Cultus, Little Cultus, Lava, Little Lava, South Twin, North Twin, Hosmer, Elk, Sparks, East, and Paulina. Principal reservoirs in the subbasin are Wickiup and Crane Prairie.

Soils

Soils in the upper Deschutes River subbasin are formed partially to entirely from materials deposited by volcanic eruptions. These materials include pumice, ash, and cinders. These deposits fell upon previously developed soils that became buried. Most of the buried soils were formed from hard basalts, and andesites, tuffs, breccias, glacial till and outwash gravels. Practically all bedrock materials are extrusive volcanic rocks (USDA 1966). These volcanic soils are characterized by being very porous.

Vegetation

Mountain hemlock, alpine, and subalpine plant communities occur in the high elevation and high precipitation zones of the subbasin (Appendix I, Figure 2). Mixed conifer and ponderosa pine communities are common to the middle elevation and precipitation zones. Sagebrush, juniper, and sparse ponderosa pine communities occur on the semiarid, lower elevations along the eastern edge of the subbasin. Lodgepole pine occurs over a wide

range of site conditions and elevations. Riparian vegetation is dominated by willow, alder and sedges.

Land Uses

Land ownership in the upper Deschutes River subbasin is predominantly public: USFS Deschutes National Forest, and Bureau of Land Management (Appendix I, Figure 3). Other public lands include city, county, and Oregon State Parks.

Primary land uses in the subbasin are agriculture, wood products manufacturing, recreation and tourism. Agriculture in the subbasin is primarily animal production (horses, llamas, cattle, emus, hogs and sheep). Secondary in importance is the production of animal feed, primarily alfalfa hay. The wood products industry has been the leader in manufacturing jobs, however, many high-tech and cottage industries have appeared in recent years as the timber jobs declined. In 1987, the tourism and recreation industry was the second largest source of income in Central Oregon. This trend has continued.

The City of Bend is the principal community in the subbasin. The next largest is Redmond, followed by Sisters, LaPine, Gilchrist and Crescent.

The population of Deschutes County has grown at a faster rate than any other area of Oregon during the decade of the 1990's. The 1995 population projection for Deschutes County was 92,245 and reaching 128,868 by the year 2010. Jefferson County is expected to grow to 22,618 and Klamath County to 69,058 by 2010. Statewide, Oregon is projected to increase by 931,357 people during the 1990-2010 period, the greatest growth during any 20-year period in its history (Portland State University 1993).

The upper Deschutes River subbasin's natural resources, including forests, lakes, streams, and wildlife contribute substantially to recreation and tourism in the region. The Deschutes National Forest is the largest landowner in the subbasin.

Most major streams, rivers, reservoirs, and natural lakes are on public land. Private ownership is most prevalent along streams, primarily the Little Deschutes River and tributaries, the Deschutes River between Bend and Lake Billy Chinook, Squaw Creek, and Fall River.

Protected Areas

The Three Sisters Wilderness Area (Deschutes National Forest) encompasses 283,402 acres, the largest wilderness area within the subbasin. In 1984, the Oregon Wilderness Act created the 157,000 acre Oregon Cascade Recreation Area. It is located on four National Forests including 42,656 acres of the Deschutes in the south end of the subbasin.

Large portions of the streams in the upper Deschutes River subbasin are provided protection under the Oregon State Scenic Waterway System and Federal Wild and Scenic River Act. These programs are designed to protect and enhance the scenic, aesthetic, natural, recreation, and fish and wildlife values along scenic waterways. Oregon Scenic Waterway System designation includes Deschutes River from Wickiup stream gauge to General Patch Bridge (RM 226.6 to RM 199), Harper Bridge to the COID diversion (RM 192.6 to RM 171), Sawyer Park to Tumalo State Park (RM 164 to RM 158) and Deschutes Market Road to Lake Billy Chinook (RM 157 to RM 120).

Federally designated Wild and Scenic portions of the upper Deschutes River include: Wickiup Dam to the north boundary of Sunriver (RM 226.7 to RM 186.2, recreational), north boundary of Sunriver to Lava Island Camp (RM 186.2 to RM 175,

scenic), Lava Island Camp to the Bend Urban Growth Boundary (RM 175 to RM 172, recreational), and Odin Falls to Lake Billy Chinook (RM 140 to RM 120). The Little Deschutes River, from headwaters to Hemlock Creek (RM 84 to RM 97), and Crescent Creek, from Crescent Lake Dam to County Road 61 (RM 18.5 to RM 30) are also designated Wild and Scenic under the Omnibus Oregon Wild and Scenic River Act (P.L. 100-557). Big Marsh Creek is designated as a recreational stream from headwaters to mouth (RM 15 to RM 0). Squaw Creek is designated as wild from its source, including tributaries, downstream to the boundary of the Three Sisters Wilderness, 27 stream miles. It is designated as scenic from the Three Sisters Wilderness boundary downstream to the USGS gauging station, 800 feet upstream from the McAllister Ditch, 8.8 stream miles. The lower seven miles are located within the BLM Steelhead Falls Wilderness study area.

Fish and Wildlife Resources

Fish and Wildlife Status – Subbasin-wide

Wildlife

The Deschutes River subbasin affords a wide variety of aquatic, riparian, and upland habitats. These varied habitats support a complex diversity of wildlife species, including large and small mammals, passerine birds, raptors, upland birds, waterfowl and wading birds, reptiles and amphibians. Some species are resident throughout the year, others are migratory either within the subbasin or, in many cases, seasonally migrate outside the subbasin. The status of the several hundred species of wildlife that use the subbasin varies widely, some being very abundant and others existing in low abundance. Populations of certain species are very tenuous, and their future presence in the subbasin will require improved information and decisive management actions. Many wildlife species found in the subbasin are classified as threatened, endangered, sensitive, or of special concern under the federal Endangered Species Act, or under Oregon Administrative Rules (Appendix I, Table 1).

Fish and Wildlife Status – Lower Deschutes River

Fish

The completion of Pelton and the Reregulating dams in 1958 and Round Butte Dam in 1964 effectively eliminated the production of anadromous fish in the upper Deschutes River subbasin. Passage of adult salmonids around the Pelton/Round Butte Project was accomplished with a three mile long fishway that extended above Pelton Dam, and a tramway that lifted fish over Round Butte Dam. However, 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). 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. Upcoming re-licensing of the Pelton/Round Butte Project has prompted reexamination of the feasibility of downstream and upstream fish passage through the complex (Ratliff et al 1996).

Anadromous fish present in the lower Deschutes River subbasin (Appendix I, Table 2) include spring and fall chinook salmon, coho salmon, sockeye salmon, summer steelhead, and Pacific lamprey. Current management goals and year 2000 escapement estimates for subbasin anadromous fish populations are summarized in Appendix I, Table 3.

Spring chinook salmon

Spring chinook salmon historically spawned in the mainstem Deschutes River upstream from the location of the Pelton/Round Butte Project, in Squaw Creek, the Metolius River, the Warm Springs River system and Shitike Creek. Historic use of Crooked River by spring chinook salmon is documented but conflicting reports exist on when this population was lost (Nehlsen 1995).

Wild spring chinook salmon currently spawn in the Warm Springs River system and Shitike Creek (Appendix I, Figure 4). Wild spring chinook salmon spawning in the Warm Springs River occurs primarily above Warm Springs National Fish Hatchery (WSNFH). All fish passing WSNFH must enter a trap at the hatchery and be passed above that facility to gain access to the spawning areas. Only wild spring chinook are allowed upstream into the spawning areas (WSNFH Operational Plan 1992-1996).

Spring chinook salmon contribute to significant Deschutes River sport and tribal fisheries, primarily in the reach downstream of Sherars Falls. Annual returns of spring chinook to the Deschutes River are impacted by Columbia River mainstem fisheries and river impoundment passage losses through Bonneville and The Dalles reservoirs (Appendix I, Figure 5). Columbia mainstem harvest rates have been greatly reduced since 1975 to protect weak upriver stocks and have been maintained at low levels through ESA constraints on mainstem fishery impacts to Snake River populations. Very few spring chinook originating above Bonneville Dam are intercepted in ocean fisheries (Marmorek et al. 1996).

Management of spring chinook salmon is guided by the need to escape a minimum of 1,300 adult wild spring chinook upstream of the barrier dam at WSNFH. Adult recruitment to the spawning grounds has been at or above replacement for a majority of the years of record (brood years 1969-1994) suggesting a relatively stable population (Appendix I, Figure 6). Deviations between observed and predicted values of ln(recruit/spawner) for brood years 1969-94 reflect annual changes in density independent mortality from sources other than harvest and upstream passage loss. In general, survival was better than average in 1969-75 and poorer than average in 1987-94 brood years (Appendix I, Figure 7). Widescale climatic environmental factors influencing management actions, that affect juvenile migration in the Columbia and Snake mainstems, and affecting ocean conditions have been found to coincide across mid-Columbia and Snake Basin spring chinook populations with variations in recruitment common across populations, although to varying degrees (Schaller et al. 1999). Survival of Warm Springs smolts to adults at the Columbia River mouth are estimated to average 3.07% (Marmorek et al. 1996).

The Deschutes River spring chinook population is improved from a depressed level in the early 1990's (Appendix I, Figure 8).

Fall chinook salmon

Fall chinook salmon are indigenous to the Deschutes River subbasin and presently spawn in the mainstem lower Deschutes River from the river mouth to Pelton Reregulating Dam (RM 100). While spawning occurs throughout the mainstem river, recruitment of spawners to the upper six miles of the lower Deschutes River (Dry Creek to Pelton Reregulating Dam) has declined in recent years. Redd counts during years 1988 to 1999 suggest that a change in spawning distribution may have occurred and a higher percentage of all spawning is taking place downstream from Sherars Falls.

The Deschutes River population is presently the second largest wild fall chinook salmon population upstream from Bonneville Dam. The run to the Hanford Reach, between McNary and Priest Rapids dams, of the Columbia River is the only larger population. Fall chinook salmon contribute to significant Deschutes River sport and tribal fisheries, primarily in the reach downstream of Sherars Falls. Annual returns of fall chinook to the Deschutes River are impacted by ocean and Columbia River mainstem fisheries and river impoundment passage losses through Bonneville and The Dalles reservoirs (Appendix I, Figure 9).

Management for fall chinook salmon is guided by estimated run to the river and escapement above Sherars Falls. Adult recruitment to the spawning grounds has been at or above replacement for a majority of the years of record (brood years 1977-1991), and while variable, suggests a relatively stable population (Appendix I, Figure 10). Deviations between observed and predicted values of ln(recruit/spawner) for brood years 1977-91 reflect annual changes in density independent mortality from sources other than harvest and upstream passage loss. In general, survival was better than average in the 1977 and 1984 brood years and poorer than average in the 1987, 89, and 91 brood years (Appendix I, Figure 11).

The fall chinook salmon population in the lower Deschutes River is not supplemented with hatchery releases and is considered to be healthy; wide fluctuations in population estimates could be due to the population estimation techniques (Appendix I, Figure 12).

Summer steelhead

Summer steelhead occur throughout the mainstem lower Deschutes River below Pelton Reregulating Dam (RM 100) and in most tributaries below the dam (Appendix I, Figure 13). Before construction of the Pelton/Round Butte Project, summer steelhead were also found in the Deschutes River upstream to Big Falls (RM 128), in Squaw Creek, and in Crooked River (Nehlsen 1995). Historic summer steelhead presence in the Metolius River is uncertain (Nehlsen 1995).

Wild summer steelhead spawn in the lower Deschutes River, Warm Springs River system, Shitike, Skookum, Wapinitia, Eagle, and Nena creeks, 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 opportunities in Nena Creek are limited to the lower two miles by a natural barrier.

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 to

spawn in the subbasin. The amount of genetic interchange between stray wild and subbasin origin wild summer steelhead is unknown.

Summer steelhead contribute to significant Deschutes River sport and tribal fisheries throughout the lower river. Annual returns of summer steelhead to the Deschutes River are impacted by Columbia River mainstem fisheries and river impoundment passage losses through Bonneville and The Dalles reservoirs.

The *U.S. vs. Oregon* (ODFW 1987b) agreed upon management objective for the Deschutes River is 6,575 wild summer steelhead above Sherars Falls.

Wild summer steelhead were listed as a federal threatened species in 1999. The summer steelhead population in the Deschutes River is currently much improved from a depressed level in the early 1990's (Appendix I, Figure 14). Abundance of the wild component of the population is increasing.

Pacific lamprey

Pacific lamprey are found in the in the lower Deschutes River, Shitike Creek, Beaver Creek, and the Warm Springs River. Pacific lamprey distribution and life-history information has not been collected in the Deschutes River subbasin. Abundance of Pacific lamprey in the subbasin has not been estimated, but is thought to be low. Pacific lamprey abundance throughout the Columbia River Basin has decreased significantly in recent years, and they are listed as a species of concern by the USFWS (species of concern are those taxa whose conservation is of concern, but for which further information is still needed).

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. Lamprey are particularly valued by tribal elders.

Redband trout

Redband trout (*Oncorhynchus myiss*) are indigenous to the lower Deschutes River subbasin (Appendix I, Table 2). Redband trout are found throughout the mainstem lower Deschutes river and its tributaries, but are most abundant in the White River system, which is blocked to anadromous fish passage approximately two miles from the mouth by impassable waterfalls.

Indigenous populations were supplemented with hatchery rainbow trout from 1934 to 1993 in the White River system, and from the 1940's to 1978 in the mainstem lower Deschutes River. The lower Deschutes River subbasin is currently managed by ODFW for wild fish only. Redband trout are quite abundant in the lower Deschutes River.

Bull trout

Bull trout (*Salvelinus confluentus*) are indigenous to the lower Deschutes River subbasin (Appendix I, Table 2). They are found in the mainstem river from Pelton Reregulating Dam to Maupin, the Warm Springs River, and Shitike Creek (Appendix I, Figure 15). Bull trout have not been documented in the lower Deschutes River below Sherars Falls, nor in the White River system.

Both fluvial and resident bull trout populations are believed to exist in the lower Deschutes River subbasin. The Shitike Creek and Warm Springs River populations of bull trout to 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 tributary streams. Juveniles and sub-adults migrate to the mainstem lower Deschutes River to rear. An upstream spawning migration takes place with the onset of maturity.

Completion of Pelton and Round Butte dams, and the subsequent abandonment of fish passage through the Pelton/Round Butte Project, effectively isolated bull trout populations in the Metolius River subbasin from those in the Lower Deschutes River subbasin.

Bull trout are currently listed as a threatened species under the federal Endangered Species Act. The status of the bull trout population in the lower Deschutes River subbasin unknown, but is believed to be depressed. The bull trout population in Shitike Creek is healthy, but numbers are low in the Warm Springs River.

Mountain whitefish

Mountain whitefish (*Prosopium williamsoni*) are indigenous to the subbasin and are found in the lower Deschutes River, Warm Springs River, White River, and Shitike Creek (Appendix I, Table 2).

Brook trout

Brook trout (*Salvelinus fontinalis*), an introduced species, are found in the Warm Springs and White rivers and Clear, Frog, Boulder, Barlow, Bonney, Mineral, Buck, Mill and Shitike creeks (Appendix I, Table 2).

Brown trout

Brown trout (*Salmo trutta*), an introduced species, may be present is small numbers in the lower Deschutes River in the vicinity of the Pelton/Round Butte Project (Appendix I, Table 2).

Nongame fish

Many species of nongame fish are present in the lower Deschutes River subbasin, including suckers, chiselmouth, sculpin, dace, pikeminnow, and redside shiners (Appendix I, Table 2).

Wildlife

California bighorn sheep (*Ovis canadensis californiana*), native to the lower Deschutes River subbasin but extirpated by the early 20th century, were reintroduced in 1993 with the release of 35 animals. A second release of 18 animals was made in 1995. This reintroduction has been very successful, the current population of California bighorn sheep in the Deschutes River subbasin is estimated at 180 individuals.

ODFW biologists conduct annual herd composition and trend surveys on bighorn sheep, mule deer (*Odocoileus hemionus*), Rocky Mountain elk (*Cervus canadensis*), and pronghorn antelope (*Antilocapra americana*) in the lower Deschutes River subbasin. These populations in the subbasin are relatively stable, with deer populations increasing slightly over the last few years.

Winter raptor, upland gamebird, waterfowl, and breeding bird surveys are also conducted annually to determine population trends in the lower Deschutes River subbasin. Bird populations that are monitored appear to be stable at this time.

Fish and Wildlife Status – Pelton/Round Butte Project

Fish

Pelton Dam (RM 103) and Pelton Reregulating Dam (RM 100) were begun in 1956. Fish passage facilities were constructed to maintain anadromous fish runs as part of the original FERC license. An upstream migrant trap and three mile long fish ladder were constructed to pass adults upstream. Some problems occurred when adults avoided the trap or when water temperatures increased in the ladder. Juvenile fish were passed downstream with a horizontal skimmer at the east embankment of Pelton Dam. Pelton Reservoir (Lake Simtustus) proved to be a serious problem to downstream migrating juveniles due to the high temperatures in the lower six miles of the reservoir forming a thermal block (OSGC 1959). Large schools of young chinook salmon and summer steelhead were observed periodically throughout the summer and fall of 1958 in the Deschutes and Metolius river channels and large numbers were caught by anglers.

Construction of Round Butte Dam (RM 111) was completed in 1964. Upstream and downstream fish migration facilities were also constructed at Round Butte Dam. Adult spring chinook salmon and summer steelhead were passed upstream over Round Butte Dam with a tramway system.

A stationary skimmer at the east embankment of Round Butte Dam and a large floating skimmer were constructed to collect and pass migrating juvenile anadromous fish downstream. Juvenile anadromous fish were captured from Lake Billy Chinook, transported to the base of Round Butte Dam, and released into Lake Simtustus. However, the completion of Round Butte Dam appeared to contribute to the final failure of juvenile fish passage out of the upper Deschutes River subbasin. Once Round Butte Dam was completed in 1964, studies found that chinook salmon and summer steelhead juveniles tended to wander in the different arms of the reservoir and did not pass well through Billy Chinook and Simtustus reservoirs. Survival of summer steelhead through Pelton Dam, from emigration to returning adults, was estimated at less than 1% prior to completion of Round Butte Dam (Gunsolus and Eicher 1962). Survival of downstream migrating juveniles, from Lake Billy Chinook to the Pelton skimmer, appeared to be less than 1% for experimentally released hatchery fish, after completion of Round Butte Dam.

In 1968, attempts to continue upstream passage of adult anadromous fish were abandoned. Remaining runs of wild spring chinook and summer steelhead were observed to spawn naturally below the project and hatchery strains of spring chinook and summer steelhead were developed at Round Butte Hatchery to mitigate for lost passage to upper subbasin spawning and rearing areas.

Historic and current fish species presence in Lake Billy Chinook and Lake Simtustus is summarized in Appendix I, Table 2.

Chinook salmon

A remnant population of spring chinook salmon is believed to exist in Lake Billy Chinook. The population would be extremely depressed. Anglers reported seeing chinook salmon adults in the Deschutes River up to Steelhead Falls during the mid-1980's. They have not been reported there in recent years. Juvenile chinook salmon were captured during seining in the Deschutes River below Steelhead Falls in 1986 (PGE, unpublished data). A few chinook salmon were reported as harvested from the reservoir during creel surveys conducted in the last few years. A single 8-inch chinook salmon was captured in trap nets

set below the mouth of the Metolius River in 1994. There are reports of angler captures of spring chinook in the reservoir nearly every year. This suggests that the population may still exist.

Redband trout

Redband trout are located throughout Lake Billy Chinook and Lake Simtustus, in the Metolius, Deschutes, and Crooked rivers and their tributaries. Redband trout are currently listed as a species of concern by the USFWS.

Production constraints for redband trout in both reservoirs include competition, predation, and poor habitat quality. Kokanee, smallmouth bass, suckers, and brown trout all compete with redband trout for prey items. The competition for prey items is intensified because the small quantity of shallow shoreline habitat in the reservoirs limits macro-invertebrate and insect production. These prey populations may be further reduced by reservoir drawdowns which cause direct mortality and reduce the amount of available habitat. Bull trout, brown trout, smallmouth bass and pikeminnow probably consume some redband trout, but the extent of this predation is unknown.

Bull trout

Lake Billy Chinook serves as a rearing area for bull trout that spawn in Metolius River tributaries. They also utilize the Deschutes River from Lake Billy Chinook upstream to Steelhead Falls, lower Squaw Creek, and the Crooked River upstream to Opal Springs (Appendix I, Figure 15). The abundance of juvenile bull trout is apparently high and the abundance of subadults appears to be increasing.

Bull trout are present in Lake Simtustus in low abundance. They enter the reservoir through the outlet structure and turbines of Round Butte Dam. Bull trout in the reservoir cannot successfully reproduce in Willow or Squaw creeks because water temperatures are too warm for successful egg hatching. Bull trout have not been captured in Willow Creek. Bull trout grow quite well in Lake Simtustus, attaining weights exceeding 10 pounds. They probably feed predominately on kokanee and may become separated spatially from other forage fish in the littoral zone because of high water temperatures.

Bull trout are currently listed by the USFWS as a federal threatened species. However, retention of one bull trout over 24 inches per day is allowed in lakes Billy Chinook and Simtustus.

Rainbow trout

The rainbow trout population in Lake Simtustus is probably entirely from hatchery fish. It is possible that some reproduction is occurring in Willow and Squaw creeks. Rainbow trout are located throughout the reservoir. Abundance of rainbow trout in the reservoir has likely declined since hatchery fingerling releases have been terminated.

Production constraints for rainbow trout include competition with other reservoir fishes, predation, poor habitat, and infections from the disease *C. shasta*. Kokanee, suckers, and brown trout all compete with rainbow trout for prey items. Bull trout, brown trout and northern pikeminnow probably consume some rainbow trout. The extent of this predation is unknown. Very little spawning habitat exists. Rainbow trout stocking has been limited due to concerns about their ability to migrate downstream into the Deschutes River where they would breed with, and compete with, wild redband trout.

Brown trout

Brown trout are common and found throughout Lake Billy Chinook, but they are not abundant. Densities appear to be higher near the mouth of all three river tributaries. It appears there are fewer brown trout than redband trout. It is clear that the population is at least stable and reproducing.

Brown trout are common in Lake Simtustus and distributed throughout the reservoir. Brown trout have become abundant in the reservoir since hatchery stocking began in 1986. Unlike other salmonids not indigenous to the Deschutes River, brown trout are resistant to *C. shasta*.

Brown trout are not believed to reproduce in Lake Simtustus or its tributaries. Some maturing brown trout migrate up the reservoir and enter the jump pool at Round Butte hatchery during September and October, their typical spawning season.

Production constraints for brown trout in both reservoirs include competition, predation, and poor habitat quality. Kokanee, smallmouth bass, suckers, and redband trout all compete with juvenile brown trout for prey items. Once brown trout become mostly piscivorous, smallmouth bass are probably their biggest competitor although there is probably some spatial segregation due to water temperature. Near the mouth of the Metolius River, bull trout probably compete directly with brown trout for food and space. The small quantity of shallow shoreline habitat in the reservoir limits macro-invertebrate and insect production, and probably limits the number of juvenile brown trout in the reservoir. Bull trout, smallmouth bass and pikeminnow probably consume some brown trout. The extent of this predation is unknown.

Kokanee

Kokanee are distributed throughout Lake Billy Chinook and are probably the most abundant fish species in the reservoir. They spawn mostly in the Metolius River and its tributaries, the Crooked River upstream to Opal Springs, and in the Deschutes River upstream to Steelhead Falls. Kokanee have been observed in Street Creek during the fall and probably attempt to utilize all other tributary streams for spawning.

Both wild and hatchery kokanee are present in Lake Simtustus. They are generally low in abundance. Like other salmonids, kokanee cannot successfully reproduce in Lake Simtustus. Kokanee have not been captured in Willow Creek. Kokanee generally exhibit good growth rates in Lake Simtustus, easily outgrowing those in Lake Billy Chinook.

Bass

Smallmouth bass, rare in Lake Billy Chinook until the early 1970's, are now found in high numbers throughout the reservoir. They are rarely found in Lake Simtustus. Largemouth bass are occasionally captured in Lake Billy Chinook.

Other game fish

Mountain whitefish are present but rare in lakes Billy Chinook and Simtustus. Black crappie and bluegill are present but rare in Lake Billy Chinook.

Nongame fish

Bridgelip and largescale suckers are the most abundant of several nongame fish species found in Lake Billy Chinook, and are perhaps the second most abundant fish in the reservoir, after kokanee. At their present abundance, suckers could be a major limiting factor for redband and brown trout due to competition for space and forage in the limited

amount of shallow water habitat. Present in low numbers are tui chub, dace, sculpins, goldfish, chiselmouth, and northern pikeminnow.

Chiselmouth, northern pikeminnow and largescale sucker are the most abundant of several nongame fish species found in Lake Simtustus. Chiselmouth are abundant and found throughout the reservoir. Chiselmouth may be an important food source for brown trout. The generally cool water of Lake Simtustus is probably the limiting factor for chiselmouth.

Northern pikeminnow are present at a high abundance and are found throughout Lake Simtustus. Because of its high abundance and its role as a piscivore, the northern pikeminnow is probably a major influence on game fish populations. Pikeminnow are a predator on kokanee, brown trout and rainbow trout and compete with brown trout for forage fish.

Largescale sucker may play an important role in trout management because of their great biomass and the resulting competition for food. Largescale sucker are abundant and well distributed throughout Lake Simtustus.

Bridgelip sucker and sculpins are also present in Lake Simtustus, but their abundance is much lower than other nongame fish species. As such, they do not appear to influence the biology and management of game fishes.

Wildlife

A wealth of wildlife species are found seasonally and year-round in the Pelton/Round Butte Project Area. Depending on the severity of the weather, abundance of mule deer, bald eagle and other raptors, and waterfowl populations wintering in the project area can be quite high. Mixed waterfowl flocks, containing up to 8,000 birds of as many as 28 species, have been recorded in the area. The majority of these waterfowl use the project area only during annual migrations, very few waterfowl nest there. Fourteen species of raptors have been documented in the area; many, such as bald eagles, golden eagles, osprey, and prairie falcons, are year-round residents and nest near the reservoirs. Nine species of upland gamebird have been recorded in the project area. An abundance of prey insects and ready access to water encourages use of rimrock cliffs surrounding the reservoirs, as well as bridges and buildings in the project area, by numerous bat species.

Fish and Wildlife Status – Metolius River

Fish

The completion of Pelton/Round Butte Project eliminated the production of anadromous fish in the upper Deschutes River subbasin, including the Metolius River.
Resident fish are found throughout the subbasin. The mainstem of the Metolius and Lake Creek provide spawning and rearing habitat for several trout species, kokanee, and whitefish. Bull trout and redband trout are present throughout most tributaries of the system. Appendix I, Table 2 summarizes historic and current fish species occurrence in the Metolius River and its tributaries.

Redband trout

Inland redband trout are indigenous to the Metolius River. Because of a lack of barriers, it is likely Metolius River trout were once a part of the Deschutes River redband trout complex of populations. Principal redband trout production areas above Lake Billy Chinook include the mainstem Deschutes up to Steelhead Falls, Squaw Creek, Crooked

River and Metolius River. The amount of genetic interchange between these areas has not been studied, but historically there were no physical barriers to stop movement of fish. Beginning in the 1920's hatchery rainbow trout were used to supplement the sport fishing demand on the Metolius River.

In recent years there has been increasing concern about the status of redband trout in the Metolius River. In those sections which have been monitored, the abundance of potential spawners is thought to be less than 500 fish, although spawning ground counts indicate increased numbers of redband redds since discontinuation of hatchery rainbow trout stocking. While it is not clear how these numbers compare to historical numbers or to the current habitat potential, densities of fish are very low, especially in the areas open to fishing.

Wild Metolius redband trout are likely at significant risk and in a potential conservation crisis. Redband trout are listed by the USFWS as a species of concern (species of concern are those taxa whose conservation status is of concern, but for which further information is still needed). The status of these fish is unknown outside of the four-mile reach which has been monitored. Also unknown is how many populations and life history forms may currently co-exist within the subbasin.

Bull trout

Bull trout are indigenous to the Metolius River subbasin. Bull trout were historically found throughout most of the Deschutes River subbasin (Appendix I, Figure 15). A major native American and pioneer fishery occurred on the upper Deschutes River at Pringle Falls (Ratliff and Fies 1989). There are many historical photos of large bull trout or "Dolly Varden" as they were called from both the upper Deschutes River near Bend and from the Metolius River. Bull trout were extirpated from the upper Deschutes River in the 1950's (Ratliff et al. 1994).

Up until about 1960, bull trout were trapped and removed from the Metolius River in conjunction with operation of a weir to collect salmon for hatchery brood, because of predation on spring chinook eggs and juveniles. Metolius River bull trout were at severely depressed levels as recently as the early 1980's. Recent redd counts on the entire known spawning area and trapping on Jack and Jefferson Creeks indicate a likely rebound of the population. Metolius bull trout currently appear to be in compliance with the Wild Fish Management Policy with respect to population size criteria of 300 spawners. Work is continuing to obtain estimates of the bull trout population and confirm the upward trend.

Tributaries such as Jefferson Creek, Canyon Creek, Roaring Creek, Jack Creek, and Candle Creek provide a majority of the known spawning and early rearing habitat in the Metolius River subbasin for bull trout. Abbot Creek is also reported to have supported bull trout (Foster 1957).

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

Pelton and Round Butte dams also blocked adult sockeye, lower river resident redband trout, and spring chinook salmon from accessing the Metolius River subbasin. Juveniles of these species were likely important prey items for bull trout. However, an abundant kokanee population has developed in Lake Billy Chinook as a prey source.

Metolius/Lake Billy Chinook bull trout appear to be increasing in number although potential hybridization with brook trout which occurs in some spawning streams still pose risks to the bull trout population. The protection of stable spawning and rearing areas in the Metolius River and tributaries by the USFS and CTWS has preserved the potential for the bull trout population to rebuild to near historic levels.

Bull trout are listed as a threatened species by the USFWS. However, retention of one bull trout over 24 inches per day is allowed in the Metolius Arm of Lake Billy Chinook.

Mountain whitefish

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

In the Deschutes River, redband trout and mountain whitefish share certain food habits. Mountain whitefish are primarily adapted as bottom feeders (Pontius and Parker 1973), and that competition may affect redband trout if both species forage on limited food at the same time of year. However, aquatic invertebrates in the Metolius River do not appear to be limited (Mangum 1988 and 1990).

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

Detailed population and distribution information on the entire Metolius River whitefish population is lacking. Mountain whitefish numbers from the source springs to Gorge Campground, estimated by snorkel observation throughout 1991, 1992, and 1993, ranged between 100 and 800 individuals.

Sculpins, dace, and suckers

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

Kokanee

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

Brown trout

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

Brook trout

Brook trout are present in low numbers in the mainstem Metolius and its tributaries, primarily Canyon and Abbot creeks. There are also a few naturally reproducing brook trout in Blue Lake and it is possible for these fish to move downstream to the Metolius River via Link Creek, Suttle Lake and Lake Creek. The extent of that movement is unknown but likely affected by the presence of *Ceratomyxa shasta* in Suttle Lake and Lake Creek.

Suttle and Blue Lakes

A summary of fish species presence and status in Suttle and Blue lakes is presented in Appendix I, Table 2.

Wildlife

ODFW biologists conduct annual herd composition and trend surveys on mule deer (*Odocoileus hemionus hemionus*) and Rocky Mountain elk (*Cervus canadensis*) in the Metolius River subbasin. These populations in the subbasin are relatively stable, with deer populations increasing slightly over the last few years.

Winter raptor, upland gamebird, and waterfowl surveys are conducted annually to determine population trends in the subbasin.

Fish and Wildlife Status – Crooked River

Fish

Historic game fish populations included anadromous spring chinook and summer steelhead, resident redband trout and mountain whitefish throughout the subbasin, and bull trout in the lower Crooked River. Due to the construction of numerous irrigation and hydroelectric dams, and habitat degradation caused by a combination of land and water management practices, anadromous fish runs have been lost. Bull trout also were extirpated from the subbasin with the exception of the Crooked River below Opal Springs.

Indigenous and introduced species currently present in the Crooked River subbasin include a diversity of game and non-game species. Appendix I, Table 2 summarizes historic and current fish species in the Crooked River subbasin.

Anadromous fish (historical)

Anadromous fish species which were historically present in the Crooked River include spring chinook salmon, summer steelhead and pacific lamprey. A barrier below the confluence of the North and South forks of the river was used by Native Americans for the taking of spring salmon in the 1820's (Ogden 1950, Buckley 1992). Historical spring chinook salmon and distribution are largely unknown, but they were known to occur in the subbasin as late as the 1940's (Frey 1942).

Summer steelhead were historically present throughout much of the subbasin, with the exception of the North Fork above Upper and Lower Falls. Prior to construction of Bowman, Pelton and Round Butte dams, summer steelhead were documented in Beaver, Twelvemile, Drake, Newsome, Horseheaven, Ochoco, and McKay creeks, and in the lower North Fork Crooked River (OSGC 1950-1973).

Pacific lamprey probably occurred in the Crooked River, but no records are available for that species.

Redband trout

Redband trout, a subspecies of rainbow trout adapted to the arid conditions east of the Cascade Mountains, are indigenous to the Crooked River subbasin. Known for their tolerance of high water temperatures, redband trout are present throughout the subbasin. Historically there were two populations in the subbasin, separated by a geologic barrier in the North Fork Crooked River. Today there are numerous separate smaller populations, fragmented and isolated by artificial barriers such as reservoir impoundments, irrigation diversion systems, and road culverts. Generally, redband trout populations are thought to be in a depressed status and possibly declining throughout the subbasin. Redband trout have been listed as a state sensitive species and as a species of concern by the USFWS (species of concern are those taxa whose conservation status is of concern, but for which further information is still needed).

Bull trout

Bull trout were historically found in the lower Crooked River. While there is no historic documentation of bull trout spawning in the subbasin, bull trout used the lower Crooked River for juvenile rearing and adult holding areas (Frey 1942) (Appendix I, Figure 15). Bull trout were caught as recently as the early 1980's up to the city of Prineville (Walt Carter 1992, personal communication). Today, bull trout in the Crooked River subbasin are confined to the lower Crooked River up to Opal Springs Dam, an impassable barrier since 1982. Bull trout are currently listed by the USFWS as a federal threatened species.

Mountain whitefish

Mountain whitefish are found in the Crooked River below Bowman Dam, Ochoco Creek, and occasionally in Haystack Reservoir.

Brown trout

Introduced brown trout are present in the Crooked River below Opal Springs and Haystack Reservoir.

Brook trout

Introduced brook trout are present in Allen, Lookout, and Brush creeks, tributaries of the upper North Fork Crooked River above Big Summit Prairie, and Walton Lake. These fish are the naturalized progeny of hatchery fish originally stocked in the 1920's and 1930's.

Bass

Introduced smallmouth bass are present in Prineville Reservoir, the upper Crooked River, and some tributaries. Occasionally they are observed in the lower Crooked River. Introduced largemouth bass are present in Prineville and Haystack reservoirs. They are observed occasionally in the upper Crooked River.

Black crappie

Introduced black crappie are present in Prineville Reservoir (illegal introduction), Ochoco Reservoir (illegal introduction), and Haystack Reservoir. They probably also occur in the upper Crooked River.

Brown bullhead

Introduced brown bullhead, or "catfish" as they are commonly called, are present in the upper Crooked River, the South Fork Crooked River, the North Fork Crooked River, Prineville Reservoir, the lower Crooked River, Ochoco Reservoir, Walton Lake (illegal introduction) and Haystack Reservoir.

Other game fish

Redear sunfish and bluegill are present but rare in the subbasin.

Nongame fish

Many species of nongame fish are present in the subbasin, including sculpins, suckers, chiselmouth, and northern pikeminnow. Tui chub, goldfish and carp are present in the subbasin in extremely low numbers and do not appear to be major influences on the biology and management of game fishes.

Wildlife

ODFW biologists conduct annual herd composition and trend surveys on mule deer (*Odocoileus hemionus hemionus*) and Rocky Mountain elk (*Cervus canadensis*) in the Crooked River subbasin. These populations in the subbasin are relatively stable, with deer populations increasing slightly over the last few years.

Winter raptor, upland gamebird, and waterfowl surveys are conducted annually to determine population trends in the subbasin.

Fish and Wildlife Status – Upper Deschutes River

Fish

Historic game fish populations included anadromous spring chinook and summer steelhead, resident populations of redband trout and mountain whitefish throughout the subbasin, bull trout throughout the mainstem of the Deschutes River, Little Deschutes, Odell Lake, Odell Creek, Davis Lake, and Pacific lamprey in the Deschutes River. Anadromous fish runs have been lost in the upper Deschutes subbasin due to the construction of dams on the mainstem of the Deschutes River. Bull trout were also extirpated from most of the subbasin above Steelhead Falls due to migration barriers (dams), water withdrawal from irrigation development, and excessive harvest.

Indigenous and introduced fish species currently present in the upper Deschutes River subbasin include a diversity of game and non-game species. Appendix I, Table 2 summarizes fish species presence in the upper Deschutes River subbasin.

Anadromous fish (historical)

Prior to construction of dams on the Deschutes River, the Deschutes River (up to Big Falls) and Squaw Creek supported runs of summer steelhead and spring chinook salmon. Round Butte Dam, completed in 1964, incorporated fish passage facilities, but they were not effective at smolt collection and movement downstream. Anadromous fish passage was terminated in 1968, eliminating spring chinook and summer steelhead from the upper Deschutes River subbasin.

Squaw Creek was a major producer of summer steelhead. On the Deschutes River, Big Falls is considered to have been the upstream limit of anadromous fish migration (Nehlsen 1995). Steelhead could negotiate Steelhead Falls in high winter or early spring flows, and after a fishway was constructed in 1922, could move upstream through the fish ladder for a period of years.

Pacific lamprey probably occurred in the Deschutes River above the Pelton/Round Butte project, however, very little is known about their life history, distribution, or abundance in the subbasin.

Chinook salmon

Spring chinook salmon are indigenous to the subbasin and historically were present in the Deschutes River up to Steelhead Falls and in Squaw Creek. A remnant population is believed to exist in Lake Billy Chinook and in the last 15 years, reports have been received of anglers catching chinook near Steelhead Falls. No spawning adults have been found recently in either the Deschutes River above Lake Billy Chinook or Squaw Creek.

Redband trout

The redband trout is indigenous to the upper Deschutes subbasin. Historically, they were found throughout the upper Deschutes subbasin in waters connected to the Deschutes River. Today, their distribution in the subbasin is fragmented due to dams without fish passage, natural barriers, severe stream flow alterations from irrigation development, chemical treatment projects, and introduction of non-indigenous trout stocks. Presently, they are found in the mainstem Deschutes River from Lake Billy Chinook upstream to the headwaters, the Little Deschutes River, Crescent Creek, Squaw Creek, Tumalo Creek, and Odell Creek. Redband trout populations are thought to be in a depressed status overall, with localized areas of abundance, and are listed as a state sensitive species and as a federal species of concern by the USFWS (species of concern are those taxa whose conservation status is of concern, but for which further information is still needed).

Bull trout

Bull trout are indigenous to the upper Deschutes River subbasin and historically were found in the mainstem Deschutes River to the headwaters, Odell Lake, Odell Creek, Davis Lake, and Crescent Lake. It is likely they were also present in other waters connected to the Deschutes River. Bull trout were extirpated from the Deschutes River mainstem in the 1950's due primarily to flow manipulations and dams with no upstream fish passage. Today, they are found in Odell Lake, occasionally in Odell Creek and Davis Lake, Squaw Creek below Alder Springs, and in the Deschutes River from Lake Billy Chinook upstream to Steelhead Falls (Appendix I, Figure 15). Bull trout are a federal threatened species. Harvest of bull trout is allowed only in the Deschutes River Arm of Lake Billy Chinook upstream to Steelhead Falls.

Kokanee

Kokanee were stocked in many waters of the subbasin and are found today in Odell, Crescent, Elk, Paulina and East lakes, Wickiup and Crane Prairie reservoirs. They appear rarely in Davis Lake as emigrants from Odell Lake. ODFW stocks fingerling kokanee in Crescent, East, and Paulina lakes, and Crane Prairie reservoir. The remaining kokanee populations are naturally reproducing in sufficient numbers to maintain fisheries without annual stocking. Paulina Lake grows larger-than-average-size kokanee and holds the

current state record. The Paulina Lake kokanee provide the annual supply of eggs for hatchery production in Oregon and, in some years, Idaho and Washington.

Mountain whitefish

Mountain whitefish are closely related to salmon and trout. They are indigenous to the upper Deschutes River subbasin. They are still found in their original distribution pattern with the exception of waters which were chemically treated and recolonization did not occur. Today, they are found in Little Lava Lake, the Deschutes River mainstem from the headwaters to Lake Billy Chinook, Crane Prairie and Wickiup Reservoirs, the Little Deschutes River system, Crescent and Odell Lakes, Odell Creek, Davis Lake, Fall River, Spring River, lower Squaw Creek, lower Tumalo Creek, and Cultus Lake. The largest whitefish (20" or greater) are found in the large lakes and reservoirs. The current state record whitefish was caught in Crane Prairie Reservoir.

Brown trout

Brown trout were introduced into the subbasin in the early 1900's. Today they are found in the Deschutes River mainstem from Crane Prairie Dam downstream to Lake Billy Chinook, Wickiup Reservoir, East, Paulina, and Crescent lakes, Spring River, Fall River, Little Deschutes subbasin, Squaw and Tumalo Creeks. The largest brown trout in Oregon are produced in this subbasin with the current state record of 27 lbs 12 oz from Paulina Lake. East and Paulina lakes, and Wickiup Reservoir have produced brown trout in excess of 20 lbs. Brown trout up to 15 lbs have been taken in the Deschutes River.

Brook trout

Brook trout were introduced into the subbasin in the early 1900's. They are widely distributed in the subbasin from high mountain lakes to headwater tributaries. They are found in all stream systems and most major lakes with large variations in abundance. All brook trout stocking has been discontinued in waterbodies connected to the Deschutes River. They are the most prevalent fish in both wilderness and non-wilderness high lakes. This subbasin has a history of producing large brook trout and the current state record brook trout of 9 lbs 6 oz came from the Deschutes River below Little Lava Lake.

Lake trout

Lake trout were first introduced in 1917 into Odell and Crescent lakes. Hatchery reared lake trout were stocked into Odell, Crescent, Summit, and Cultus lakes from 1951-1965. Today, they are still found in these four subbasin waters. They have maintained fishable populations through natural reproduction. Lake trout are very piscivorous, eating primarily whitefish, kokanee, tui chubs, other trout, and crayfish. They are very long-lived (>20 years) and can reach very large size. The current state record is a 36 lb 8 oz specimen from Odell Lake.

Cutthroat trout

Cutthroat trout are an introduced species to the upper Deschutes River subbasin. They are presently only being stocked in a few isolated high mountain lakes.

Atlantic salmon

Atlantic salmon, an introduced species to the upper Deschutes River subbasin, are currently present in East and Hosmer lakes. They were initially stocked at Hosmer Lake in 1958. Atlantic salmon were stocked in many subbasin lakes, however, they failed to survive or

generate fisheries in all but Hosmer and East lakes. These Atlantic salmon do not reproduce naturally and the fisheries are maintained by annual stocking.

Largemouth bass

Illegally introduced largemouth bass are present in Crane Prairie and Wickiup reservoirs, and Davis Lake. ODFW has stocked largemouth bass in Fireman's Pond in Redmond. In addition to public waters, largemouth bass are found in many private ponds.

Brown bullhead

Introduced brown bullhead are present in low numbers in Gilchrist Mill Pond (Little Deschutes River), Little Deschutes River downstream of Gilchrist, and occasionally in the Deschutes River mainstem downstream to Lake Billy Chinook. They have been illegally introduced into North Twin Lake and Wickiup Reservoir. In addition to these public waters, they are found in many private ponds.

Bluegill

Bluegill are abundant in private ponds in the subbasin. Illegally introduced into Crane Prairie in the mid 1990's, the population is growing rapidly and it is assumed bluegill will also colonize Wickiup Reservoir to some extent.

Crappie (black, white)

Crappie are rare in public waters of the subbasin, found only in Fireman's Pond (Redmond). However, they are fairly abundant in some private ponds. Crappie were illegally introduced into Crane Prairie in the mid 1990's, their status there is unknown.

Nongame fish

Several indigenous and introduced nongame fish species are present in the subbasin. Indigenous species include; sculpins, suckers, and dace. Introduced species are tui and blue chubs, and three-spine stickleback.

Wildlife

ODFW biologists conduct annual herd composition and trend surveys on mule deer (*Odocoileus hemionus hemionus*), pronghorn antelope (*Antilocapra americana*), and Rocky Mountain elk (*Cervus canadensis*) in the upper Deschutes River subbasin. Elk populations in the subbasin appear to be increasing, deer populations are stable, antelope populations appear to be declining.

Winter raptor, upland gamebird, and waterfowl surveys are also conducted annually to determine population trends in the subbasin. Most of the bird populations that are monitored appear to be stable at this time.

Habitat Areas and Quality – Subbasin-wide

Wildlife

Wildlife habitats include foraging, reproduction, roosting, perching, and any other habitat necessary to the species through its life cycle. Not only does habitat quantity and quality affect wildlife, but disturbance may also influence the ability to forage, reproduce, or disperse. Past logging, suppression of wildfire, and increased disturbance from roads and recreational uses has lowered the habitat quality for many wildlife species in the Deschutes River subbasin.

Wildlife are associated with riverine and adjacent riparian forest, wetlands, mixed coniferous forest, juniper steppe, shrub steppe, grasslands, agricultural, and urban/suburban habitats in the Deschutes River subbasin. Habitat quality varies, depending on the degree to which habitats have been converted to other land uses or impacted by human activities and invasion of non-native vegetation. Wildlife habitat has generally been lost or degraded throughout much of the Deschutes River subbasin by past and present land management, hydropower development, the spread of non-native plant species and urban/rural residential expansion. Habitat fragmentation has occurred due to roads, railroads, impoundments, housing development, fencing, urbanization, and habitat alterations from activities such as agriculture and logging.

Riparian/aquatic

The subbasin features hundreds of natural lakes, wetlands, springs and seeps in a variety of sizes, from high elevations in the Cascade Mountains to lower elevation valleys. Many of these are isolated water bodies fed by springs or snow runoff, with subterranean discharge into lava substrate. Others are connected by flowing streams. Numerous reservoirs have been created by dams to store or divert irrigation water, provide municipal water, and produce hydroelectric power. Hundreds of miles of canals distribute irrigation water throughout large areas of the subbasin. These impoundments, diversions, and canals have had a profound impact on wildlife, providing new or improved habitat for some species, while inundating habitat for others. Dams, impoundments, diversions and canals represent barriers to many aquatic and terrestrial wildlife species, and have interrupted habitat connectivity resulting in isolated sub-populations of certain species. Reduced instream flows due to seasonal diversion for irrigation affects many stream reaches and depletes aquatic and riparian habitat. For example, the instream water right for the middle Deschutes River downstream from Bend is 250 cfs, however summer flows are often less than 50 cfs.

The aquatic environment and associated riparian vegetation provided by the flowing and standing waters, seeps and springs of the subbasin are critical features for myriad wildlife species. Furbearers, including beaver, otter, muskrat, raccoon and mink, are dependant on aquatic and riparian habitats for food, cover, travel, denning, and birthing. Amphibians (tailed frog, Oregon and Columbia spotted frogs, western toad, long toed salamander) require high quality water for spawning and development of larval stages, as well as the moist environment, cover, and rich insect forage base provided by healthy riparian zones. Reptiles often associated with riparian areas include the garter and gopher snakes, and western rattlesnake. Large mammals like Rocky Mountain elk, whitetail and mule deer rely on riparian corridors for security, travel and thermal cover, calving and fawning areas, and abundant forage. Bats, including Townsend's big-eared, long-eared myotis, and silver-haired bats, feed heavily on abundant insects near lakes and streams. Many songbirds (bank swallow, willow fly catcher, water ouzel), upland birds (mountain quail, ruffed grouse), raptors (osprey, bald eagle), waterfowl (Barrow's goldeneye, bufflehead, mallard), and wading birds (least bittern, yellow rail, upland sandpiper) rely on aquatic and riparian habitat for nesting, roosting, forage and cover. Predators such as coyote, bobcat, cougar, and bear are attracted to riparian areas by abundant prey. Most terrestrial species are heavily dependent on riparian areas for at least part of their life history.

Forest

Many of the mid and high elevation lands in the subbasin are forested, including the Cascade Mountain range and the Ochoco Mountain complex. Ponderosa pine with shrub understory dominates moderate elevations, transitioning into dense lodgepole pine forests with gain in elevation, and mixed coniferous forests of fir, hemlock, and spruce at higher elevation. In the lower subbasin, pine/oak forest occurs along the eastern base of the Cascade Mountain range.

High elevation forests provide summer habitats for large migratory mammals including blacktail and mule deer, Rocky Mountain and Roosevelt elk, and black bear. Cougar, which depend heavily on a diet of deer and elk, follow their migratory prey. The mountain goat, once endemic to alpine habitats in the north Cascade Mountain range, is now extinct. Biologists are evaluating opportunities to reintroduce mountain goat at higher elevations within the Deschutes River subbasin.

Deer and elk populations have likely increased in forested portions of the subbasin as a result of past timber harvest activities which created forage in close proximity to cover. There has also been an increase in the amount of effective deer and elk cover where fire suppression has resulted in dense understory. These denser, multi-storied stands also provide habitat for many bird species. Stands infected with insects or those that have experienced blowdown and have an abundance of downed logs have provided additional security habitat. However, these dense, multi-storied stands may not be sustainable due to increased risk of wildfire and insect and disease infestations.

Mid elevation forests provide transition range and migratory corridors as deer and elk move to low elevation winter ranges, then back up to summer range. Understory shrubs, including bitterbrush, manzanita, ceanothus, big sage, and mountain mahogany, afford cover and forage for browsing animals as well as fawning and calving sites. Smaller carnivores, including wolverine, fisher and American martin, frequent these forests as well, preying on snowshoe hares, golden mantled ground squirrels, least and yellow pine chipmunks, pine squirrels, and other rodents, as well as birds. Chipmunks and other rodents develop seed caches, providing an important role in regenerating shrubs such as bitterbrush, and reseeding coniferous trees. Raptors, such as goshawk, Cooper's hawk, and flammulated, spotted, great gray, and pygmy owls, also prey on small mammals and birds, as well as insects. The bald eagle utilizes large, mature trees for nesting , roosting and perching. White-headed, black-backed, and three-toed woodpeckers, pygmy nuthatch, and mountain chickadee rely on cavities in snags to nest and roost, and on the insects produced by decaying dead-and-downed wood for forage. Ground-nesting birds, such as ruffed and blue grouse, and mountain quail, frequent these forests as well. The western toad and long-toed salamander frequent forest streams and ponds, but adults often travel far from water to forage on forest insects and other invertebrates. Garter snakes and rubber boas are relatively common forest reptiles.

Juniper steppe

Juniper steppe is a common feature of the arid mid and low elevation lands in the subbasin, and are more common now than historically. Fire suppression and grazing have allowed juniper stands to increase in density, and to invade adjacent range and grasslands that historically burned periodically, keeping juniper in check. Approximately 95% of juniper trees today are less than 100 years old, indicative of this recent invasive trend. Associated

with juniper stands are several species of shrubs, including bitterbrush and several kinds of sage brush. Native bunch grasses are also an important component, but in many areas have been displaced by invasive introduced grasses such as cheat grass, medusa head, and crested wheat. Young juniper trees also displaced native shrubs and grasses as they invaded new sites in the past 100 years.

Much of the critical winter range for large grazing wildlife consists of juniper steppe at lower elevations. Mule deer, Rocky Mountain elk, and pronghorn forage on brush, grass, and forbs, while the junipers afford thermal and hiding cover. Small mammals, including the least chipmunk, bushy-tailed woodrat, and whitefoot mouse, are prey for predators such as bobcat and coyote. Junipers provide nesting and roosting habitat for many species of birds including Swainson's and ferruginous hawks, black-billed magpie and common raven, loggerhead shrike, as well as cavity nesters like red shafted flicker and mountain bluebird. Massive crops of juniper berries are a staple food for many birds, including robin, Townsend's solitaire, and pinyon jay. Rodents, coyote, and raccoon also supplement their diet with juniper berries. Western fence lizard and western skink are common reptiles. Mid-age stands of juniper with full complements of understory feature a high diversity of wildlife.

Shrub steppe/rangeland

The lower elevations of the subbasin consist largely of open shrub steppe rangelands. Native vegetation historically included several species of sage brush, bitterbrush, bunchgrasses, buckwheats and diverse perennial and annual forbs. Because of the open nature of rangelands, adequate cover for wildlife is an important component. Undisturbed canyons, ravines, draws, rock outcrops and similar geological features provide travel, security, and thermal cover. Stands of tall sage brush and adjacent juniper provide cover for large and small mammals, as well as nesting and perching sites for birds. These are generally arid lands, and availability of water may limit distribution of some species.

Low elevation rangelands are critical wintering areas for mule deer, pronghorn and Rocky Mountain elk. Bighorn sheep may forage on rangelands close to the canyons and lava flows they frequent. Black-tailed jackrabbit, pygmy rabbit, least chipmunk, and various small rodents are resident here. Predators include badger, coyote, bobcat, and occasionally cougar. Sage grouse are dependent on open rangelands of low sage, as are burrowing owls. Sage and Brewer's sparrows, and sage thrashers nest in the brush. Golden eagle, red-tailed hawk, and prairie falcon hunt these lands, as do scavengers like the common raven and turkey vulture. Reptiles include the gopher snake, western rattlesnake, short-horned lizard, and sagebrush lizard. The spadefoot toad ventures forth to spawn in temporary pools and springs, spending the dry season in burrows.

Grassland

Grasslands consisting largely of native bunch grasses, with associated low shrubs and forbs, were historically a major feature of the Deschutes River subbasin. Over 50% of these grasslands have been converted to farmlands, irrigated pasture, low- and high-density housing, urban developments, and roadways. The Crooked River Grasslands (more than 160,000 acres), managed by the U.S. Forest Service, represent a large portion of the remaining true grasslands in the subbasin. Most other grasslands have been heavily altered by livestock grazing and other practices and are not in a natural condition.

Grasslands provide forage for grazing animals including pronghorn, mule deer, elk, and bighorn. Coyote, badger, and striped skunks hunt smaller mammals that are abundant here, including ground squirrels, field mice, and voles. Black-tailed, as well as the less abundant white-tailed jackrabbit frequent grasslands. Golden eagle, ferruginous and Swainson's hawks, prairie falcon, kestrel, and burrowing owl hunt abundant prey here. Grasslands in the Deschutes River subbasin may offer an opportunity to reintroduce the sharptail grouse which was native in Oregon. Western meadowlark, horned lark, and savannah sparrow are songbirds typical of the grasslands. Pacific gopher snake, western rattlesnake, and western fence lizard are common reptiles.

Agricultural lands (croplands, pasture, dry range)

Widespread agricultural and residential development has displaced shelter for resident birds and mammals, especially in winter. Dead, dying, and downed trees for nesting, scanning perches, and insect-feeding substrate for birds and other wildlife are absent in most residential and agricultural properties.

Deer, elk, and antelope populations have likely increased in agricultural portions of the subbasin as a result of increased forage opportunities. However, some portions of the subbasin which have been heavily grazed by livestock may provide only marginal habitat for these populations and other mammals and birds. Juniper and non-native annual grass invasion of shrub steppe habitats has reduced abundance and palatability of forage in heavily disturbed areas. This may lead to increased damage to agricultural crops in the subbasin as wildlife species move from marginal habitat to highly desirable forage in croplands.

The Conservation Reserve Program, which takes agricultural lands out of production, has provided increased forage and cover for many wildlife species. However, as these stands of grass and forbes age and stagnate, deer and elk benefits decline as forage becomes less palatable, while non-game benefits may increase in areas where habitat components become more complex. More active management of some lands on which management has been deferred could provide increased benefits to wildlife.

Urban/suburban developments

Increased human use of riparian areas has likely displaced some elk and deer from historic high quality calving and/or fawning areas. Housing development in traditional big game winter range has the potential to greatly impact those species. Migration routes of big game animals are also affected by major roads and highways in the subbasin.

Increased recreational use of public lands in the subbasin has increased disturbance to wildlife. Depending on the extent, frequency, and duration of disturbance, it may affect the animal's ability to survive during stressful periods, cause abandonment of young, and/or abandonment of habitats.

Habitat Areas and Quality - Lower Deschutes River

Fish

Livestock have traditionally grazed year-round in the lower Deschutes River canyon and tributaries, or from spring until the fall harvests were complete on the cropland. This pattern of 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 degradation of upland areas and stream corridors.

The loss of important riparian stream side vegetation often contributes to instability of the stream channel. Channel instability, combined with rapid storm runoff from degraded upland rangeland, has led to frequent and devastating flood and erosion events. These flood events unravel stream banks, remove remnant trees and top soil from the flood plain, and in some areas destroy cropland, buildings and other structures. This flooding, and the post-flood remedial channel repair projects, cause significant widening of the stream channels, loss of instream structure, loss of floodplain capacity and connectivity, and reduction in average stream depth.

Condition of the riparian vegetation is fair along the mainstem lower Deschutes River and higher elevation west side tributaries and generally poorer along the lower elevation east side tributaries. Railroad right-of-way exclusion of livestock from the shoreline for several decades along 75 miles of the mainstem Deschutes River, as well as more recent projects to control livestock grazing in the riparian areas account for better riparian condition along the mainstem river.

Many streams in the subbasin are 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.

Erosion from 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%. Replacement of conventional tillage systems for dryland wheat production with new methods, such as direct seed/no till systems, will reduce sediment delivery to streams from these typically highly erodible soils. Sediment originating from dry land farming affects the following streams within the lower Deschutes River subbasin: Antelope, Trout, Bakeoven, Buck Hollow, Macks Canyon, Sixteen Canyon, Gordon Canyon, Fall Canyon, Oak Brook, Jordan, Tygh, Wapinitia, Nena, Dry, Ferry, and Bull Run creeks, as well as White River and the mainstem Deschutes River.

Wildlife

Lower Deschutes River Management Area

The Lower Deschutes River Management Area (LDMA) encompasses 8800 acres along the lower 18 miles of the river. This area is managed by ODFW specifically for fish and wildlife. Acquired in 1983-84, much of the upland and riparian areas had been severely degraded by years of livestock grazing. Livestock exclusion fencing, riparian and forage planting, spring development and control of noxious weeds have greatly improved the fish and wildlife habitat in the LDMA.

White River Wildlife Area

The White River Wildlife Area (WRWA) is located in the White River watershed. The original ODFW acquisition in 1953 has grown to 37,361 acres in 2000. The wildlife area is managed to maintain and develop adequate high quality habitat for wintering deer and

elk, turkeys, gray squirrels, and non-game wildlife species, and to provide wildlife and recreational opportunities for the public. Good quality habitat is found within the WRWA, including wetlands; mixed conifer, pine-oak, and oak forests; and upland grasslands.

Habitat Areas and Quality - Pelton/Round Butte Project Area

Fish

Lake Billy Chinook

Habitat in Lake Billy Chinook is characterized by steep shoreline topography, a boulder and cobble substrate, and generally good water quality. Most of the shoreline consists of cobble and boulders. A few sandy beaches are present, mostly near developed recreation areas and in secluded coves. Silt and sand are also present in the deltas created by the three main tributary rivers. Due to the steep topography and rocky substrate, very little aquatic vegetation is present in the reservoir. Some woody material has accumulated in the reservoir in recent years. Most of this material is from shoreline alder trees that have fallen into the reservoir or from large woody debris brought in by the February 1996 flood.

Surface water temperature rarely exceeds 75°F. Normally, a well defined thermocline occurs at 20-25 feet during the summer months. Mullarkey (1967) found that dissolved oxygen in the newly formed reservoir was adequate for salmonids except below the thermocline in the Crooked and Deschutes river arms during the summer.

The Metolius and Crooked rivers each contribute about twice the volume of water as the Deschutes River (Mullarkey 1967). The Crooked River is generally more turbid than the other two rivers, particularly during late winter and early spring. The Crooked River also has higher alkalinity.

Lake Simtustus

Habitat in Lake Simtustus is characterized by the steep shoreline topography, a boulder and cobble substrate, and generally good water quality. Only 12% of the reservoir is less than 10 feet deep. The majority of the shoreline consists of cobble and boulders. Silt and sand are also present in the deltas created by Willow and Seekseequa creeks. Small patches of aquatic vegetation are present in the reservoir, mostly associated with the few sandy beaches. Some woody material has accumulated in the reservoir in recent years. Most of this material is from alder and juniper trees which have fallen into the lake.

Lake Simtustus is generally considered to be meso-trophic. Surface water temperature rarely exceeds 70°F. Normally, a well defined thermocline occurs at 15-25 feet during the summer months.

Habitat Areas and Quality - Metolius River

Fish

The Metolius River is one of the largest spring-fed streams in Oregon. Flows average 100 to 110 cfs at the source, and accrue an additional 1,300 cfs from the tributaries and springs (Kunkel and Marx 1991).

Prior to formation of Lake Billy Chinook the Metolius River was 41 miles long. It is now 28.6 miles long and remains a swift-flowing stream with an average drop of 35 feet per mile. Pool, riffle, and glide characteristics are not as well-defined as those of similarly sized rivers because it is spring-fed, lacks flood events, and flows on a relatively uniform gradient within a volcanic bed. The river width averages 50 feet and the water flows in a

well-defined channel. There are few wetlands along the mainstem of the Metolius, but several tributaries have extensive marshy areas, particularly in the Lake Creek area.

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

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

The recruitment of large woody debris into the Metolius is a slower process than in other rivers of similar flow because the river has a smaller watershed and fewer freshets. However, the typically stable flows and lack of freshets favor the retention of large woody material once it falls into the river. Woody material for trout habitat is very limited on the Metolius River because of past removal and the watershed's limited potential for transport of wood throughout the subbasin. In February 1996, a rain-on-snow event resulted in high flows and debris avalanches in the Metolius River below Bridge 99. Effects of these events are yet to be determined but are suspected to have resulted in significant movement of woody material.

It appears that the riparian area is adequately stocked with large conifers which will eventually improve fish habitat if allowed to enter and remain in the river (USDA Forest Service 1990b).

For most of its length the river is fast moving with few pools, and fish cover is less than optimal. Habitat projects by USFS, ODFW, Trout Unlimited, and PGE have increased fish cover above Camp Sherman bridge but no surveys have quantified the amount of cover added below the bridge from habitat restoration work (Fies 1993).

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

Suttle Lake

Suttle Lake's bottom is composed of sand, gravel, and in deeper areas, a thick layer of sediment. Most of the shallow littoral areas are composed of gravel and rock. The lake's shoreline is densely forested with conifers. Surface water temperatures of Suttle Lake reach 70°F in mid to late summer. Dissolved oxygen, pH, and other chemical characteristics are adequate at all depths throughout the lake. The lake is fairly rich in aquatic organisms.

Suttle Lake is reasonably transparent, but clarity may be decreasing due to eutrophication as a result of increased land use activities associated with the lake shore. Water sampling in the 70's and 80's found that Suttle Lake has a naturally high concentration of phosphorus for a high mountain lake (Johnson et al 1985). Elevated phosphorus levels are associated with the porous volcanic soils of the subbasin. The

phosphorus promotes the growth of planktonic algae and the lake has a history of occasional algae blooms.

The lake is classified as eutrophic. The long mountain winters may limit biological productivity for most of the year, but during the short growing season, high phosphorus levels drive the lake to a higher than expected trophic level (Johnson et al 1985). Bioassays by the EPA in 1978 indicate that nitrogen limits algae growth.

Blue Lake

The water chemistry for Blue Lake is peculiar. The concentration of phosphorus is very high which by itself would classify the lake as eutrophic. However, water transparency is high, dissolved oxygen is not depleted in the hypolimnion and except for an occasional bloom, the populations of phytoplankton are low and the species are indicators of an oligotrophic lake.

Habitat Areas and Quality - Crooked River

Fish

Many headwater streams support native redband trout populations where there is year-round flow, instream cover, cobble and boulder substrate, and good streamside vegetation. Most of the best habitat in the subbasin is on the Ochoco National Forest.

Walton Lake is the only reservoir in the subbasin not managed for irrigation or hydroelectric power. The lake was constructed to provide a still water angling site in the Ochoco Mountains and, unlike many nearby Central Oregon irrigation impoundments, has a stable water level. It is a relatively high elevation lake surrounded by a pine and fir forest.

Prineville, Ochoco, Antelope Flat, Allen Creek and Haystack reservoirs, and Reynolds Pond were built as irrigation impoundments to store and release water for croplands and livestock production. The reservoirs created habitat that is only fair for game species. The inundated lands provided only a moderate base for fish habitat. For example, the habitat in Prineville and Ochoco reservoirs is characterized by a lack of shoreline vegetation, an expansive mud flat substrate in the upper end, and mud mixed with boulder and cobble substrate in the lower end.

Habitat Areas and Quality - Upper Deschutes River

Fish

Streams and rivers of the upper Deschutes River subbasin are generally either spring-fed with stable annual flow patterns or glacier and snowmelt systems with high spring runoff and low summer flow patterns. Some are a combination of both systems. Most of these streams once supported abundant aquatic life and indigenous fish populations. However, land and water management practices over the past 100 years have resulted in an overall decline in water quality and quantity, riparian condition, river channel morphology, and subsequent declines or extirpation of indigenous fish populations.

Three large storage reservoirs were constructed in the upper Deschutes River subbasin. Crescent Lake was built by the Deschutes County Municipal Improvement District (later reorganized as the Tumalo Irrigation District) in 1922 and rehabilitated by the U.S. Bureau of Reclamation (USBR) in 1956. As part of the USBR's Deschutes Project, Crane Prairie was completed in 1940 and Wickiup Reservoir in 1949. The

purpose of the reservoirs was to store water during the non-irrigation season (winter) to supplement natural river flows during the summer. Operation of these reservoirs has led to degradation of the aquatic environment due to extreme seasonal flow fluctuations caused by irrigation releases and storage. Seasonal water fluctuation has created drawdown zones in the river channel where riparian vegetation is absent. Good riparian habitat conditions result in cool water, and directly influence instream habitat by maintaining stable stream banks, good water quality, and late summer flows.

Effects on fish habitat from loss of riparian vegetation include increased stream temperature, loss of cover, increased bank erosion, widening and shallowing of the stream channel, and reduction or loss of perennial flow. Degraded riparian zones are present throughout the upper Deschutes River subbasin.

Natural recruitment of spawning gravel from upstream sources was eliminated by the construction of Wickiup and Crane Prairie dams. Original gravel has been moved downstream by excessively high flows or deposited along stream margins which are de-watered during the fall spawning period.

The subbasin is blessed with many natural lakes in public ownership. These natural lakes are in generally good condition in terms of fish habitat and water quality. The major impact has been recreational development such as campgrounds, resorts, and boat facilities. Some of the high mountain lakes, wilderness and non-wilderness, have suffered shoreline damage from overuse by livestock, campers, and vehicles.

Little Deschutes River

Heavily eroded stream banks and degraded riparian areas are common in many areas on the Little Deschutes River due to historic cattle use and residential development along the stream corridor and impacts from water management for irrigation use. Spawning habitat is generally lacking, but in areas where suitable gravel exists, it is generally free of silt and of excellent quality.

Squaw Creek

Squaw Creek is federally designated under the Omnibus Oregon Wild and Scenic Rivers Act of 1988. It is designated as Wild from its source, including tributaries, downstream to the boundary of the Three Sisters Wilderness, 27 stream miles. It is designated as Scenic from the Three Sisters Wilderness boundary downstream to the USGS gauging station, 800 feet upstream from the McAllister Ditch, 8.8 stream miles. The US Forest Service is responsible for management under their Wild and Scenic River Plan.

The lower section of Squaw Creek remains relatively natural except for limited livestock grazing, off-road recreational vehicle use, and dispersed camping. The lower seven miles are located within the BLM Steelhead Falls Wilderness study area.

Watershed Assessment - Subbasin-wide

A number of reports have been completed for areas within the Deschutes River subbasin that include substantial information characterizing the state of the subbasin natural resources, including fish and wildlife habitat. Many documents are relevant to the entire subbasin, others are specific to portions of the subbasin.

The Ochoco, Deschutes, and Mt. Hood national forests have completed watershed analyses of national forest lands in the Deschutes River subbasin (USDA Forest Service

1995a,b,c,d, 1996, 1997a,b, 1998a,c, 1999). Watershed analysis is one of four components of the *Aquatic Conservation Strategy*, developed by the Forest Ecosystem Management Assessment Team in 1993, which directs management of areas and resources covered by the *Supplemental Environmental Impact Statement*. The watershed analysis is designed to develop and document an understanding of the ecological structures, functions, processes, and interactions occurring within the watershed. It includes assessment of the status of Threatened and Endangered Species, anadromous fish and old-growth ecosystems in the national forest portion of the watershed.

Portland General Electric (PGE) and the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) have conducted exhaustive studies of fish, terrestrial, cultural, recreational, and aesthetic/visual resources, as well as water quality and land management and use in the Deschutes River as part of the application for FERC re-licensing of the Pelton/Round Butte Project. This process, ongoing since 1995, is summarized in a four volume *Pelton Project FERC License 2030 Final License Application* (CTWS and PGE 1999).

The Ecosystem Diagnosis and Treatment (EDT) methodology has been applied to most of the Deschutes River subbasin, funded by the CTWS. The EDT consists of a reach by reach diagnosis of the quality and quantity of fish habitat in the subbasin and will generate restoration recommendations. EDT analysis was also conducted for wildlife in the subbasin. The EDT report is contained in the *Pelton Project FERC Final License Application* (CTWS and PGE 1999).

A Conceptual Foundation for the Management of Native Salmonids in the Deschutes River (Lichatowich 1998) compiles information from existing literature concerning chinook salmon, sockeye salmon, summer steelhead, resident redband and bull trout, and kokanee in the Deschutes River subbasin and develops a conceptual foundation for each species.

Historical Salmon and Steelhead Runs of the upper Deschutes River and their Environments (Nehlsen 1995) reviews historical information on the Deschutes River above the Pelton/Round Butte project. It includes the upper Deschutes River, Squaw Creek, Metolius River and Crooked River. It describes physical and hydrological characteristics, water developments and habitat changes, and historic anadromous fish runs.

ODFW and OWRD have established priorities for restoration of streamflow from consumptive uses, as part of the *Oregon Plan for Salmon and Watersheds* (Measure IV.A.8). ODFW has identified the "need" for streamflow restoration through ranking of biological and physical factors, water use patterns and the extent to which water is a primary limiting factor (Appendix I, Figure 16). OWRD ranked the opportunities and likelihood for achieving meaningful streamflow restoration. Rankings were performed for subwatersheds at approximately the fifth field hydrologic units (HUCs). OWRD Watermasters will incorporate the priorities into their field work activities as a means to implement flow restoration measures. The "needs" priorities will be used by the Oregon Watershed Enhancement Board as one criterion in determining funding priorities for enhancement and restoration projects. Watershed councils and other entities may also use the needs priorities as one piece of information determining high priority restoration projects.

The Oregon Department of Agriculture is currently leading the process of developing an agriculture water quality plan that will meet state and federal water quality standards for the Deschutes River subbasin. A *Lower Deschutes Agricultural Water Quality Management Plan* has been adopted which identifies strategies to prevent and control non-point source water pollution from agricultural lands through a combination of educational programs, suggested land treatments, management activities and monitoring. Developed by the Lower Deschutes Local Advisory Committee, with assistance from ODA and Wasco County SWCD, this plan applies to lands in current agricultural use and those lying idle or on which management has been deferred. A draft *Middle Deschutes Agricultural Water Quality Management Plan* has been written, which covers the Metolius River, lower Crooked River, and the upper Deschutes River below Bend. Public comment period on the draft is due to be completed in January 2001. Initial planning for the upper Deschutes River above Bend and the Crooked River are scheduled to begin in 2002.

The *Oregon Migratory Game Bird Program Strategic Management Plan* (ODFW 1993c) identifies policies which provide direction for the management of migratory game birds in Oregon. Strategies are described that assist in the development of specific operational plans to achieve the program mission and integrate with other state and federal agencies and private organizations.

The *Oregon Black Bear Management Plan* (ODFW 1993a), *Mule Deer Management Plan* (ODFW 1990a), *Elk Management Plan* (ODFW 1992b), and *Cougar Management Plan* (ODFW 1993b) summarize the history of these game animals and their management in Oregon. The plans list concerns and the strategies to be used in addressing identified problems. Management direction is provided to inform the interested public of how Oregon's wildlife species will be managed and to guide management activities.

The *Oregon Wildlife Diversity Plan* (ODFW 1993d) provides direction for the maintenance and enhancement of the vertebrate wildlife resources of Oregon. The plan identifies goals and objectives for maintaining a diversity of non-game wildlife species in Oregon, and provides for coordination of game and non-game activities for the benefit of all species.

The Natural Heritage Program maintains a database on habitats and species occurrences throughout the State of Oregon.

Inventory of Riparian Habitats and Associated Wildlife along the Columbia and Snake Rivers (McKern 1976 and Tabor 1976) was an inventory of riparian habitats and associated wildlife under existing conditions to establish baseline data. The study area included the Columbia River from the mouth to the Canadian border.

Study of Impacts of Project Modification and River Regulation on Riparian Habitats and Associated Wildlife along the Columbia River (Tabor et al. 1981) determined the effects of river regulation for maximum power production on key riparian habitats and wildlife. The study area included the Columbia River from Vancouver to Grand Coulee Dam.

In fulfillment of section 1004(b)(1) of the 1982 NWPPC Fish and Wildlife Program, *Status Review of Wildlife Mitigation at Columbia Basin Hydroelectric Projects, Columbia Mainstem and Lower Snake Facilities* was completed by BPA in 1984 (BPA 1984). It reviewed the status of past, present, and proposed future wildlife planning and mitigation programs at existing hydroelectric projects in the Columbia River Basin. It was

intended that this evaluation would form the basis for determining any remedial measures or additional project analysis.

Wildlife Impact Assessment: Bonneville, McNary, The Dalles, and John Day Projects (Rassmussen and Wright 1990a,b,c,d) estimated the impacts of hydroelectric construction and inundation on wildlife and wildlife habitat. A total of 65,629 acres and 48,442 Habitat Units were estimated lost as a result of construction of these four mainstem Columbia River dams.

The *Oregon Trust Agreement Planning Project* (BPA Project # 199208400) (BPA 1993) was initiated by the Oregon Wildlife Coalition to create a list of potential wildlife mitigation opportunities in the Columbia Basin by priority and to attempt to determine the costs of mitigating for wildlife losses in Oregon. Using screening criteria, this project resulted in a prioritized list of 287 potential mitigation sites and cost estimates for general habitats within the mitigation area.

Assessing the Oregon Trust Agreement Planning Project Using Gap Analysis Project (BPA Project # 95-65) (ODFW 1997a) refined the previous effort to identify wildlife mitigation opportunities in Oregon. It identified gaps in bio-diversity and needs for terrestrial habitat restoration, and resulted in identification and ranking of a short list of high priority habitat restoration opportunities in the Lower Mid-Columbia Subregion, including the Deschutes River subbasin.

(Note: all or part of the wildlife losses for the Lower Mid-Columbia Subregion may be mitigated for in the Deschutes River subbasin, though it is unlikely that it would be proposed or could occur).

Watershed Assessment - Lower Deschutes River

The *Lower Deschutes River Management Plan and Environmental Impact Statement* (BLM et al. 1993) is a comprehensive plan developed to guide the management of the lower 100 miles of the Deschutes River. It was developed as required by the Oregon Legislature, in HB 3019 and SB 202, and U.S. Congress as a result of designation of this portion of the river as a component of the National Wild and Scenic Rivers system. The Warm Springs Wild and Scenic Rivers Act also recognizes and has adopted the plan. This plan addresses issues of concern in the river corridor, proposes management guidelines, and develops strategies for implementation.

The *Two Rivers Resource Management Plan and Environmental Impact Statement* (BLM 1986) is designed to provide a comprehensive framework for management of public lands in the John Day and lower Deschutes rivers. This plan suggests guidelines and provides a platform for management of all resources and uses within the principles of multiple use and sustained resource yield.

The *Columbia Basin System Planning Salmon and Steelhead Production Plan, Deschutes River Subbasin* (ODFW and CTWS 1990) was developed to identify options or strategies for increasing salmon and steelhead production in the Columbia River Basin. The Deschutes River subbasin production plan was one of 31 developed system wide under the auspices of the Columbia Basin Fish and Wildlife Authority. This plan documented existing and potential anadromous fish production, summarized management goals and objectives, documented existing management efforts, identified problems and opportunities

associated with increasing anadromous fish numbers, and presented preferred and alternative management strategies.

The *Lower Deschutes River Subbasin Management Plan* (ODFW 1997b) identifies land ownership, climate, topography, land use, and fish resources and their limiting factors, as well as summarizing fish management goals and objectives for the lower 100 miles of the river. In addition to characterizing the current status of watersheds, information is also presented on changes to the subbasin's forests, rangeland, streams, lakes and reservoirs.

The *White River Falls Fish Passage Project Report* (ODFW et al. 1985) presents a feasibility study for increasing production of anadromous fish in the lower Deschutes River subbasin by providing passage of anadromous fish species above the impassable falls at RM 2 of the White River. This study includes information on fish species present, limiting factors, as well as goals, objectives and strategies for addressing these factors.

Lower Deschutes River Gravel Study (Huntington 1985), a BPA funded study from 1983 to 1985 investigated the possibility that controlled flows below the Pelton/Round Butte restricted gravel movement and degraded spawning gravel for wild fall chinook and summer steelhead. This study inventoried spawning habitat, gravel permeability and composition, and analyzed historical flow records and salmon and trout utilization of spawning habitat. The study also makes recommendations concerning augmentation of natural spawning gravels.

To determine the effects of the Pelton/Round Butte Project relative to geomorphological changes observed in the lower Deschutes River, PGE commissioned a study to examine historical patterns, processes and rates of channel change, analyze longitudinal trends in composition and texture of gravel deposits, and evaluate the hydraulics and sediment transport regime along the lower Deschutes River. Four reports are available from PGE, providing a complete geomorphological description of the second largest watershed in Oregon (Grant et al. 1998, Fassnacht 1998, McClure 1998, and O'Connor et al. in preparation).

A study to compare historic abundance of large wood in the Metolius and lower Deschutes rivers with current abundance was also funded by PGE. *Historical Riparian Conditions and Large In-channel Wood, Lower Deschutes River, Oregon* (Minear 1998) includes an extensive search of historical archives for documentation of riparian conditions prior to construction of the Pelton/Round Butte Project and extensive land use changes in the subbasin.

Baseline data characterizing temperature, water quality parameters, and benthic biota of the lower Deschutes River is available in a PGE commissioned study, *Lower Deschutes River Studies Water Quality and Biota* (Raymond et al. 1998). Also available from PGE, Modeling Water Temperatures in the Lower Deschutes River, Oregon – 1998 (Huntington et al. 1998) provides historic and current water temperature data.

Fish population studies in the lower Deschutes River include:

- *Life History of Rainbow Trout and Effects of Angling Regulations*, Deschutes River, ODFW Information Report 89-6 (Schroeder and Smith 1989).
- *Lower Deschutes Redband Trout Population Inven*tories (Newton and Nelson 1995-2000).
- *Lower Deschutes Summer Steelhead* (Olsen et al. 1992).

- *Spring Chinook Salmon in the Deschutes River, Oregon,* ODFW Information Report 89-4 (Lindsay et al. 1989).
- *Fall Chinook Salmon in the Deschutes River, Oregon,* ODFW Information Report 88-6 (Jonasson and Lindsay 1988).
- *Steelhead-Rainbow Early Life History and Habitat* (Zimmerman and Reeves 1998).
- *Feeding Level in Pelton Ladder vs. Return Frequency* (Nyara 1998).
- *Bull Trout Life History, Genetics, and Habitat Needs in the Lower Deschutes River, Oregon* (Brun 1998-2000).

In 1983, BPA began funding the Trout Creek Fish Habitat Restoration Project. The initial phase of this project included the preparation of the *Trout Creek Riparian Restoration Plan* (Northwest Biological Consulting 1983), which included a resource assessment and strategies for implementing remedial measures. The Trout Creek Habitat Restoration Project (TCHRP) (BPA Project # 199404200) is an ongoing fish habitat restoration project centered around restoring areas identified in the 1983 habitat survey. Annual TCHRP progress reports are available from ODFW.

The *Trout Creek Watershed Resource Inventory, Problem Assessment and Treatment Alternatives* (Edlund and Penhollow 1996) provides an inventory and analysis of much of the Trout Creek watershed. This landowner-initiated process involved collecting available information about the watershed and resulted in recommendations for specific projects to protect and restore or properly manage damaged areas of the watershed. The Hay Creek, Mud Springs, and Tenmile creeks portion of the watershed were not included in this assessment.

The Trout Creek Watershed Council and Jefferson County Soil and Water Conservation District have an ongoing, multi-year project with BPA to conduct a comprehensive watershed assessment of private lands in the Trout Creek drainage. The Trout Creek Watershed Improvement Project (Project No. 9802800) will ultimately develop a long-range action plan that will guide the implementation of practices on private lands to enhance steelhead smolt production and instream habitat recovery.

The *Buck Hollow Watershed Plan/Environmental Assessment* (NRCS 1994), *Bakeoven Watershed Action Plan* (Bakeoven Watershed Council 1995), *Pine Hollow Watershed Action Plan* (Pine Hollow Watershed Council 1996), and *Fulton and Gordon Canyons Watershed Action Plan* (Fulton and Gordon Canyons Watershed Council 1997) have been developed to assess needs, objectives, expected impacts and actions to be taken to reduce soil erosion and flooding and improve water quality in those watersheds.

Other watershed councils in the lower Deschutes River subbasin are in the process of developing watershed assessments and action plans, including the Gerking Canyon, Macks Canyon, Grass Valley, and White River watershed councils.

The *White River Wildlife Area Long Range Management Plan* (ODFW 1993e) identifies goals and objectives for management of the wildlife area to maintain, develop, and enhance high quality wildlife habitat for the people of Oregon, thereby reducing depredation on adjacent private lands.

Watershed Assessment - Pelton/Round Butte Project Area

The *Crooked River Subbasin Fish Management Plan* (ODFW 1996a) was developed by ODFW to direct management of fish resources of the Crooked River, its tributaries, and the

lakes and reservoirs within the Crooked River subbasin, including lakes Billy Chinook and Simtustus. This plan identifies fish species present in the subbasin, as well as their limiting factors. It presents a logical, systematic approach to conserving the aquatic resources of the subbasin, establishes management priorities and directs attention to the most critical problems affecting the fisheries. It also informs the public and other agencies about the department's management programs and provides them the opportunity to help formulate those programs.

Portland General Electric (PGE) has had an active fisheries program at the Pelton/Round Butte Project since the initial FERC licensing process began in 1956, prior to construction. *Fisheries Program at the Pelton/Round Butte Project, 1956-1995* (Ratliffe and Schulz 1998), a five-part report documents this program and its accomplishments. Part I describes the fish passage era, 1956-1968, when PGE and fisheries agencies attempted to pass anadromous fish over the Project. Part II describes the transitional period, 1966-1973, from fish passage to hatchery propagation for anadromous fish mitigation. Part III covers the Round Butte Hatchery era, 1972-1995, including details on the construction of the facility and evolution of the hatchery program. Part IV details how the Project has been operated to protect fisheries habitats downstream of the Reregulating Dam. Part V describes the resident fish programs, management, and habitat in Lake Billy Chinook and Lake Simtustus.

A literature review of more that 25 species of fish that inhabit the area influenced by the Pelton/Round Butte Project developed *Native Fish Species of the Deschutes River* (Witty in preparation), a reference to improve the understanding of these species and their roles in the ecosystem.

Fish population studies at the Pelton/Round Butte Project include:

- *Angler Surveys on Lake Billy Chinook, 1990-1993*, ODFW Information Report 95-1 (Thiesfeld et al. 1995).
- *Migration Patterns of Adult Bull Trout in the Metolius River and Lake Billy Chinook, Oregon*, ODFW Information Report 96-1 (Theisfeld et al. 1996).
- *Distribution, Life History, Abundance, Harvest, and Limiting Factors of Bull Trout in the Metolius River and Lake Billy Chinook, Oregon, 1984-1994*, ODFW Information Report 96-7 (Ratliff et al. 1996).
- *Evaluation of Fish Stocking into Lake Simtustus* (Thiesfeld et al. 1998).
- *Lake Billy Chinook Kokanee Study* (Thiesfeld and Dale 1998).
- *Lake Billy Chinook Rainbow Trout Study* (Groves and Shields 1998).
- *Food Habits of Bull Trout in the Metolius River/Lake Billy Chinook System* (Lewis 1998a).

Shortly after completion of Pelton and Round Butte dams, a number of studies were conducted concerning passage of anadromous fish above the Pelton/Round Butte Project, including:

- *Evaluation of the Fish Passage Facilities at the Pelton Project on the Deschutes River in Oregon* (Gunsolus and Eicher 1962).
- *The Effect of Small Impoundments on the Behavior of Juvenile Anadromous Salmonids* (Korn et al. 1967).

Lack of strong surface currents toward the historic downstream fish passage facility at Round Butte Dam was identified as one of the major problems that prevented successful

fish passage in the 1960's. In recent years, PGE has conducted several studies of surface currents in Lake Billy Chinook in anticipation of designing a new downstream fish facility as part of the FERC relicensing process and eventual reintroduction of anadromous fish above the project:

- *Measuring Currents in Lake Billy Chinook Using Boat-mounted Acoustic Doppler Current Profiler* (Truebe 1996).
- *Surface Currents in Lake Billy Chinook as Measured by Drogues (Ratliff and McCollister* 1998).
- *A Numerical Model for Studying Currents in Lake Billy Chinook* (Khangaonkar 1998).

An important concern with reintroduction of anadromous fish above the Pelton/Round Butte Project is the potential for transmission of fish pathogens from below the Project to the upper subbasins. *Fish Disease Risk Analysis* (Engelking and Bartholomew 1998) identified potential pathogens throughout the Project areas, sampled fish for presence, prevalence, and virulence of pathogens, and obtained information necessary to evaluate and monitor these pathogens.

A critical component of the evaluation of the feasibility of anadromous fish passage above the Pelton/Round Butte Projects was habitat availability. *Quantification of Habitat for Anadromous Fish Above Round Butte Dam* (Dambacher et al. 1998) gathered information from various agencies and conducted some required surveying to be compiled into a comprehensive and accessible GIS format by stream reach.

Timing of Kokanee Through Round Butte Dam (Schulz and Ratliff 1998), initiated in 1995 by PGE, was designed to correlate movement of kokanee through Round Butte Dam with environmental factors and to determine if sockeye migration tendencies existed in the resident kokanee population.

Littoral Fish Populations and Activity in Pelton/Round Butte Project Reservoirs (Lewis 1998b), yet another PGE study, was designed to determine the relative abundance, activity and diet of littoral fish species in Project reservoirs as relates to water temperature and correlate this information with potential interactions between resident fish populations and anadromous smolts if passage is established.

Watershed Assessment - Metolius River

A *Joint Aquatic and Terrestrial Programmatic Biological Assessment* (April 2000- to April 2001) for federal lands within the Deschutes River subbasin administered by the Bureau of Land Management Prineville Office and for federal lands administered by the Deschutes and Ochoco national forests was completed in April of 2000 (BLM and USDA Forest Service 2000). This is a programmatic consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service on proposed and ongoing programs as they relate to the proposed, threatened, or endangered species that occur within the action area. The document will be amended annually to include new information on species listings, include new information on management requirements to hasten the recovery of listed species, and report annual accomplishments.

The *Metolius River Subbasin Fish Management Plan* (ODFW 1996b) was developed by ODFW to direct management of fish resources of the Metolius River, its tributaries, and the Cascade Mountain high lakes within the Metolius River subbasin. This

plan identifies fish species present in the subbasin, as well as their limiting factors. It presents a logical, systematic approach to conserving the aquatic resources of the subbasin, establishes management priorities and directs attention to the most critical problems affecting the fisheries. It also informs the public and other agencies about the department's management programs and provides them the opportunity to help formulate those programs.

The *Metolius Mule Deer Winter Range Habitat Management Plan* (ODFW et al. 1994) has not formally been adopted by the participating agencies, ODFW, BLM, USFS, CTWS, and PGE, but is being used for planning purposes. The purpose of this plan is to provide direction for managing habitats within the Metolius Deer Winter Range with emphasis on mule deer management. It also provides a perspective on the overall land ownerships and the other resource values, interests, and uses.

Watershed Assessment - Crooked River

The U.S. Bureau of Reclamation (USBR) completed the *Prineville Reservoir Resource Management Plan* in 1992 (USBR 1992). The Plan provides a ten-year plan and framework to develop site-specific recreation proposals for campsites, improving boat launching facilities, and providing boat-in campsites. It also has management recommendations for off-road vehicle use, grazing, concessions, and the reservoir road system. Opportunities also exist for developing additional shoreline access though the development of trail systems to walk-in areas for additional recreational uses.

The *Lower Crooked River Chimney Rock Segment Management Plan and Environmental Assessment* (BLM and USBR 1992) was developed under guidelines specified in the Wild and Scenic Rivers Act for that portion of the Crooked River which was designated as a National Wild and Scenic River in 1988.

The *Middle Deschutes/Lower Crooked River Wild and Scenic Rivers' Management Plan and Assessment* (BLM et al 1992) was developed for the 20 miles of the Middle Deschutes from Odin Falls to Lake Billy Chinook and the 9.8 miles of the Lower Crooked River from the National Grassland Boundary near Ogden Wayside to RM 8.

The *Crooked River Subbasin Fish Management Plan* (ODFW 1996a) was developed by ODFW to direct management of fish resources of the Crooked River, its tributaries, and the lakes and reservoirs within the Crooked River subbasin. This plan identifies fish species present in the subbasin, as well as their limiting factors. It presents a logical, systematic approach to conserving the aquatic resources of the subbasin, establishes management priorities and directs attention to the most critical problems affecting the fisheries. It also informs the public and other agencies about the department's management programs and provides them the opportunity to help formulate those programs.

The Crooked River Watershed Council (CRWC) Watershed Assessment has used information compiled from reports and management plans, area natural resource experts, and landowners to develop a characterization and assessment of watershed conditions for the Crooked River subbasin. This draft assessment identifies priority restoration, protection and monitoring sites in the subbasin and provides base information for additional watershed planning projects. Target completion date for the *Crooked River Watershed Assessment and Action Plan* is spring of 2001.

A *Joint Aquatic and Terrestrial Programmatic Biological Assessment* (April 2000- to April 2001) for federal lands within the Deschutes River subbasin administered by the Bureau of Land Management Prineville Office and for federal lands administered by the Deschutes and Ochoco national forests was completed in April of 2000 (BLM and USDA Forest Service 2000). This is a programmatic consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service on proposed and ongoing programs as they relate to the proposed, threatened, or endangered species that occur within the action area. The document will be amended annually to include new information on species listings, include new information on management requirements to hasten the recovery of listed species, and report annual accomplishments.

The *Crescent Ranger District Landscape Assessment Project* (USDA Forest Service 1998b) was undertaken to clarify important environmental conditions and trends to better frame and direct programs and projects on the District. This assessment includes land, vegetation, terrestrial, aquatics, natural disturbance regimes, and human uses. It is reviewed and updated annually.

The *Brothers/LaPine Resource Management Plan and Environmental Impact Statement* (BLM 1989**)** is designed to provide a comprehensive framework for management of public lands in the upper Deschutes River subbasin. This plan suggests guidelines and provides a platform for management of all resources and uses within the principles of multiple use and sustained resource yield.

The *Upper Deschutes Wild and Scenic River and State Scenic Waterway Comprehensive Management Plan* (BLM and Oregon State Parks 1996) was developed to guide management of the federal and state wild and scenic portions of the upper Deschutes River and its tributaries.

The BLM is currently developing a plan to determine allowable land use for their lands in the urban interface area. These are lands surrounding Redmond, Bend, LaPine, Cline Buttes, and Smith Rocks. A draft document is anticipated in March 2001.

The U.S. Bureau of Reclamation has completed a number of reports concerning water conservation projects in the upper Deschutes River subbasin which have been undertaken since 1991. These reports are related to the *Upper Deschutes River Water Conservation Study* and the *Canal Lining Demonstration Project* and are listed in the references for this document (USBR 1991 through 2000).

In a cooperative effort between USGS, USFS, CTWS, ODFW, ODEQ, OWRD, DSL, and Upper Deschutes Watershed Council, a *Regional Coordinated Water Quality Monitoring Plan* for the upper Deschutes River subbasin has been prepared and is currently under final review. This monitoring plan encompasses that portion of the upper Deschutes River between Wickiup Reservoir and Lake Billy Chinook.

The *Upper Deschutes River Subbasin Fish Management Plan* (ODFW 1996d) was developed by ODFW to direct management of fish resources of the upper Deschutes River, its tributaries, and the Cascade Mountain high lakes within the upper Deschutes River subbasin. This plan identifies fish species present in the subbasin, as well as their limiting factors. It presents a logical, systematic approach to conserving the aquatic resources of

the subbasin, establishes management priorities and directs attention to the most critical problems affecting the fisheries. It also informs the public and other agencies about the department's management programs and provides them the opportunity to help formulate those programs.

Using information compiled from reports, management plans, local natural resource experts, and watershed residents, the Upper Deschutes Watershed Council is currently developing an *Upper and Little Deschutes River Watershed Assessment*. The council is also working to complete an action plan for the Squaw Creek watershed to establish management activities and priorities and identify parties to implement actions.

Limiting Factors – Subbasin-wide

Wildlife

Riparian/aquatic

Past, present, and future impacts on aquatic and riparian habitats include diversion of stream flows, abrupt flow fluctuations that interrupt waterfowl nesting and amphibian spawning, extraction of groundwater that affects spring discharge and stream flows, livestock grazing and other agricultural and timber practices, developments including urbanization, hydroelectric, recreational and destination developments (golf courses, resorts, etc.), roads, bridges, culverts, chemicals utilized for weed and pest control, water pollution, and erosion. Increased recreational use of rivers and reservoirs causes disturbance of wildlife, and impacts riparian habitat.

Forest

Impacts occurring in forest habitats include accelerated timber harvest resulting in reduced numbers of large diameter trees. Fire suppression and protection over several decades has allowed heavy accumulation of understory fuels in many stands, posing a high risk of stand destruction due to wildfire. Treatment of fuels by using prescribed fire, mowing, and thinning may reduce understory brush, downed wood, thickets, and other critical habitat components for many wildlife species. Timber management practices have resulted in fragmentation of mature stands, drastically reducing habitat connectivity important to many species. Dense road systems further fragment habitat and encourage heavy vehicular travel that disturbs wildlife and reduces effectiveness of cover, while providing avenues for invasion of noxious weeds. Heavy grazing has changed the understory characteristics of many forests and impacted forest riparian areas. Aspen stands, once a common feature in many forests, have been drastically reduced by grazing and fire protection.

Improving forest health to desirable levels can take many decades, and requires careful long-range planning and close coordination between stakeholders. Desired conditions to manage towards include improved connectivity between stands of large diameter trees (greater than 21inches at breast height), retention of snags and downed dead wood, and reduced continuity of heavy fuels, while retaining critical habitat components. A mosaic of habitat is desirable, with patches of understory shrubs of varying ages. Protection and restoration of aspen stands could provide habitat diversity that would benefit many species. Treatments that open up understory white fir to allow growth of shrubs, forbs, and grasses for wildlife forage are very beneficial. Reducing road densities is critical to minimizing wildlife disturbance, controlling invasive weeds, and reducing erosion. Removal of unnecessary fences would improve migration and prevent injury of

large mammals; use of wildlife-compatible designs for needed fences would be highly beneficial.

Juniper steppe

Juniper invasion has suppressed native grasses and shrubs through competition for water, accelerated erosion, and in some cases reduced watershed discharge through transpiration. Dense stands of young juniper degrade winter habitats for large mammals, eliminate range for sage grouse, and generally reduce biodiversity of native plants and wildlife. Many private and public landowners are now managing juniper density and encroachment by cutting and burning to re-establish grass and shrubs. These treatments, when managed carefully, can restore and improve habitat for wildlife as well as livestock. In order to be beneficial to wildlife, juniper treatment projects should retain some stands and individual trees for cover, nesting, perching and roosting, mast crops, habitat diversity and "edge" effect bordering clearings. Old growth trees should be retained, and connective corridors left for wildlife movement. Effective juniper management can help offset impacts to wildlife from agriculture, grazing, and urban and suburban developments.

Shrub steppe/rangeland

During the past 200 years, the vegetative characteristics of rangeland have been drastically altered throughout the subbasin. Early homesteading, clearing, tilling, flood irrigation, conversion to crops and pasture, heavy livestock grazing, fencing, roading, and fire suppression have eliminated, displaced, or suppressed native plants and wildlife. Burning, spraying, and seeding vast areas with crested wheat grass and other exotic plants have reduced diversity of native plants and wildlife. Urbanization, suburban housing, and other developments have eliminated or converted considerable range and created disturbed environments for wildlife.

Dry rangeland soils are delicate, forming microbiotic crusts in undisturbed areas. These soil-forming crusts have been compacted and depleted over great expanses of rangeland by grazing, off-road vehicle use, scarifying, herbicide spraying, and other disturbing influences. The nutrient cycle of these disturbed soils has been compromised, rendering them less productive. Encroachment of juniper, invasive weeds and exotic plants has taken a toll on wildlife habitat. A major challenge in the subbasin is to control populations of weeds, including cheat grass, medusa head, knappweed, whitetop, yellowstar thistle, dalmation toadflax, and many other plants that are detrimental to wildlife, and livestock as well.

Increased recreational use of rangelands can impact vegetation, as well as disturbing environment for wildlife. Off-road vehicles, snowmobiles, camping, sightseeing, and similar activities should be carefully planned and controlled to minimize habitat and wildlife impacts. Vast expanses of rangeland in the subbasin are under Bureau of Land Management stewardship, and managed for multiple use.

Modern range management trends, including reduction on livestock numbers, improved grazing management, juniper treatments, weed control, prescribed fire, and road closures, are helping to restore rangeland quality on some private and public lands, but many areas are in need of improvement. Many wildlife species benefit from improved management practices. Intensive efforts over vast areas are needed to control invasive vegetation, restore beneficial nutrient and water cycles, re-establish native bunchgrasses and shrubs, and encourage patches of tall sage and other cover.

Grassland

Grasslands of the subbasin suffer many of the same impacts as the rangelands. Management activities that reduce fencing and roads, control invasive vegetation, minimize erosion, and restore natural soil conditions and native bunchgrasses are beneficial to wildlife.

Agricultural lands and urban/suburban developments

Widespread agricultural and residential development has displaced shelter for resident birds and mammals, especially in winter. Dead, dying, and downed trees for nesting, scanning perches, and insect-feeding substrate for birds and other wildlife are absent in most residential and agricultural properties. Construction and maintenance of power transmission corridors has altered vegetation and increased access to and harassment of wildlife.

Housing development in traditional big game winter range has the potential to greatly impact those species. In addition, migration routes of large game animals are affected by major roads and highways in the subbasin.

Limiting Factors - Lower Deschutes River

Fish

The Pelton/Round Butte Project eliminated upstream passage of salmon, steelhead, and bull trout in the Deschutes River subbasin. If fish passage is reestablished as part of the FERC re-licensing process of the Pelton/Round Butte Project, these populations will again be allowed to utilize historic spawning areas in the upper Deschutes River and its tributaries.

Introduced brook trout and brown trout are known to limit bull trout populations in some areas of the subbasin through competition and, in the case of brook trout, hybridization, and are possible factors in the demise of bull trout in historic habitat. The extent of these interactions in most of the Deschutes subbasin is unknown. Brook trout are known to have invaded streams within the Warm Springs River system that were once used by bull trout and compete directly for food and space.

Loss of instream flows, increased stream temperature, loss of riparian vegetation, increased sediment inputs and other water quality factors have been identified as limiting factors for bull trout. These factors currently reduce habitat and limit distribution of bull trout in the Deschutes River subbasin.

The Pelton/Round Butte Project on the mainstem Deschutes River is a passage barrier to bull trout, preventing mutual interchange of genetic material between bull trout populations above and below the project. It has also resulted in the loss of traditional anadromous prey species to bull trout above the project. Other passage barriers in the basin have precluded bull trout access to historic habitat, inundated critical habitat, and contribute to high water temperatures.

The incident of stray hatchery steelhead in the lower Deschutes River poses a serious challenge to the continued genetic health and productivity of the wild Deschutes River summer steelhead. The Deschutes River receives large numbers of out of subbasin stray hatchery and potentially stray wild summer steelhead, which may compete for spawning areas and interbreed with the wild Deschutes River steelhead. It is possible these stray hatchery fish have introduced significant genetic material that is maladaptive to wild

summer steelhead in the lower Deschutes River subbasin. As this genetic material accumulates in the wild population, the productive capacity of the wild lower Deschutes River summer steelhead may decline.

Fish production in much of the lower Deschutes River subbasin is thought to be limited by water quality and quantity. Water quality limitations include seasonal temperature extremes, turbidity, and sedimentation. Water quality issues are directly associated with consumptive water withdrawals, watershed conditions, reduction in the ability of streams to interact with their floodplains, and reduced recharge in the forested headwaters.

Oregon Department of Environmental Quality has identified 22 streams in the subbasin, including the White River and the mainstem Deschutes River from the mouth to the Reregulating Dam, as water quality limited for one or more parameter (Appendix I, Figure 17). The parameter identified on the 1998 303(d) list for all of these streams is temperature; in addition, many are water quality limited due to sedimentation, habitat modification, pH, and dissolved oxygen. Eleven of these streams are in the Trout Creek system.

Several habitat problems were identified as limiting steelhead and redband trout production in the tributary streams, such as Buck Hollow, Bakeoven, Trout, and Shitike creeks. These included: 1) low stream flow, 2) unstable stream banks, 3) low stream shading, 4) shallow pools, 5) elevated water temperature, 6) low amount of pool habitat, and 7) gravel impacted with fine sediment. Cattle grazing appeared to be a significant limiting factor for riparian vegetation (Northwest Biological Consulting 1983).

Following a 100-year frequency flood in 1964, stream reaches in the Trout Creek system were channelized in an effort to speed passage of flood waters and streamside vegetation was removed to avoid potential debris dams. This work, done by the U.S. Army Corp of Engineers, was the accepted corrective technique for flood ravaged streams. During this project, trees near the stream were removed and gravel berms were pushed up to straighten the stream in most of the lower 40 miles of Trout Creek and portions of Antelope Creek. In many places, these gravel berms block fish passage, and straightened channels isolate the stream from its normal floodplain.

In the upland portions of the lower Deschutes River subbasin, high erosion rates resulting from livestock overgrazing in the early 20th century have reduced the water holding capacity of naturally shallow soils. The tributary streams, such as Buck Hollow, Bakeoven, Trout, and Shitike creeks, have become increasingly vulnerable to flash flooding and debris flows. Intense runoff events in 1964 and 1978 scoured long reaches of streams, causing massive erosion and siltation of pools. Rubble fans from side canyons forced stream erosion of large bottom land meadows. Loss of flood plain soils and continuation of historic management systems have made recovery a slow process.

Dry land and irrigated farming and extensive livestock grazing of open range land have been responsible for the elimination and degradation of the riparian zone throughout much of the lower Deschutes River subbasin. Degraded riparian stream corridors, stream isolation from the flood plain, and water withdrawals for irrigation reduce the flow in many streams in the subbasin by late spring or early summer. Juvenile salmonids have been lost where irrigation diversions are unscreened or inadequately screened (ODFW 1997b). Many of these diversions have now been screened to protect fish. However, there are 25

unscreened gravity diversion structures in the lower Deschutes River subbasin (off reservation). Four of these diversions are in the Trout Creek system, on streams that do not support anadromous fish, and the remainder are in the White River system, upstream from White River Falls. Logging practices on forest lands in the upper portions of some streams have decreased the ability of the watershed to store water and regulate runoff.

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.

Railroad construction along both river banks impacted riparian and aquatic habitat by eliminating areas of riparian vegetation and filling sections of river. Culverts installed at tributary stream crossings eventually formed barriers that now preclude upstream fish migration. Routine maintenance of the railroad and right-of-way continues to impact the river and the riparian corridor (ODFW 1997b).

The road transportation network in the subbasin ranges from Interstate 84 to primitive forest roads and crude wheel tracks in the open rangeland. Roads have typically been constructed in stream bottoms and frequently resulted in loss of riparian vegetation, changes in channel configuration, filling of the stream channel and constriction of flow at bridge sites. Road corridors are frequent and chronic sources of erosion that increases turbidity and sedimentation in adjacent streams (ODFW 1997b).

Timber harvest has occurred within the Mount Hood National Forest, Ochoco National Forest, the CTWS reservation, and on state and privately owned forest lands within the lower Deschutes River subbasin. Logging and skid roads were commonly constructed in stream bottoms. Stream crossings have included fords or under-sized culverts. Merchantable timber has been removed from the stream bottoms, accelerating erosion, lowering water tables, degrading stream channels, exaggerating flow and water temperature extremes and resulting in significant stream sedimentation (ODFW 1997b).

Wildlife

Wildlife abundance has been affected by past hydropower development, past and current land management practices, and the spread of non-native plant and wildlife species. Factors influencing deer and elk populations include conversion of historic winter range and shrub steppe habitat to other uses and competition with native plant assemblages by noxious weeds. Land prices continue to rise, making it more economically difficult to preserve remaining undeveloped lands for wildlife. Continued decline in populations of salmonids and other fish species results in loss of overall biomass being contributed to the subbasin. This reduction has negative effects on wildlife abundance. Opportunities to restore wildlife populations and improve wildlife habitat diminish over time as habitat loss and degradation continues. Shrub steppe habitats in the lower Deschutes River subbasin are particularly sensitive to additional loss as the majority of the Columbia Plateau has been converted to a variety of agricultural uses.

Many factors identified as limiting to fish populations also affect wildlife. Disturbances in riparian areas and floodplains impact many wildlife species. Increased human use of riparian areas has likely displaced some elk and deer from historic high quality calving and/or fawning areas. Numerous birds and small mammals are displaced by loss or modification of riparian vegetation.

Increased recreational use of public lands in the subbasin increases disturbance to wildlife. Depending on the extent, frequency, and duration of disturbance, it may affect the animal's ability to survive during stressful periods, cause abandonment of young, and/or abandonment of habitats.

Limiting Factors - Pelton/Round Butte Project Area

Fish

Habitat limitations for fish in lakes Billy Chinook and Simtustus include only moderate concentrations of nutrients in the water, a very low abundance of aquatic vegetation, a lack of structural complexity, and water that is too cold for optimal warmwater fish production. The steep sides of the reservoirs also greatly limit the abundance and distribution of littoral fish species. Rainbow and brown trout, smallmouth and largemouth bass, black crappie and bluegill are littoral fishes in Lake Billy Chinook, while rainbow and brown trout are littoral fish found in Lake Simtustus. Because of the limited habitat available for these species, their abundance is much lower than would be found in a reservoir with a shallow gradient shoreline. A lack of shoal areas, juvenile rearing cover, and an adequate supply of forage fish may be limiting factors for smallmouth bass in Lake Billy Chinook (ODFW 1996a).

Wildlife

Wildlife abundance has been affected by past hydropower development, past and current land management practices, and the spread of non-native plant and wildlife species. Factors influencing deer and elk populations include conversion of historic winter range and shrub steppe habitat to other uses and competition with native plant assemblages by noxious weeds. Land prices continue to rise, making it more economically difficult to preserve remaining undeveloped lands for wildlife. Continued decline in populations of salmonids and other fish species results in loss of overall biomass being contributed to the subbasin. This reduction has negative effects on wildlife abundance. Opportunities to restore wildlife populations and improve wildlife habitat diminish over time as habitat loss and degradation continues. Shrub steppe habitats in the lower Deschutes River subbasin are particularly sensitive to additional loss as the majority of the Columbia Plateau has been converted to a variety of agricultural uses.

Many factors identified as limiting to fish populations also affect wildlife. Disturbances in riparian areas and floodplains impact many wildlife species. Increased human use of riparian areas has likely displaced some elk and deer from historic high quality calving and/or fawning areas. Numerous birds and small mammals are displaced by loss or modification of riparian vegetation.

Increased recreational use of public lands in the subbasin increases disturbance to wildlife. Depending on the extent, frequency, and duration of disturbance, it may affect the animal's ability to survive during stressful periods, cause abandonment of young, and/or abandonment of habitats.

Limiting Factors - Metolius River

Fish

Fish habitat limitations in the Metolius River include high water velocities and poor pool-to-riffle ratios, lack of suitable trout cover from large woody debris, water temperatures

lower than that conducive to rapid trout growth, unscreened irrigation diversions on Lake Creek, and partial barriers at Lake Creek Lodge and Suttle Lake outlets (ODFW 1996b). Other limitations may be identified following completion of comprehensive stream surveys.

Introduced brook trout and brown trout are known to limit bull trout populations in some areas through competition and, in the case of brook trout, hybridization, and are possible factors in the demise of bull trout in historic habitat. The extent of these interactions in the Deschutes River subbasin is unknown.

Loss of instream flows, loss of riparian vegetation, increased sediment inputs and other water quality factors have been identified as limiting factors for bull trout. These factors currently reduce habitat and limit distribution of bull trout in the Metolius River subbasin.

The Pelton/Round Butte Project on the mainstem Deschutes River is a passage barrier to bull trout, preventing mutual interchange of genetic material between bull trout populations above and below the project. It has also resulted in the loss of traditional anadromous prey species to bull trout above the project. Other passage barriers in the basin have precluded bull trout access to historic habitat, inundated critical habitat and contribute to high water temperatures.

The Oregon Department of Environmental Quality (DEQ) has designated the North and South forks of Lake Creek water quality limited streams for high summer water temperatures (Appendix I, Figure 17). No other streams in the Metolius River subbasin are on the DEQ 303(d) list identifying stream segments that do not meet water quality standards of the federal Clean Water Act.

The only habitat limitation in Suttle Lake is water quality related. The unusually high phosphorus level promotes excessive algae growth and subsequent die-offs have resulted in minor fish losses of primarily kokanee (ODFW 1996b).

Habitat limitations for Blue Lake are basically related to low fish growth and survival rates due to low productivity, cold water temperatures, and an absence of spawning habitat (ODFW 1996b).

Wildlife

Wildlife abundance has been affected by past hydropower development, past and current land management practices, and the spread of non-native plant and wildlife species. Factors influencing deer and elk populations include conversion of historic winter range to other uses and competition with native plant assemblages by noxious weeds. Land prices continue to rise, making it more economically difficult to preserve remaining undeveloped lands for wildlife. Continued decline in populations of fish species results in loss of overall biomass being contributed to the subbasin. This reduction has negative effects on wildlife abundance. Opportunities to restore wildlife populations and improve wildlife habitat diminish over time as habitat loss and degradation continues. Construction of Round Butte Dam inundated about 12 miles of the Metolius River, including valuable riparian habitats that provided important habitats to a variety of wildlife species.

Many factors identified as limiting to fish populations also affect wildlife. Disturbances in riparian areas and floodplains impact many wildlife species. Increased human use of riparian areas has likely displaced some elk and deer from historic high

quality calving and/or fawning areas. Numerous birds and small mammals are displaced by loss or modification of riparian vegetation.

Increased recreational use of public lands in the subbasin increases disturbance to wildlife. Depending on the extent, frequency, and duration of disturbance, it may affect the animal's ability to survive during stressful periods, cause abandonment of young, and/or abandonment of habitats.

Limiting Factors - Crooked River

Fish

Fish production in the Crooked River subbasin is limited by water quality and quantity, including flow reduction or loss, temperature, sedimentation, and turbidity (Bottom et al. 1985). Fish abundance is directly related to volume of water available in streams, which affects all life stages including spawning, incubation, rearing, and migration.

Oregon Department of Environmental Quality has identified 43 streams in the Crooked River subbasin as water quality limited for one or more parameter (Appendix I, Figure 17). The parameter identified on the 1998 303(d) list for most of these streams is temperature; in addition, many are water quality limited due to sedimentation, turbidity, flow modification, habitat modification, pH, and dissolved oxygen.

Sedimentation and turbidity reduces spawning habitat, egg survival, and food production of insects and plankton. High water temperatures result in stress or direct mortality to cold water fish species and increases competition from nongame species such as suckers, chiselmouth, and pikeminnow, which can tolerate higher temperatures (ODFW 1996a).

Good quality large woody debris is lacking in most of the Crooked River subbasin. Abundance and quality of large woody debris affects food production, rearing, stream flow, and migration of fish species. Large woody debris helps to form pools which provide rearing habitat, traps spawning gravel, provides a refuge for fish during high runoff events, provides cover from predators, stabilizes banks from erosion, and provides structure for aquatic insects (ODFW 1996a).

Reservoirs for irrigation and hydroelectric production have created artificial habitats for native and introduced fish species. Habitat limitations for reservoir fisheries include seasonal and daily water level fluctuation or drawdown, water temperature, low minimum pool levels, turbidity, poor riparian conditions, and a limited amount of fish holding structure. Drawdown limits natural production of warmwater species by dewatering nests and causing mortality of eggs and young. In extreme cases, low pools limit survival of both cold and warmwater species from extreme temperatures or low dissolved oxygen. Drawdown also limits the establishment of shoreline and riparian vegetation. Turbidity and sedimentation from wave action on barren soil banks and from degraded watershed conditions also limits fish production, spawning and survival. In many cases, artificial impoundments in the subbasin have allowed nongame fish species such as northern pikeminnow and suckers to expand their range and compete effectively with preferred game species such as trout or bass (ODFW 1996a).

Major habitat limitations in Walton Lake include food availability for fish populations, seasonal water quality problems of blue green algae blooms, low dissolved

oxygen, high summer temperatures, and occasional winter dieoffs of hatchery rainbow trout (ODFW 1996a).

Habitat limitations for fish in Prineville, Ochoco, Antelope Flat, Allen Creek, and Haystack reservoirs, and Reynolds Pond include seasonal and annual water level fluctuations and drawdown, high suspended sediments which limit photosynthesis, only moderate concentrations of nutrients in the water, very low abundance of aquatic vegetation, a lack of structural complexity, and water that is too cold for optimal warmwater fish production and too warm for optimal trout production (ODFW 1996a).

Outlet facilities at all reservoirs in the subbasin are unscreened and likely cause losses in fish populations. Unknown numbers of fish emigrate through outlets at Prineville, Ochoco, Antelope Flat, and Allen Creek reservoirs, and Walton Lake, to the rivers or streams below. The outlet structure at Haystack Reservoir is unscreened and fish that exit the reservoir become stranded and die in the canal when it is dewatered in the fall (ODFW 1996a).

Wildlife

Wildlife abundance has been affected by past hydropower development, past and current land management practices, and the spread of non-native plant and wildlife species. Factors influencing deer and elk populations include conversion of historic winter range to other uses and competition with native plant assemblages by noxious weeds. Land prices continue to rise, making it more economically difficult to preserve remaining undeveloped lands for wildlife. Continued decline in populations of fish species results in loss of overall biomass being contributed to the subbasin. This reduction has negative effects on wildlife abundance. Opportunities to restore wildlife populations and improve wildlife habitat diminish over time as habitat loss and degradation continues. Construction of Round Butte Dam inundated the lower portion of the Crooked River, including valuable riparian habitats that provided important habitats to a variety of wildlife species.

Many factors identified as limiting to fish populations also affect wildlife. Disturbances in riparian areas and floodplains impact many wildlife species. Increased human use of riparian areas has likely displaced some elk and deer from historic high quality calving and/or fawning areas. Numerous birds and small mammals are displaced by loss or modification of riparian vegetation.

Increased recreational use of public lands in the subbasin increases disturbance to wildlife. Depending on the extent, frequency, and duration of disturbance, it may affect the animal's ability to survive during stressful periods, cause abandonment of young, and/or abandonment of habitats.

Limiting Factors - Upper Deschutes River

Fish

Oregon Department of Environmental Quality has identified 6 streams in the upper Deschutes River subbasin, the Little Deschutes River, and most of the mainstem Deschutes River from Crane Prairie Reservoir to Lake Billy Chinook as water quality limited for one or more parameter (Appendix I, Figure 17). The parameter identified on the 1998 303(d) list for most of these streams is temperature; in addition, many are water quality limited due to sedimentation, turbidity, flow modification, habitat modification, pH, and dissolved oxygen.

Streams and rivers in the subbasin affected by reduced flows are the Deschutes River from Wickiup Dam to Lake Billy Chinook, the Little Deschutes River below the mouth of Crescent Creek, Crescent Creek, Paulina Creek, Tumalo Creek and Squaw Creek.

Subbasin streams which experience excessively high water temperatures are the Deschutes River between the North Canal Dam at Bend and Lower Bridge near Terrebonne, Tumalo Creek, Paulina Creek, Crescent Creek, and Squaw Creek.

In the LaPine area of south Deschutes County, many building lots were created before Oregon land use laws came into existence. At least 1,800 lots have water tables at two feet or less. Pollution of groundwater is highly likely if these dispersed lots are developed in an area where sewer service is unavailable.

Large woody material is severely lacking in the Deschutes River especially in the reach from Wickiup Dam downstream to Benham Falls. Other streams lacking large woody material are the Little Deschutes River below Gilchrist, lower Crescent Creek, Spring River, Tumalo Creek, and Squaw Creek below the town of Sisters (ODFW 1996d).

The majority of water quantity and quality problems, including flow alteration, temperature and sedimentation, lack of cover, and physical alteration of stream channels result from non-point source pollution activities associated with land use practices. In the upper Deschutes River subbasin, the land use practices most commonly responsible for degrading stream and river habitats were irrigation development, livestock grazing, timber harvest, private land development, and recreation (ODFW 1996d).

In the subbasin, the single most degrading land use activity has been irrigation development which began almost 100 years ago. Irrigation diversions and irrigation storage reservoirs contribute to instream aquatic problems primarily by disrupting natural flow patterns (ODFW 1996d).

In some subbasin streams such as Tumalo Creek and Squaw Creek, water rights for natural stream flow were over-appropriated, resulting in dry stream reaches during the irrigation season. Crane Prairie, Wickiup and Crescent Lake dams forever changed the natural flow patterns of the Deschutes River, Little Deschutes River, and Crescent Creek. The winter flows of the Deschutes River from Crane Prairie Dam to Bend are unnaturally low because water is being stored. During the irrigation season, the flow pattern is reversed with abnormally high flows above Bend and abnormally low flows below Bend. The same pattern is present on the Little Deschutes River and Crescent Creek (ODFW 1996d).

Unscreened diversions can divert fish into irrigation systems where they become stranded and die. On the upper Deschutes River, there are four major irrigation diversions without screens or equipped with ineffective louvers. There are two hydroelectric diversions (Bend Hydroelectric and Cline Falls) without screening. There are no screens on Squaw or Tumalo creeks, or Little Deschutes River diversions. Crane Prairie Reservoir and Crescent Lake dam outlets are screened but do not meet current criteria for screening. Wickiup Reservoir Dam outlet is not screened (ODFW 1996d).

Historically, livestock grazing in the riparian zones of subbasin streams was more widespread than today. As ranch properties along streams were sold and subdivided for residential development, livestock numbers declined. There are still portions of the Deschutes River, Little Deschutes River, Crescent Creek, and Squaw Creek which have not recovered from livestock grazing over 100 years ago. Excessive grazing removed riparian

vegetation resulting in accelerated bank erosion, channel cutting, sedimentation, turbidity, and loss of cover (ODFW 1996d).

Upstream fish passage was not provided on many man-made structures within the subbasin. Limiting access to spawning areas was largely responsible for extirpation of the bull trout from a large part of its historic distribution. Facilities without upstream fish passage facilities are Crane Prairie and Wickiup reservoir dams, Crescent Lake dam, Bend hydroelectric dam, and North Canal dam (ODFW 1996d).

Fishways do exist on the Gilchrist Mill Pond dam (Little Deschutes River) and Bend Feed Canal (Tumalo Irrigation District). Natural falls are abundant on the mainstem Deschutes River and they were both passable and impassable. Fish ladders were built at Steelhead Falls, Big Falls, and Cline Falls, however they are not functional at the present time. Other natural falls passable at certain flows are Awbrey, Odin, and Dillon falls. These barriers have isolated existing redband trout populations, creating small separate gene pools of fish (ODFW 1996d).

Most of the forested lands in the subbasin have sustained some level of harvest and roading in the past 70 years. The overall impact on streams and rivers from timber harvest has been minimal with the exception of the early practice of transporting logs down the upper Deschutes River. Woody material, naturally recruited to the river or not, was routinely removed to facilitate log transportation. There was also harvest of timber along streams. Removal of streamside timber reduced future recruitment of new woody material, and coupled with fluctuating stream flows, allowed bank erosion to accelerate. The major impact from roading was at stream and river crossing where impassable culverts were often placed thus delaying or preventing upstream fish movement (ODFW 1996d).

One of the most recent land use activities affecting stream and river habitats has been the subdividing and construction of homes, golf courses and resorts on private lands, primarily on Squaw Creek and the Deschutes, Little Deschutes, Spring and Fall rivers. This land use began to expand tremendously in the late 1970's and continues to the present. Impacts from this type of land use on streams and rivers are: loss of riparian vegetation through land clearing, loss of stream bank habitat, instream structure, and water surface area from construction of retaining walls and boat docks, and degradation of water quality from fertilizers, pesticides, and failed septic systems (ODFW 1996d).

Reservoirs constructed to provide irrigation water in the subbasin have created artificial habitats for indigenous and introduced fish species. Habitat limitations for reservoir fisheries include seasonal water drawdown, elevated water temperatures, low minimum pool levels, loss of vegetation in drawdown zones, loss of fish holding structure, and inundation of stream spawning habitat (ODFW 1996d).

Impoundments have allowed illegally introduced nongame species such as tui chub and three-spine stickleback to expand their range and population size to compete effectively with preferred game fish species (ODFW 1996d).

The only impoundment created by a hydroelectric facility in the upper subbasin is Mirror Pond on the Deschutes River within the City of Bend. Mirror Pond has become one of the primary attractions of Bend as a park for a variety of recreation and local events. However, this impoundment has created a settling basin for sediment being carried in the river and has been dredged on one occasion at a high cost both in dollars and environment disruption of the stream channel. A smaller impoundment created by the North Canal dam

downstream of Mirror Pond has also created a settling basin for sediment and loss of the natural stream channel (ODFW 1996d).

Wildlife

Wildlife abundance has been affected by past hydropower development, past and current land management practices, and the spread of non-native plant and wildlife species. Factors influencing deer and elk populations include conversion of historic winter range to other uses and competition with native plant assemblages by noxious weeds. Land prices continue to rise, making it more economically difficult to preserve remaining undeveloped lands for wildlife. Continued decline in populations of fish species results in loss of overall biomass being contributed to the subbasin. This reduction has negative effects on wildlife abundance. Opportunities to restore wildlife populations and improve wildlife habitat diminish over time as habitat loss and degradation continues. Construction of Round Butte Dam inundated about 8.5 miles of the upper Deschutes River, including valuable riparian habitats that provided important habitats to a variety of wildlife species.

Many factors identified as limiting to fish populations also affect wildlife. Disturbances in riparian areas and floodplains impact many wildlife species. Increased human use of riparian areas has likely displaced some elk and deer from historic high quality calving and/or fawning areas. Numerous birds and small mammals are displaced by loss or modification of riparian vegetation.

Increased recreational use of public lands in the subbasin increases disturbance to wildlife. Depending on the extent, frequency, and duration of disturbance, it may affect the animal's ability to survive during stressful periods, cause abandonment of young, and/or abandonment of habitats.

Artificial Production - Lower Deschutes River

Two facilities release anadromous fish into the lower Deschutes River subbasin. Spring chinook salmon are provided by Warm Springs National Fish Hatchery, located at RM 11 of the Warm Springs River, and both spring chinook salmon and summer steelhead are provided by Round Butte Hatchery located at RM 113 of the Deschutes River (Appendix I, Figure 18).

Spring chinook salmon

Warm Springs National Fish Hatchery

The Warm Springs National Fish Hatchery (WSNFH) program is cooperatively managed by the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) and the U.S. Fish and Wildlife Service (USFWS) with the goal to operate the hatchery in a manner that will provide harvest opportunities and protect remaining wild fish populations. The hatchery production goal is 750,000 spring chinook salmon smolts for release on-station. A barrier dam across the Warm Springs River, adjacent to the hatchery facility, is used to direct fish into a fish ladder. The fish ladder directs adult fish into holding ponds, or to pass fish upstream around the barrier dam. Only wild fish are allowed above the barrier dam. The minimum escapement goal for wild spring chinook salmon above the hatchery is 1,300 adults. Broodstock collection goal is 630 adults for hatchery production and will include approximately 10% wild fish.

The original brood stock for WSNFH was taken from wild spring chinook returning to the Warm Springs River. Brood fish are currently collected throughout the run in

proportion to their time of return. 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 were incorporated into the brood stock in 2000.

The CTWS has proposed release of up to 100 adult spring chinook salmon from the WSNFH to spawn naturally in Shitike Creek. These adults are surplus to the broodstock and natural spawning needs at WSNFH. The goal is to increase natural production in Shitike Creek. In the 1970's a municipal water supply dam was removed at approximately RM 5.0, opening passage to the upper Shitike Creek subbasin. Recovery of spring chinook has been slow with an average of 16 redds observed annually for the entire watershed. This is a pilot program and will be dependant on surplus spring chinook at the WSNFH.

Steelhead hatchery production at the WSNFH was terminated in 1981 due to disease problems and hatchery facility constraints to producing a two-year-old smolt. The current goal is to use the hatchery to protect naturally produced steelhead in the Warm Springs River. The trap is operated year-round to trap and remove known hatchery steelhead. All known hatchery steelhead strays collected at the hatchery have been sacrificed and distributed to the CTWS. All unmarked steelhead are passed upstream.

Hatchery and Genetics Management Plan (HGMP) information for the spring chinook salmon program at Warm Springs National Fish Hatchery is included separately in Appendix II.

Round Butte Hatchery

Round Butte Hatchery (RBH) is located on the Deschutes River at the base of Round Butte Dam, and is operated by the ODFW. The facility is funded by Portland General Electric (PGE) to mitigate for the fishery losses caused by the Pelton/Round Butte Project. RBH and its satellite (Pelton Ladder) are used for adult collection, egg incubation and rearing of spring chinook and summer steelhead. The mitigation goal for the Pelton/Round Butte Project requires PGE to return an average annual run of 1,200 spring chinook adults to the project area.

Water is supplied to the hatchery from tunnels in the canyon wall that collect seepage from the upstream reservoir (Lake Billy Chinook). The Pelton Ladder is operated as a satellite rearing facility. The facility is a former fish passage ladder which has had some sections converted for rearing fish. It is located at the base of Lake Simtustus which provides a constant water flow of 3,591 gpm.

The spring chinook smolt production goal for the RBH is 320,000 smolts for release into the Deschutes River. Up to 95% of the smolts are reared and acclimated in the Pelton Ladder and allowed to volitionally release in to the Deschutes River below Pelton Re-regulation Dam. The remaining 5% are reared at Round Butte Hatchery and direct stream released at the Pelton Trap below the Reregulating Dam (RM 100). Broodstock is collected between May and August from adult chinook that swim into the Pelton Trap (point of farthest upstream migration for anadromous fish) and transferred to RBH. The broodstock goal is to collect approximately 410 adults annually. All spring chinook smolts are marked prior to acclimation and release. Spring chinook surplus to broodstock needs are provided to the CTWS and local food banks.

RBH also rears spring chinook salmon for the Hood River subbasin.

Summer steelhead

Round Butte Hatchery

RBH is the only hatchery releasing summer steelhead in the lower Deschutes River subbasin. The mitigation goal for the Pelton/Round Butte Project requires PGE to return an average annual run of 1,800 summer steelhead adults

Broodstock for the summer steelhead program at RBH are currently collected from hatchery origin fish returning to Pelton trap. Approximately 160,000 summer steelhead are pond reared annually and released below the Reregulating Dam.

The target date for preparation of HGMP for RBH production is 2003-04. Until that time, the hatchery programs for spring chinook salmon and summer steelhead will be covered under the Mid-Columbia Biological Opinion from Section 7 consultation with the National Marine Fisheries Service.

Rainbow trout

Indigenous populations of redband trout were supplemented with hatchery rainbow trout from 1934 to 1993 in White River and 1940 to 1978 in the mainstem lower Deschutes River in order to meet management objectives of that time. Current management specifically precludes releases of hatchery rainbow trout in White River and the mainstem lower Deschutes River.

C. shasta susceptible hatchery rainbow trout were annually stocked in the lower Warm Springs River by CTWS. Stocking of these rainbow trout was discontinued in 2000 due to concerns of potential conflict with wild summer steelhead stocks.

Oak Springs Hatchery

Oak Springs Hatchery is located on the Deschutes River approximately nine miles from Maupin Oregon (Appendix I, Figure 18), and is used for incubation and rearing of summer and winter steelhead for release outside of the Deschutes River subbasin. Oak Springs Hatchery also maintains two resident rainbow trout stocks for release statewide, outside of the Deschutes River subbasin.

Artificial Production - Pelton/Round Butte Project Area

Lake Billy Chinook

Upon completion of Round Butte Dam in 1964, intensive research was undertaken to develop a recreational fishery in Lake Billy Chinook. Early stocking efforts concentrated on rainbow trout, although numerous other species of fish were also stocked. Rainbow trout fingerlings were stocked annually from 1964 to 1975 by the Oregon State Game Commission (OSGC). However, it was discovered that the lake had *Ceratomyxa shasta*, a parasitic disease that kills salmonids that are not resistant to it. The development of a rainbow trout fishery was limited by the disease which resulted in high mortalities of stocked rainbow trout.

In 1970-71, the OSGC also released kokanee fingerling into the lake. The OSGC also released excess summer steelhead smolts in 1966 and Atlantic salmon fingerlings in 1973. From 1962-64, the Oregon State Fish Commission (OSFC) released young coho salmon to evaluate downstream passage facilities associated with Round Butte and Pelton dams.

Lake Billy Chinook is currently managed for kokanee, bull trout, smallmouth bass, redband trout, and brown trout. No hatchery fish are stocked in the reservoir. However, fin clipped hatchery rainbow trout are released annually in the Crooked River at Opal Springs (RM 6.9), just above Lake Billy Chinook, and fin clipped hatchery rainbow were released in the Metolius River below Camp Sherman (RM 39) until 1994. Some of these fish migrate downstream and enter the reservoir fishery. The hatchery program at Opal Springs will be adjusted in the future to reduce the number of, or prevent, hatchery rainbow trout entering Lake Billy Chinook.

Bass, black crappie, and bluegill were never stocked into the reservoir. Largemouth and smallmouth bass have been present in Prineville Reservoir since 1961 and are most likely the source of bass in Lake Billy Chinook. Black crappie and bluegill are present in many private farm ponds in the area and may have been introduced into Lake Billy Chinook from irrigation runoff water.

Lake Simtustus

When Lake Simtustus was created, there were many different and sometimes conflicting objectives for the reservoir. Until 1968, when upstream passage of fish was terminated, the management objective was to continue the native runs of anadromous fish. Juvenile anadromous fish were captured from Lake Billy Chinook, transported to the base of Round Butte Dam, and released into Lake Simtustus. However, there were also attempts to create a fishery in the reservoir. Fingerling and catchable size rainbow trout and kokanee were stocked in the reservoir by the USFWS under the direction of the CTWS. Kokanee were also stocked by the OSGC on an occasional basis. Kokanee are now stocked annually. Starting in 1969, studies were initiated to determine the feasibility of rearing chinook salmon in the reservoir and juvenile salmon were released into the reservoir annually until 1978. From 1973 to 1986, excess grade out steelhead from Round Butte hatchery were stocked in the reservoir. Although these fish were intended to provide a fishery in the lake, some of these fish may have emigrated downstream as smolts and contributed to steelhead runs in the Deschutes River. Rainbow trout stocking by the USFWS was terminated in 1978 after discovery of the disease *C. shasta* in the reservoir. Fingerling and catchable *C. shasta* resistant rainbow trout were stocked by ODFW from 1985 to 1991. Fingerling rainbow trout stockings were terminated due to concerns about their downstream migration into the Deschutes River, which is managed exclusively for wild rainbow trout. Catchable rainbow trout are still stocked annually in Lake Simtustus. Brown trout were stocked annually from 1987 to 1996, but stocking was discontinued due to concerns with emigration to the lower Deschutes River.

Artificial Production - Metolius River

Although brook, brown and rainbow trout, and kokanee have been stocked in the Metolius River subbasin in the past, no hatchery fish are currently stocked in the Metolius River, its tributaries, or other waterbodies directly connected to the river.

Wizard Falls Hatchery

Wizard Falls Hatchery is located at RM 33 of the Metolius River (Appendix I, Figure 18). This hatchery raises Atlantic salmon and brook trout for release into several lakes in the Cascade Lakes region west of Bend, rainbow trout for release into several lakes in the

Little Deschutes River region south of Bend and the extreme upper Deschutes River, and kokanee for release in several lakes and reservoirs in the upper Deschutes River subbasin, including Lake Simtustus and Crane Prairie Reservoir.

Artificial Production - Crooked River

Historic hatchery stocking programs in the Crooked River subbasin were relatively small compared to other hatchery programs around the state. Small numbers of fingerling rainbow and brook trout were stocked in USFS streams in the late 1920's and early 1930's, while Ochoco Reservoir was stocked regularly once completed in 1918.

With concerns for meeting the Trout and Warmwater Fish Plans, adopted by the Oregon Fish and Wildlife Commission in 1987 (ODFW 1987a and 1987c), and the Wild Fish Policy, (ODFW 1990c), all existing hatchery programs are being reviewed for compliance. Many programs are being critically reviewed for potential genetic and disease impacts on indigenous stocks of native fish. Deep Creek and Marks Creek stocking with hatchery rainbow was recently discontinued due to wild fish genetic concerns.

Current hatchery stocking programs in the subbasin occur primarily in standing water impoundments, with very few programs in moving waters. South Fork Crooked River, where major chemical rehabilitation programs in the 1970's and 1981 are thought to have eliminated all indigenous redband trout, receives a small number of Deschutes rainbow fingerling. A small number of legal rainbow trout are stocked in Ochoco Creek through the city of Prineville, primarily used by juvenile, young adult, and senior citizen residents of Prineville. The lower Crooked River below Opal Springs, which is a mitigation site for the Deschutes Valley Water District hydroelectric dam that eliminated resident fish passage, receives legal rainbow trout. The Bend/Ochoco ODFW District is evaluating passage over the dam to reconnect resident fish populations.

The Crooked River below Bowman Dam has been managed as a "wild plus hatchery rainbow trout" stream because of occasional rainbow trout escapement from Prineville Reservoir via the unscreened outlet.

Prineville Reservoir

Hatchery rainbow trout fingerlings have been stocked annually since Bowman Dam was completed. Various trout species and strains have been released over the past years, including Oak Springs rainbow trout, Eagle Lake rainbow trout, and summer steelhead. Oak Springs rainbow trout are currently stocked annually.

Largemouth and smallmouth bass were stocked into the reservoir in 1960 and 1961 shortly after reservoir completion. Bass populations, since initial releases, have been sustained entirely from natural reproduction. Black crappie were illegally stocked in the late 1980’s.

Ochoco Reservoir

There are no records of warmwater fish being stocked in Ochoco Reservoir, but it appears that bass and perhaps black crappie were introduced soon after completion of the dam. Eastern brook trout were stocked as early as 1932. Rainbow trout have been stocked annually since 1950. Juvenile coho were stocked in 1966 but contributed very little to the fishery in subsequent years.

Artificial Production - Upper Deschutes River

Historic hatchery stocking programs in the upper Deschutes River subbasin were very extensive beginning in the early 1900's. Some of the earliest stocking occurred in the high mountain lakes where brook and rainbow trout were packed in by ODFW and Forest Service horse and mule pack strings. Most major waters in the subbasin had been stocked by 1930.

All current hatchery programs are being reviewed for compliance with the Trout and Warmwater Fish Plans, adopted by the Oregon Fish and Wildlife Commission in 1987 (ODFW 1987a and 1987c), and the Wild Fish Policy, (ODFW 1990c). Programs are being critically reviewed for potential genetic and disease impacts on indigenous trout stocks.

Current hatchery stocking programs in the subbasin are primarily in standing waters. Stocking of streams is limited to Fall River and the Deschutes River between Wickiup Reservoir and Sunriver. The majority of stocking is with fingerling-size rainbow, brook and cutthroat trout, kokanee, and coho salmon. Stocking of legal-size trout and Atlantic salmon is done on several waters to generate put-and-take fisheries or specialized fisheries such as Hosmer Lake Atlantic salmon and trophy brown trout at East and Paulina lakes.

Largemouth bass and redear sunfish have been stocked in Fireman's pond. Numerous private ponds are stocked with a mixture of cold water and warmwater species, some on an annual basis, some sporadically as requested by the landowner. Transporting fish from public waters or private hatcheries to private ponds requires an ODFW approved fish transport permit. Each permit is reviewed and approved, conditioned, or denied depending on species involved, extent and nature of receiving water, and access of fish to escape into public waters.

Fall River Hatchery

Fall River Hatchery is located on Fall River at approximately RM 4.75 (Appendix I, Figure 18). The hatchery has operated since the late 1920's and provides legal-size rainbow trout for release into several Cascade lakes, Fall River and the extreme upper Deschutes River and fingerling cutthroat and brook trout for airstocking of the Cascade high lakes. The hatchery grounds also provide angler access to Fall River.

Existing and Past Efforts – Subbasin-wide

Oregon Department of Fish and Wildlife

ODFW has established priorities for streamflow restoration needs in the Deschutes River subbasin (Appendix I, Figure 16), as well as all other basins in the state. Priorities are based on individual rankings of several biological and physical factors, water use patterns and restoration optimism. Biological and physical factors include the number of native anadromous species, presence of a designated “Core Area”, fish related ecological benefits, other types of ecological benefits, physical habitat condition, the extent of human influence, water quality, current status or proposed sensitive, threatened, or endangered, presence of instream flow protection (Instream Water Rights), and natural low flow problems. Water use pattern factors include the estimated amount of consumptive use and the frequency that an existing Instream Water Right is not satisfied. The final factor in the ranking of restoration need is an optimism factor of how well the fish resources would

respond if flow were restored. Many of these factors were derived from existing data sources while others were ranked by ODFW District Fish Biologists, based on local knowledge and professional judgement. Extensive use was made of Geographic Information Systems (GIS) and relational database analytical methods. The flow restoration priorities project was funded by the Oregon Watershed Enhancement Board, through a grant to the Oregon Water Resources Department.

Oregon Watershed Enhancement Board

OWEB funded ODFW and OWRD, through a grant to OWRD, to determine streamflow restoration priorities in Columbia River Basin tributaries.

Oregon Water Resources Department

In conjunction with ODFW, OWRD has established priorities for streamflow restoration in the Deschutes River subbasin. The OWRD ranked the opportunities and optimism for achieving meaningful streamflow restoration in each subbasin, based on the availability and perceived effectiveness of several flow restoration measures. These included transfers and leases to instream uses, cancelled water rights, enforcement and monitoring, improved diversion methods, stream inventories, conservation planning, improved efficiencies, and measurement and reporting of use. By overlaying the identified need and opportunities for restoration, the State of Oregon has identified the subwatersheds were it will apply resources toward achieving streamflow restoration.

Existing and Past Efforts - Lower Deschutes River

U.S. Forest Service

The U.S. Forest Service (USFS) has implemented instream habitat restoration projects on Rock, Threemile, and Gate creeks in the White River system. This work, aimed primarily at rehabilitation of the streams impacted by the Rocky Burn forest fire in the early 1970's, and subsequent logging and grazing, has included assistance with fish passage improvement, riparian fencing, and placement of large woody debris. In addition, the USFS has modified campgrounds and hiking trails, closed and scarified roads, and replanted trees in timber sale harvest units to reduce erosion and stream sedimentation.

Fish passage

Culvert removal or replacement has improved fish passage at several locations on the national forest. Streams on the forest have been assessed for fish passage problems. USFS considers correction of fish passage problems a priority need in the White River subbasin.

Diversion screening

The USFS has been a partner with ODFW in diversion modification and screening projects in the White River subbasin.

Stream bank stabilization and instream habitat structures

The USFS has placed log structures in several streams in the Rocky Burn area, as well as some other streams, in the White River subbasin. These structures, made up of one to several logs each, stabilize the banks and provide instream habitat for both adult and juvenile fish. Stream banks have received additional stabilization by plantings of native vegetation in the riparian areas of the project areas.

Riparian fencing

Riparian fencing has been installed along Rock, Threemile, and Gate creeks to protect riparian vegetation and existing bank integrity from livestock and to allow natural rehabilitation of the riparian and instream habitat.

Campground restoration

The USFS has made modifications to their campgrounds in the White River subbasin to repair and improve riparian areas. Camp sites have been moved back from the edge of the creek and defined, and areas not designated as camp sites have been planted with native vegetation.

Photographic documentation

Following stream bank stabilization and instream habitat structure placement, photopoints were established and are routinely photographed in the Rocky Burn projects to document changes in channel conditions and riparian recovery in the treated areas.

Stream temperature monitoring

Continuous temperature monitors are currently deployed at 17 sites in the national forest portion of the White River subbasin.

Stream surveys

Since 1990, the USFS has conducted stream surveys in those portions of all the streams in the White River subbasin which lie within the national forest. In addition, monitoring of shade, bank erosion, stream cross-section, and stream substrate is conducted in those portions of Rock, Threemile, and Gate creeks that were impacted by the Rocky Burn in the early 1970's, as well as a representative natural stream section in Badger Creek.

Bureau of Land Management

The Bureau of Land Management (BLM) manages the public lands in the lower Deschutes River subbasin for multiple use while protecting the natural resources. They are the federal managing agency for the lower Deschutes River Wild and Scenic River.

Riparian enhancement and protection

All livestock allotment management plans (currently 72) have been reviewed and modified to protect and enhance riparian and aquatic resources to comply with the Northwest Power Planning Council's *Strategy for Salmon 1992.*

Approximately 34 miles of mainstem Deschutes River has been fenced and excluded from livestock grazing. In addition, 14 springs have been developed and fenced to exclude livestock. These spring developments help distribute cattle more homogeneously over the allotments, protect and recover the springs for wildlife, and provide hot season rest for the streams and river.

Biological monitoring

Ongoing monitoring for riparian and aquatic resources includes riparian transects in each livestock riparian pasture to track changes in species and relative abundance over time. Proper Functioning Condition surveys have been conducted to determine stream channel ability to dissipate energy and store water. In addition, BLM conducts annual steelhead spawning surveys in the lower Deschutes River subbasin.

Temperature monitoring

The BLM has established 17 water temperature monitoring sites in the lower Deschutes River subbasin.

Recreation

BLM administers approximately 170 permits for fishing and white water boating guides and outfitters on the lower Deschutes River. They also manage approximately 40 campgrounds and day use areas in the subbasin. All campgrounds within the wild and scenic rivers have been modified as necessary to protect riparian and aquatic resources.

U.S. Geological Survey

Stream flow data is collected at four USGS gauging sites in the lower Deschutes River subbasin. The mainstem Deschutes is monitored at USGS gauging station 14092500 near Madras and the USGS station 1410300 at Moody Rapids, near the mouth. The Warm Springs River is monitored at USGS station 14097100 near Kahneeta resort, and Shitike Creek is monitored at USGS station 14092750 at Peter's Pasture.

Confederated Tribes of the Warm Springs Reservation of Oregon

On Reservation

The biological context for tribal restoration efforts on the Warm Springs Reservation and in the ceded lands of the Deschutes River subbasin revolve around the lifecycle of species and their habitat requirements. The natural resource management philosophy of the Warm Springs Tribe combines an understanding of tribal values with the knowledge to assess conditions in the natural environment. These concepts are at the base of tribal restoration activities.

Bull trout (BPA Project # 199405400)

BPA has funded studies of bull trout life history, genetics and habitat needs in the lower Deschutes River subbasin for 1998-2001. This study, titled *Bull Trout Life History, Genetics, and Habitat Needs on the Warm Springs Reservation*, is designed to determine distribution and abundance of juvenile and adult bull trout, establish the relationship between stream temperature and bull trout distribution, determine fluvial and resident life history patterns, characterize interactions between bull trout and introduced brook trout, and determine the genetic characteristics of bull trout in the lower Deschutes River subbasin. In association with this study, 18 thermographs have been deployed in the Warm Springs River and Shitike Creek.

Watershed restoration

On the Warm Springs Reservation, a watershed restoration program has been implemented since the 1970's. Projects include:

- Riparian fencing
- Planting and seeding in riparian area
- Road eradication and closures (100 miles/year)
- Culvert/road crossing improvements
- Juniper removal
- Instream work including: instream structures, stabilization project
- Solar off channel water developments
- Spring developments
- Prescribed fire (3000 acres/year)

- Forest health silvicultural treatments
- Diversion screen improvement
- Big game guzzler construction (5)
- Bitterbrush seed collection and seedling planting program
- Fish carcass introduction (nutrient enhancement)
- Osprey nesting platform construction
- Goose nesting platform construction
- Passage impediment (manmade) removal
- Fishing sanctuary implementation
- Snag and down log maintenance
- Water take out designation and improvements
- Riparian condition monitoring (photo trends)
- Noxious weed treatments

Biological monitoring

The CTWS conduct summer steelhead redd count surveys in index areas of the Warm Springs River and Shitike, Eagle, Nena, and Skookum creeks. The CTWS also conduct redd count and carcass surveys for spring chinook salmon in the Warm Spring River and Shitike Creek. Redd counts for bull trout are also conducted annually.

To sample outmigrating fall and spring chinook salmon and summer steelhead, the CTWS has operated a Humphrey Trap in the lower Warm Springs River since 1975, and in Shitike Creek since 1994.

Adult spring chinook salmon returns to the Warm Springs River have been monitored at WSNFH since the early 1970's. An adult weir is installed annually near the mouth of Shitike Creek to monitor adult spring chinook returns.

During the summer months the CTWS conduct snorkel surveys to estimate juvenile summer steelhead abundance in Shitike Creek.

Monitoring of distribution and abundance of anadromous and resident fish species on the Warm Springs Reservation has been conducted since the 1980's. Radio telemetry of spring chinook salmon and bull trout have been undertaken for several years.

In addition, monitoring of physical properties including stream temperature and flows, sediment input and movement, dissolved oxygen, bacteria levels, stream bank stability, fish habitat parameters (wood, pools, etc), upland conditions, and soil condition and stability has occurred throughout the Reservation.

Wildlife monitoring activities on the Warm Springs Reservation include:

- Snag inventories
- Spring and fall aerial big game surveys
- Radio transmitter monitoring for deer, elk, bear and cougar
- Siteability population monitoring for deer and elk
- Spotted owl monitoring (since the late 1980's)
- Raptor monitoring
- Turkey roost identification and protection
- Big game harvest monitoring
- Sandhill Crane nesting survey (annually)

- Plant community, structure and function monitoring
- Noxious weed monitoring

Funding for biological monitoring activities is provided by the CTWS, EPA, BPA, GWEB, OWEB, NRCS, Oregon Trout, Trout Unlimited, Pacific Salmon Commission, Farm Services Administration, Bureau of Indian Affairs, and many others.

Enforcement

A Ranger program was implemented in 1994 to enforce tribal natural resource codes for hunting, fishing, watershed impacts, etc. This program is in addition to the Fish and Game branch of the Warm Springs Police Department, which also enforces tribal natural resource protection codes.

Off- Reservation

On ceded lands in the Deschutes River subbasin, the Confederated Tribes of the Warm Springs Reservation of Oregon provides technical, management, and policy recommendations and comment to public and private land owners, water users, and resource managers. These activities include comment on actions of the Bureau of Land Management, US Bureau of Reclamation, US Fish and Wildlife Service, National Marine Fisheries Service, Northwest Power Planning Council, Portland General Electric, State of Oregon, county soil and water conservation districts, watershed councils, irrigation districts, environmental organizations, various county governments, and many others.

Restoration actions have occurred on tribally owned, off-Reservation properties in the Deschutes River subbasin as well. Projects include riparian fencing, seeding, instream stabilization work, solar water developments, noxious weed treatment and prescribed fire.

Spring chinook salmon

In cooperation with the USFWS and USGS, CTWS is conducting a study to determine the over-wintering distribution of juvenile spring chinook salmon released from the WSNFH and their interactions with wild fish in the lower Deschutes River.

Fall chinook salmon

In conjunction with ODFW, annual fall chinook redd surveys are conducted by CTWS along the entire lower Deschutes River. Tribal staff also assist ODFW with estimates of escapement for fall chinook salmon above Sherars Falls.

The Chinook Technical Committee of the Pacific Salmon Commission is currently funding a mark-recapture study in the lower Deschutes River to improve the estimate of fall chinook salmon escapement to the river.

Funding is currently being sought for a coded wire tagging project for Deschutes River juvenile fall chinook salmon. Tag recovery information will be used to assess survival from juvenile to returning adult, distribution in ocean fisheries, and exploitation rates in ocean and Columbia mainstem fisheries.

Oregon Department of Fish and Wildlife

Trout Creek Habitat Restoration Project (BPA Project # 199404200)

The Trout Creek Habitat Restoration Project (TCHRP) is a Bonneville Power Administration (BPA) funded mitigation project, designed to restore, improve, or maintain riparian and instream habitat to increase the number of spawning adult summer steelhead returning to the Trout Creek system. Ancillary goals are to increase the resident redband

trout populations and to benefit wildlife by providing increased cover and forage along the improved riparian areas. The TCHRP has made significant contributions to restoring instream and riparian habitat in the subbasin. In cooperation with landowners, livestock have been controlled or excluded on over 70 miles of stream. Water for livestock is provided along the streams by development of 11 off-channel watering sites and livestock water gaps that are placed and maintained by ODFW personnel.

Nearly 5,000 instream structures have been placed to improve habitat diversity, provide cover and rearing habitat, and trap gravel. In addition, over 20,000 linear feet of juniper and rock riprap have been placed to stabilize actively eroding banks.

Macro-invertebrate samples were collected in the Trout Creek system in 1989 to provide a baseline for future monitoring.

Thermographs are currently deployed at 18 sites in the Trout Creek system. In 1998, staff gauges were placed at RM 2 on Trout Creek and near the mouth of Sagebrush Creek, tributary to Trout Creek, to monitor stream flow in the system.

A total of 115 photopoints have been established in the Trout Creek system since implementation of the Trout Creek Habitat Restoration Project to document changes in channel conditions and riparian recovery in areas treated. Photographs are taken at these sites approximately every three to four years.

In 1998, ODFW began operating a downstream migrant trap at RM 4 of Trout Creek. Information from this trap is being used to estimate numbers of wild summer steelhead smolts migrating from the system and determine biological and life history patterns of wild summer steelhead. This monitoring continues, funded by BPA.

Diversion screening

ODFW, with Mitchell Act and BPA funding, has provided individual irrigators with self-cleaning rotary pump intake screens for over 30 irrigation pumps located on lower Deschutes River tributaries supporting anadromous fish. Additionally, approximately 10 gravity diversions have been screened. 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. New and innovative technology in the form of infiltration galleries has been employed in the Trout Creek subbasin to protect juvenile salmonids from entrainment in irrigation systems.

Two diversions on the White River Wildlife Area have been screened to prevent fish loss to the irrigation ditches. Thirteen diversions in the White River subbasin remain unscreened.

Riparian fencing

On the mainstem lower Deschutes River, livestock has been excluded by riparian fencing on 28 miles of river frontage on lands managed by the ODFW. An additional 11 miles of exclosure fencing has been built in cooperation with other land management agencies.

Biological monitoring

Summer steelhead spawning ground surveys have been conducted annually since 1988 on index stream reaches in the Trout Creek system, since 1990 in Bakeoven and Buck Hollow creeks. Fall chinook salmon spawning ground surveys have been conducted annually since 1972 in the mainstem lower Deschutes River.

Population estimates of summer steelhead and fall chinook salmon passing Sherars Falls (RM 44) have been made annually since 1977 using Peterson mark-recapture estimation techniques. These estimates are made by tagging adults captured at a trap located in the fish ladder at Sherars Falls and making later recovery of both tagged and untagged fish at WSNFH and RBH, and from fall chinook carcass recovery in the lower river.

Herd composition and trend surveys are conducted annually to monitor California bighorn sheep, mule deer, Rocky Mountain elk, pronghorn antelope, winter raptors, upland gamebirds and waterfowl.

Photographic documentation

Sixty-five photopoints have been established on the mainstem lower Deschutes River to monitor riparian recovery in areas where livestock have been excluded from the river since 1985.

Regulatory activities

Angling in the lower Deschutes River is restricted to the use of artificial lures and flies, except that bait may be used in a three mile reach below Sherars Falls. Anglers are not allowed to fish from a floating device. Angling for salmon and steelhead in the tributaries to the lower Deschutes River is not allowed, except in the lower two miles of White River. Harvest of summer steelhead in the Deschutes River subbasin is limited to hatchery fish only. Harvest of spring and fall chinook salmon is allowed only in those years when ODFW opens a special season for those species.

The lower Deschutes River supports a popular redband trout fishery. Angling regulations and management strategies have been designed to protect juvenile steelhead and to potentially increase certain size groups of wild redband trout. Harvest of redband trout is restricted to two fish per day between 10 and 13 inches. White River is open for trout angling the entire year, Trout Creek is open for catch and release of trout, and all other tributaries to the lower Deschutes River are closed to angling.

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.

ODFW adjusts big game hunts annually to maintain population goals and address damage problems on agricultural lands.

Forage and cover planting

Forage and cover crops are planted annually on two parcels of land in the Lower Deschutes Management Area (LDMA) for utilization by waterfowl, upland game birds and songbirds, as well as deer and small mammals. Crops are left standing to provide food and cover. On the White River Wildlife Area, annual plantings of cereal grains and green forage crops supplement native vegetation utilized by wildlife species. In addition, a cooperative project with the Mule Deer Foundation and the Foundation for North American Wild Sheep has planted forage crops on an abandoned wheat field near Dead Horse Canyon to provide food and cover for bighorn sheep, deer, and other wildlife.

ODFW has also planted trees to create dispersed camping sites along the lower 18 miles of the Deschutes River.

Spring development

In the LDMA, spring areas have been fenced and watering troughs placed to collect water output for off-river livestock and wildlife watering. ODFW has obtained the water rights to one spring near the Harris Ranch homestead site (RM 11), and water output is used to irrigate forage crops.

Habitat diversity and cover for wildlife has been provided by plantings of trees and shrubs at Harris Ranch in the LDMA and a dozen spring developments between Sherars Falls and the mouth of the Deschutes River. Most of these plantings have been a cooperative effort with the Mule Deer Foundation.

Guzzlers

Guzzlers provide water for wildlife in arid portions of the subbasin. These fiberglass catch basins have a corrugated metal roof that funnels rain and/or snow into the basin to provide year-round water for wildlife ranging from birds to big game animals. Approximately 24 guzzlers are currently maintained by ODFW in the lower Deschutes River subbasin, mostly on private lands.

Noxious weed control

Control of noxious weeds, such as Scotch thistle, yellow star thistle, goatshead puncture vine, hoary cress, and the knapweeds is an ongoing project in the subbasin.

Oregon Department of Forestry

Oregon Department of Forestry (ODF) enforces the Oregon Forest Practices Act (OFPA) on all forest lands not federally owned. The OFPA contains guidelines to protect fish bearing streams during logging and other forest management activities. These guidelines include stream buffer zones and riparian management areas.

ODF also provides technical assistance to non-industrial forest land owners concerning insects, diseases, harvest techniques and reforestation. ODF works with forest land owners to develop timber management plans and administers federal cost-share programs to encourage good forest management practices.

Oregon Department of Environmental Quality

The Clean Water Act requires each state to set Total Maximum Daily Load allocations (TMDL) for each water body on the 303(d) list. TMDLs are an analytical process for describing the maximum amount of pollutants from all sources that may enter a specific waterbody without violating water quality standards. Collection of water quality data is a component of the development of TMDLs. Oregon Department of Environmental Quality (DEQ) data collection efforts concentrate on collecting additional data for parameters already included on the 303(d) list. TMDLs are planned for completion by the end of 2006 for the lower Deschutes River, however, no monitoring sites are in place at this time.

In June 2000, DEQ will begin a four-year river health study in the John Day and lower Deschutes rivers. Twenty-five sites will be monitored to determine the health and diversity of fish and aquatic insects, water chemistry, average peak stream temperature, and other information that can be used to determine overall stream health.

Soil and Water Conservation Districts

Soil and Water Conservation District (SWCD) works with farmers and ranchers to develop conservation plans and administers grants to encourage basic conservation work on private lands in the lower Deschutes River subbasin. Farmers in the lower subbasin are served by

Wasco, Sherman, and Jefferson SWCD. Conservation practices include no-till fallow, strip cropping, sediment basins, terraces, grass filter strips and waterways, residue management and riparian reserves.

Buck Hollow Watershed Project

Using GWEB, USDA, BPA and private and in-kind funding, the Buck Hollow Creek Watershed Project has restored an extremely degraded stream system in the lower Deschutes River subbasin. Heavy grazing and farming over the past 100 years had deteriorated the quality of the watershed. Two floods, in 1964 and 1978, completely devastated the already degraded watershed. Working to reduce erosion, improve water quality, and ultimately increase fish populations, the Buck Hollow Project works to improve the uplands, where the water begins. Landowners and project workers have built more than 150 water and sediment control basins, 138,000 feet of gradient terraces, and 2 acres of grassed waterways to capture water and let it slowly trickle out into the streams. Landowners on 114,000 acres have developed conservation and grazing plans to have less impact on the uplands and manage riparian areas, and convert to conservation tillage practices. Fifty miles of fence has been installed for 13 riparian pastures and three riparian exclosures. Stream bank stabilization, consisting of deflectors and juniper "rip-rap", has been completed on over five miles of stream. Fish passage has been restored in a Rosgen 'D' class stream segment that had been a barrier. Thousands of trees and shrubs have been planted along eleven miles of stream and 79 acres of uplands. Thirteen springs, five livestock wells, and two solar powered livestock watering facilities have been developed. Other work in the watershed includes range improvement seeding, and juniper and brush control. Four water temperature monitoring sites are maintained by SWCD personnel in the project area.

Bakeoven Watershed Project

Land treatment projects to improve watershed health in Bakeoven Creek have emphasized range health and range management systems. Using mostly GWEB grant monies, Wasco County SWCD has worked with willing landowners to reduce erosion, improve water quality, and ultimately increase fish populations by improving the upland watershed health. Landowners and project workers have built 30 water and sediment control basins to capture water and let it slowly trickle out into the streams. Landowners have also changed their land management techniques by adjusting their grazing to have less impact on the uplands and keep cows out of riparian areas. Fifteen miles of fence have been installed to exclude livestock from the stream. Off-stream livestock watering facilities have been developed at six sites. Brush control on over 2,000 acres and range seeding on over 200 acres has improved wildlife forage and cover. A significant portion of cropland has been converted to the Conservation Reserve Program. Preliminary figures from a riparian assessment, currently in progress, indicates 25% of riparian areas in good condition, 16% fair, and 59% in poor condition.

White River Watershed Project

Beginning in 1999, with funding from the Deschutes Resources Conservancy and Oregon Watershed Enhancement Board, Wasco County SWCD has worked with landowners in the watershed to convert 1,650 acres of conventionally tilled wheat crop land to direct seed/no till systems to reduce runoff and erosion. Work is in progress with irrigation districts in the

watershed for improving conveyance efficiency on two irrigation ditches in water conserving projects that will result in reduction in stream withdrawals. ODFW is assisting the SWCD in design of screens for one irrigation ditch in the watershed, and engineering design work is being done for piping the ditch. A watershed council was appointed by Wasco County Court in 2000 and a watershed assessment and action plan are in progress.

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) is the federal agency within the U.S. Department of Agriculture (USDA) which provides financial, technical and educational assistance to implement conservation practices on privately owned land. Using this help, farmers and ranchers in the lower Deschutes River subbasin apply practices that reduce soil erosion, improve water quality and enhance forest land, grazing land and wildlife habitat. USDA funded cost-share programs are funded through the Commodity Credit Corporation (CCC) and administered by the Farm Service Agency (FSA); NRCS provides technical support for these programs. All USDA incentive and cost-share programs require landowner participants to develop a conservation plan for the practice, inspection of the project site to determine that the practice has been installed as planned, and an annual status review. If a landowner installs a practice and does not maintain or continue that practice as outlined in the conservation plan, he is required to pay back the cost-share monies and pay an additional penalty.

Fulton and Gordon Canyons Watershed Council

The Fulton and Gordon Canyons Watershed Council was formed in 1997. Working cooperatively, private landowners, the Sherman County SWCD, NRCS, and the Watershed Council have developed and implemented farm conservation plans to resolve some of the serious cropland erosion and water quality problems in the watershed. The Fulton and Gordon Canyons Watershed Action Plan (Fulton and Gordon Canyons Watershed Council 1997) identifies high priority concerns in the watershed and identifies strategies to improve the status of these parameters.

Macks Canyon Watershed Council

The Macks Canyon Watershed Council was formed in 1999 to address water quality issues in Macks, Jones, and French canyons. Grant funds procured by the Sherman County SWCD are assisting in implementation of many conservation activities such as terracing, sediment basins, spring developments, cross fencing, tree planting, and grazing management. Conservation plans are being developed for all the producers in the watershed.

Trout Creek Watershed Council

The Trout Creek Watershed Council is currently working to complete a watershed assessment to identify watershed conditions of concern, acknowledge data gaps, develop recommendations for addressing concerns, and provide baseline information for additional watershed planning efforts. Several projects have already been completed by the Trout Creek Watershed Council.

Infiltration galleries

Five infiltration galleries were created to eliminate push-up dams and convert flood irrigation to more efficient sprinkler irrigation. Three of the galleries are located in the

Willowdale area, the other two are near the town of Ashwood in the upper watershed. Elimination of the push-up dams restores passage for native steelhead and redband trout in Trout Creek. These projects were funded by BPA and OWEB and are installed and maintained by the landowners.

Stream bank stabilization

Stream bank near the town of Ashwood which was heavily eroded from flooding in 1996 has been stabilized using juniper rip-rap. The juniper trees also provide cover for rearing juvenile summer steelhead and resident redband trout.

Oregon Water Trust

Oregon's Instream Water Rights Law allows water right holders to donate, lease or sell some or all of their water right for transfer to instream use. Oregon Water Trust (OWT), a private, non-profit group, negotiates voluntary donations, leases or permanent purchases of out-of-stream water rights to convert to instream water rights in those streams where acquisition will provide the greatest potential benefits for fish and water quality. OWT has completed instream leases on Trout Creek for 1.28 cfs and on the Deschutes River for 1 cfs. OWT has also completed three leases in the White River system that returned 1.19 cfs instream (Andrew Purkey, personal communication). These water rights are held in trust for the people of Oregon by the Oregon Water Resources Department.

Deschutes Resources Conservancy

The Deschutes Resources Conservancy (DRC) is a non-profit organization whose goal is to improve water quantity and quality in the Deschutes River subbasin. The DRC supports projects in the subbasin, from tributary headwaters to the Columbia River, that result in sustainable economic and environmental benefits. Transactions include conservation easements, water rights trades or purchases, and irrigation system improvements.

Harpham Flat fencing

The Harpham Flat project will exclude livestock from grazing on two miles of the Lower Deschutes River near the town of Maupin. The project will help reduce stream bank erosion, restore riparian vegetation and reduce conflicts between cattle and recreational users on this popular stretch of river. The project is a partnership between the Confederated Tribes of Warm Springs, Bureau of Land Management and the DRC.

Rohde irrigation conversion

In partnership with the Jefferson County Soil and Water Conservation District, Oregon Water Trust, Bonneville Power Administration and Columbia Empire Farms, the DRC is assisting a private landowner in converting from flood to sprinkler irrigation methods. The project will have a positive impact on the water quality, quantity and fish and wildlife habitat on Trout Creek. The project includes the removal of a push-up dam, elimination of over eight miles of unlined irrigation ditch and the donation of 0.7 cfs of conserved water that will be returned instream.

Trout Creek riparian fencing

With the help of the DRC and the Trout Creek Watershed Council, a private landowner will construct 4.5 miles of riparian fencing around a high mesa pasture that will exclude livestock from grazing in approximately three miles of Tenmile Creek, two miles of Trout Creek, and three miles of the Deschutes River. The construction of new riparian fencing

and the elimination of a previously used watering gap complements the Bureau of Land Management and Oregon Department of Fish and Wildlife's efforts to manage grazing along Tenmile Creek in a manner that is conducive to fish and wildlife values.

No-till demonstration project

A small-grain farmer from the Juniper Flats region of Wasco County has agreed to use his farm as a no-till demonstration site for at least five years. Initially, the farmer will convert 900 acres of traditional tillage cropland to no-till methods. Wasco County SWCD and the DRC propose to cost-share with the farmer for three years to help with startup expenses and risk management. In return, the farmer will allow the SWCD to conduct educational and outreach activities on his farm. The SWCD will conduct field days, tours and neighborhood presentations to increase awareness of no-till methods and share results with other farmers in the region. The DRC is also exploring the opportunities for developing tradable carbon credits from this project.

Macks Canyon watershed restoration

This project focuses on the entire watershed from ridge top to ridge top, starting at the top and working down. Several treatments will be used including terraces, water and sediment control basins, sediment basins, and spring developments. The project is designed to decrease soil erosion and prevent sediment from entering Mack's Canyon and the Deschutes River.

Warm Springs riparian fencing

The DRC and the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWS) have partnered to install approximately 18 miles of riparian fencing, cattle guards, and off-stream livestock watering stations on tribal land bordering the Deschutes River, Skookum Creek and the Warm Springs River.

Oregon Wildlife Coalition

Although no site-specific wildlife mitigation projects have been funded by BPA in the lower Deschutes River subbasin, the Oregon Wildlife Coalition is implementing a programmatic mitigation project that may result in the implementation of mitigation projects within the subbasin. The goals of this project, Securing Wildlife Mitigation Sites – Oregon (Project No. 9705900), are to:

- Fund project coordination activities to identify, plan, propose, and implement wildlife mitigation projects within the Lower Mid-Columbia subregion, including the lower Deschutes River subbasin.
- Prioritize potential mitigation projects within the lower Deschutes River subbasin.
- Acquire or lease lands with priority habitats within the lower Deschutes River subbasin to permanently protect wildlife habitats.
- Enhance acquired or leased lands through alteration of land management practices, active restoration of habitats, control of noxious weeds and other non-native vegetation, control of public access, etc. to provide benefits to target/indicator wildlife species within the lower Deschutes River subbasin.
- Develop and implement a monitoring and evaluation plan with both HEP based and non-HEP based monitoring criteria within the lower Deschutes River subbasin.

Existing and Past Efforts - Pelton/Round Butte Project Area

Confederated Tribes of the Warm Springs Reservation of Oregon

On ceded lands in the Deschutes River subbasin, the Confederated Tribes of the Warm Springs Reservation of Oregon provides technical, management, and policy recommendations and comment to public and private land owners, water users, and resource managers. These activities include comment on actions of the Bureau of Land Management, US Bureau of Reclamation, US Fish and Wildlife Service, National Marine Fisheries Service, Northwest Power Planning Council, Portland General Electric, State of Oregon, county soil and water conservation districts, watershed councils, irrigation districts, environmental organizations, various county governments, and many others.

ODFW, PGE and the CTWS are investigating the potential for reintroduction of anadromous fish above the Pelton-Round Butte Project Area. If summer steelhead are reintroduced above the dams there is the risk that diseases not present in the upper Deschutes River subbasin will also be introduced. Since 1998, the CTWS has allowed ODFW and Oregon State University to collect up to 20 unmarked steelhead for pathological studies. The unmarked steelhead are examined for parasites, viruses and bacteria. The steelhead also provide DNA and allozyme samples and otoliths for future evaluation. In addition to the unmarked steelhead, approximately 20 to 30 Round Butte Hatchery summer steelhead are also sampled.

Portland General Electric

Portland General Electric (PGE) is currently evaluating the feasibility of anadromous fish reintroduction above the Pelton/Round Butte Project Area. Studies are in place related to downstream migrant collection efficacy, upstream adult passage, water temperature and water quality, and upstream passage of disease pathogens. In addition, as part of the Pelton/Round Butte Project FERC relicensing effort, PGE has collected a variety of information concerning wildlife populations in the project area.

Downstream fish collection and handling studies

Studies include:

- reactivation of the historical downstream facility at Round Butte Dam on an experimental basis,
- construction of a downstream migrant sorting facility at Round Butte Dam to allow for efficient holding and marking of fish on an experimental basis, designing a new downstream passage facility at Round Butte Dam,
- hydrodynamic modeling of Lake Billy Chinook currents, construction of an architectural model of the Round Butte Dam forebay area to facilitate discussion and understanding of the possible alternative structures for future downstream fish movement, and
- engineering designs for downstream passage and selective withdrawal facilities.

Downstream juvenile migrant studies

A number of studies are evaluating the downstream migration of juvenile salmonids.

- Timing and numbers of kokanee/sockeye fry and bull trout juveniles will be monitored using screw traps near the mouths of the Metolius and Deschutes rivers.

- Emigration from Lake Billy Chinook of yearling kokanee/sockeye and juvenile bull trout will be monitored at three potential routes, the turbine gatewells, the spillway and the historic Round Butte skimmer.
- Travel times and relative survival of yearling kokanee/sockeye will be determined by placing Passive Integrated Transponders (PIT tags) in fish captured at the Round Butte skimmer, releasing them below the Reregulating Dam and recapturing them at Bonneville Dam.
- Survival of returning adult sockeye from yearling kokanee/sockeye releases from Lake Billy Chinook will be determined by fin-marking kokanee/sockeye releases to the lower Deschutes River for identification upon adult return in 2002.
- Efficiency of egg incubation boxes for spring chinook salmon smolts in the upper Metolius River subbasin will be evaluated.
- Migration patterns for steelhead smolts through Lake Billy Chinook will be determined using radio-tagged and fin-marked steelhead smolts.
- Timing and migration patterns for spring chinook salmon smolts into and through Lake Billy Chinook will be monitored in 2001 using radio-tagged and fin-marked spring chinook salmon smolts.
- Growth rates and survival of bull trout PIT tagged and moved into Lake Simtustus will be compared to growth and survival of bull trout in Lake Billy Chinook and the lower Deschutes River.
- Assessment of relative numbers of bull trout transferred into Lake Simtustus that emigrate downstream through the turbines at Pelton Dam will be done using radio-tagged juvenile and sub-adult fish.
- Survival, growth rate, and straying frequency for bull trout transferred from Lake Billy Chinook to the lower Deschutes River will be determined using PIT tagged juvenile and sub-adult fish.

Upstream migration facilities

PGE is constructing a temporary upstream migrant trap at Round Butte Powerhouse to facilitate movement of bull trout from Lake Simtustus into Lake Billy Chinook. This temporary trap is a modification of one used in 1999 at the same location. Conceptual designs of a permanent upstream trap at Round Butte Dam will also be developed in 2000.

Upstream migration studies

Two bull trout studies are planned for 2000:

- A comparison of the timing of migration of maturing adult bull trout into the upstream fish traps at Pelton trap and the Round Butte Dam upstream fish trap will be conducted.
- Success of transporting adult bull trout from the Round Butte Dam upstream fish trap to the lower Metolius River will also be assessed.

Water temperature and water quality

Continuous monitoring of water temperature at nine sites in Lake Billy Chinook will continue, as well as monthly dissolved oxygen, specific conductivity, turbidity, and pH at thirteen sites in Project and Project-associated waters. In addition, water temperatures are monitored at eight sites in the lower Deschutes River, from the Reregulating Dam to the mouth, for calibration of the SNTemp Model to predict water temperatures in the lower

river. Refinement of temperature and water quality predictions, using the "BETTER" water quality model, is planned for 2000.

Pelton/Round Butte Fish Health Risk Assessment

The Pelton/Round Butte Fish Health Risk Assessment, a cooperative effort between PGE, ODFW, and OSU, began in 1997 to assess the risk to native resident fish from fish pathogens which may be carried by anadromous fish and bull trout proposed for reintroduction into the subbasin above the dams. This study will continue to assess the presence and risks of IHN, VHS, EIBS, whirling disease, Ceratomyxa, furunculosis and BKD in various parts of the upper and lower subbasin.

A special whirling disease study will also be conducted in 2000 to determine if:

- Juvenile bull trout will be infected with *Myxobolus cerebralis*, the causative agent of whirling disease, in the lower Deschutes River.
- The life cycle of *M. cerebralis* is being completed in Lake Simtustus, using kokanee/sockeye.
- The life cycle of *M. cerebralis* is being completed in the lower Deschutes River, using resident redband trout.

Wildlife

The following annual wildlife surveys are conducted in the area surrounding Lake Billy Chinook, Lake Simtustus and the Reregulating reservoir:

- Winter waterfowl counts
- Waterfowl nesting productivity surveys
- Waterbird surveys
- Upland gamebird surveys
- Winter bald eagle counts
- Bald eagle nesting surveys
- Raptor nesting surveys
- Winter raptor counts
- Winter mule deer surveys
- Bat surveys of project facilities
- Surveys of animals using the Pelton fish ladder wildlife crossings

Guzzlers

Guzzlers provide water for wildlife in arid portions of the subbasin. These fiberglass catch basins have a corrugated metal roof that funnels rain and/or snow into the basin to provide year-round water for wildlife ranging from birds to big game animals. Approximately 24 guzzlers are currently maintained by PGE in the project area and Metolius Mule Deer Winter Range.

Existing and Past Efforts - Metolius River

U.S. Forest Service

Instream wood restoration

To increase rearing habitat for redband and bull trout, large wood has been placed in the Metolius River since the mid 1980's. Hazard trees in developed areas on USFS lands are currently dropped into the river to provide instream structure. Five to ten trees are felled into the river each year. The majority of this work is near campgrounds and summer

homes near Camp Sherman, but some treatment has occurred from the headwater springs to near the mouth of the river.

Trees that naturally fall into the river and span the channel are generally left if the log can be safely portaged or floated around. In the lower 15 miles, within the segment designated as scenic, little if any wood management is done. Above Bridge 99, in the recreation segment, some wood is moved to allow safe passage but retained in the river for fish habitat.

Road obliteration

Many road obliteration projects have occurred in the Metolius River subbasin to reduce sediment delivery to bull trout spawning streams. These projects have varied from large obliteration projects to small projects after timber sales. A large project in 1999 obliterated 26 miles of road in the subbasin.

Tributary enhancements

Side channel and wood enhancement projects have occurred in Roaring, Jefferson, Candle, and Jack creeks. These projects were completed from 1988 through 1994. Heavy tree mortality after the drought of the early 1990's has recovered instream wood densities since then.

Dispersed camping

Dispersed camping and campground development projects have served to reduce the density of camping in the riparian area and have reduced the road densities. Notable projects include the conversion of a RV campground to walk-in tent only camping at Riverside Campground. Dispersed camping along Lake, First, and Jack creeks, and the Metolius River have been reduced. Camping along the lower Metolius River has been reduced by road closures below Bridge 99.

River trail maintenance

Projects including trail reduction, stepping stones into the river, erosion control, trail reroutes, bridges over wet areas, and parking barriers are maintained annually along the Metolius River.

Flood repair and storm proofing

After the 1996 flood, several road crossings in the subbasin were improved to handle large floods. Ten culverts were replaced with bridges or larger culverts. Candle Creek Bridge replaced two culverts which were adult passage barriers on an important bull trout spawning stream. Road obliterations were also completed with this work.

Fish passage improvements

An inventory of juvenile fish passage barriers has been completed across the forest and will be used to focus efforts on increasing the use of tributary streams for juvenile bull trout and redband rearing.

Water quality monitoring

Nitrogen and phosphorus have been monitored since 1997 to establish a baseline for monitoring change as part of the Wild and Scenic River Plan. The headwater springs of the Metolius River have been found to have high phosphorus levels.

Temperature has been monitored since 1988 in many of the streams of the Metolius River subbasin. These data are primarily summer data, but some winter data are available

for some stations. Primary stations include bull trout spawning streams and the Metolius River and Lake Creek.

Spawning gravels have been monitored in ten streams in the watershed since 1988. This monitoring tracks percent fines in the gravels during drought and flood years.

Biological monitoring

Invertebrates have been monitored since 1988. This monitoring has been used together with other data to show habitat quality in some streams is impacted by sediment (Lake Creek) and by moderate nutrient availability (Metolius River).

Most of the fish bearing streams of the subbasin have been inventoried using the USFS protocol for stream survey. Some repeated surveys have noted increases in instream wood, probably a result of high tree mortality related to the drought in the early 1990's.

Juvenile bull trout monitoring has been conducted since 1992 on the Metolius River and its tributaries. Juvenile bull trout numbers have remained stable, the exception being the summer following the 1996 flood when numbers were reduced.

Bull trout redd counts have been conducted since 1986. Available data shows a long term recovery of adult spawners with population fluctuations that are believed to be due to angling limitations and kokanee availability in Lake Billy Chinook.

Redband trout redd counts and snorkel counts have been conducted since 1995. This program is designed to monitor redband trout population numbers after hatchery rainbow trout releases were discontinued in 1994. Numbers of redband trout have nearly doubled since the monitoring began.

Photopoints

Riparian photopoints have been established to monitor the condition of the stream bank in relation to winter fishing on the Metolius River.

U.S. Geological Survey

The U.S. Geological Survey (USGS) is currently conducting a study of survival of chinook salmon fry released into the Metolius River. This study is designed to determine relative survival rates of fry from hatchery versus wild parents.

Confederated Tribes of the Warm Springs Reservation of Oregon

On ceded lands in the Deschutes River subbasin, the Confederated Tribes of the Warm Springs Reservation of Oregon provides technical, management, and policy recommendations and comment to public and private land owners, water users, and resource managers. These activities include comment on actions of the Bureau of Land Management, US Bureau of Reclamation, US Fish and Wildlife Service, National Marine Fisheries Service, Northwest Power Planning Council, Portland General Electric, State of Oregon, county soil and water conservation districts, watershed councils, irrigation districts, environmental organizations, various county governments, and many others.

Biological monitoring

Bull trout redd counts are conducted annually by CTWS in the Whitewater River, tributary to the Metolius River. In addition, juvenile bull trout abundance is monitored in Whitewater River and Jefferson and Bald Peter creeks.

Oregon Department of Fish and Wildlife

ODFW has worked with public agencies and private landowners to improve existing practices through planning processes and direct habitat improvement projects in the Metolius River subbasin. Comments are made on federal land use issues through the National Environmental Policy Act process with the USFS, BLM, and Bureau of Reclamation (USBR); and on fish, water, riparian, and wetland issues with state agencies such as OWRD, ODEQ, Oregon Department of Forestry, and Oregon Division of State Lands; and county and city issues with the Deschutes and Jefferson County Soil and Water Conservation Districts, and Deschutes and Jefferson counties. On occasion, ODFW is involved with violations of state regulations and provides input where losses or mitigation of fish populations or their habitat is concerned.

Fish passage

ODFW is currently working with the owner of a small hydroelectric development on Link Creek to restore fish passage at that location.

Biological monitoring

Complete population abundance and distribution studies have never been conducted throughout the entire 28 miles of river. Two studies by ODFW of the Metolius River rainbow have been conducted since 1980.

Redband trout redd counts are conducted annually by ODFW on five sections of the Metolius River and in Lake and Abbot creeks.

From 1981 to 1985, ODFW conducted a study entitled Metolius River Wild Trout Investigations (Fies and Robart 1988). This study describes population dynamics of the wild trout population in the upper river above Camp Sherman, describes trout habitat and quality, maps and describes instream cover above the Camp Sherman bridge, and generates a biomass estimate in an area of typical habitat. No significant population or distribution studies have been done in the lower river.

Since 1991, studies have been undertaken in the Metolius subbasin including lower Lake Creek to investigate life history of wild rainbow trout and potential interactions between hatchery and wild rainbow trout. These studies have been conducted by ODFW Research staff using snorkel counts from the source to Gorge Campground (approximately four miles).

Genetic analysis of wild trout populations above the Camp Sherman Bridge (the upper two miles of the subbasin) was conducted in 1985 (Currens 1987).

Regulatory activities

Angling regulations and management strategies have been designed to protect bull trout in the Metolius River. Angling in the Metolius River is restricted to catch and release of all fish using artificial flies and lures or fly angling only with barbless hooks, depending on location on the river. All tributaries to the Metolius River, except Lake Creek, are closed to all angling. Retention of two brown or brook trout is allowed per day in Lake Creek. A permit from the Confederated Tribes of the Warm Springs Reservation of Oregon is required to fish in the Metolius Arm of Lake Billy Chinook. Retention of one bull trout per day is allowed in the Metolius Arm.

Noxious weed control

Control of noxious weeds, such as Scotch thistle, yellow star thistle, goatshead puncture vine, hoary cress, and the knapweeds is an ongoing project in the subbasin.

Oregon Department of Forestry

Oregon Department of Forestry (ODF) enforces the Oregon Forest Practices Act (OFPA) on all forest lands not federally owned. The OFPA contains guidelines to protect fish bearing streams during logging and other forest management activities. These guidelines include stream buffer zones and riparian management areas.

ODF also provides technical assistance to non-industrial forest land owners concerning insects, diseases, harvest techniques and reforestation. ODF works with forest land owners to develop timber management plans and administers federal cost-share programs to encourage good forest management practices.

Oregon Department of Environmental Quality

The Clean Water Act requires each state to set Total Maximum Daily Load allocations (TMDL) for each water body on the 303(d) list. TMDLs are an analytical process for describing the maximum amount of pollutants from all sources that may enter a specific waterbody without violating water quality standards. Collection of water quality data is a component of the development of TMDLs. Oregon Department of Environmental Quality (DEQ) data collection efforts concentrate on collecting additional data for parameters already included on the 303(d) list. Monitoring has begun in the Metolius River subbasin and has been scheduled for TMDL development in 2002.

County Soil and Water Conservation Districts

County Soil and Water Conservation District (SWCD) works with farmers and ranchers to develop conservation plans and administers grants to encourage basic conservation work on private lands in the lower Deschutes River subbasin. Farmers in the Metolius River subbasin are served by the Deschutes County SWCD.

Oregon Water Trust

Oregon's Instream Water Rights Law allows water right holders to donate, lease or sell some or all of their water right for transfer to instream use. Oregon Water Trust (OWT), a private, non-profit group, negotiates voluntary donations, leases or permanent purchases of out-of-stream water rights to convert to instream water rights in those streams where acquisition will provide the greatest potential benefits for fish and water quality. These water rights are held in trust for the people of Oregon by the Oregon Water Resources Department.

Oregon Wildlife Coalition

Although no site-specific wildlife mitigation projects have been funded by BPA in the Metolius River subbasin, the Oregon Wildlife Coalition is implementing a programmatic habitat acquisition project that may result in the implementation of mitigation projects in the subbasin. The goals of this project, "*Securing Wildlife Mitigation Sites – Oregon"* (Project No. 199705900) are to:

- Fund project coordination activities to identify, plan, propose, and implement mitigation projects within the Columbia Basin, including the Metolius River subbasin.
- Prioritize potential mitigation projects.

- Permanently protect priority habitats through fee-title acquisition, perpetual conservation easement, perpetual or long-term lease, and/or acquisition of instream water rights.
- Enhance acquired, eased, or leased habitats through alteration of land management practices, active restoration of habitats, control of noxious weeds and other non-native vegetation, control of public access, etc. to provide benefits to target/indicator fish and wildlife species.
- Develop and implement a monitoring and evaluation plan with both HEP-based and non-HEP based monitoring criteria.

Existing and Past Efforts - Crooked River

U.S. Forest Service

Steps have been taken in recent years on federal lands to reverse the impacts of timber harvest on fish habitat. Implementation of interim stream side harvest buffer zones of 150 to 300 feet on Ochoco National Forest streams will assist in recovery of streamside vegetative potential as future timber sales are designed and implemented (USDA 1995). Adequate buffers will provide shade, stream bank stability, and future large woody debris.

Confederated Tribes of the Warm Springs Reservation of Oregon

On ceded lands in the Deschutes River subbasin, the Confederated Tribes of the Warm Springs Reservation of Oregon provides technical, management, and policy recommendations and comment to public and private land owners, water users, and resource managers. These activities include comment on actions of the Bureau of Land Management, US Bureau of Reclamation, US Fish and Wildlife Service, National Marine Fisheries Service, Northwest Power Planning Council, Portland General Electric, State of Oregon, county soil and water conservation districts, watershed councils, irrigation districts, environmental organizations, various county governments, and many others.

Oregon Department of Fish and Wildlife

ODFW has worked with public agencies and private landowners to improve existing practices through planning processes and direct habitat improvement projects in the Crooked River subbasin. Comments are made on federal land use issues through the National Environmental Policy Act process with the USFS, BLM, and Bureau of Reclamation (USBR); and on fish, water, riparian, and wetland issues with state agencies such as OWRD, ODEQ, Oregon Department of Forestry, and Oregon Division of State Lands; and county and city issues with the Crook County Soil and Water Conservation District, Crook County and city of Prineville Planning Departments. In addition, ODFW coordinates with the Ochoco and North Unit irrigation districts on water withdrawal issues and management of irrigation reservoirs including Prineville, Ochoco, and Haystack reservoirs. On occasion, ODFW is involved with violations of state regulations and provides input where losses or mitigation of fish populations or their habitat is concerned.

Riparian fencing

Changes in livestock grazing practices have the greatest potential to affect improvement in riparian areas and fish habitat in the Crooked River subbasin. ODFW provides comments in the scoping process, development of alternatives, and draft environmental assessments on livestock grazing allotment management plans on public lands. ODFW has received

grants from the Restoration and Enhancement program, Oregon Watershed Enhancement Board, and the National Wildlife Heritage Foundation to cost share fencing projects to improve riparian areas and fish habitat on both private and public lands. ODFW has cost shared fencing projects with 23 private landowners on approximately 34 miles of streams, and numerous projects with the Big Summit and Paulina Ranger Districts of the Ochoco National Forest.

Fish passage

ODFW is working with the Ochoco National Forest to identify and prioritize passage barriers. Inadequate road culverts on the Ochoco National Forest with velocity or height barriers, or that are undersized, are being replaced with bridges or open arch culverts where possible, and reconstructed to pass 50 year flood events. ODFW is also updating, identifying, and prioritizing existing or potential fish passage barriers in the subbasin such as private irrigation impoundments and concrete or wooden irrigation diversions.

Diversion screening

An active program is underway to screen diversions to prevent fish from being stranded and dying in canals. Screening has been completed at 15 diversions in the subbasin. Progress is ongoing to cost share and install additional screens on private lands while funds are available through tax credits, fishing license surcharge, OWEB, USFWS, USBR, and landowner cost-share.

Instream water rights

State legislation passed in 1989 mandated the development of instream water rights to provide for aquatic life, habitat and recreation, for present and future generations. Instream water right applications were filed with the OWRD in 1990 for 35 reaches on 28 streams in the Crooked River subbasin and Willow Creek. These flow recommendations were developed using the Oregon Method from flow data collected in the late 1960's and early 1970's. Instream water rights could only be applied for where there was existing flow data on record from a recognized methodology. Some applications in the Crooked River subbasin are still unresolved, but instream water rights have been adopted for most stream reaches and tributaries of the Crooked River subbasin.

Instream habitat structures

ODFW has worked with numerous landowners in the subbasin to place boulder and log instream structure in McKay, Mill, Allen, Ochoco and Willow creeks to increase habitat diversity and provide cover and rearing habitat.

ODFW has also worked with numerous cooperators on enhancement of artificial habitats where native fish populations have been replaced with warmwater and other cold water game species, and hatchery rainbow trout. Projects have included placement of large woody material, and boulders and/or artificial trees to improve juvenile fish production and rearing habitat in Lake Billy Chinook, Prineville Reservoir, Reynolds Pond, and Haystack Reservoir. Cooperators have included the USFS, Portland General Electric Company (PGE), Crook County Parks and Recreation, Ochoco Anglers Association, Central Oregon Bass Club, and USBR.

Several enhancement projects have focused on improving angler access for shoreline or boating use. Barrier free angling sites have been installed at Walton Lake, Haystack Reservoir, the Crooked River below Bowman Dam, and Ochoco Creek to

facilitate access for anglers in wheelchairs. Boat ramps have been extended at Prineville Reservoir, Lake Billy Chinook, and an Oregon Department of Fish and Wildlife (ODFW) Restoration and Enhancement project is in progress with the USFS to extend the boat ramp at Antelope Flat Reservoir. Ramps have been extended to provide continued boat access despite drawdown from irrigation, or in the case of Billy Chinook, low winter storage levels.

The quality of bass habitat in Prineville Reservoir is declining. Siltation is covering rock areas, stumps and other previously used habitat. Organic structure such as stumps are rotting and decreasing in quantity and quality. Extensive habitat work is needed to maintain or improve structure, primarily for largemouth bass. Habitat projects were completed in 1984 and 1986 by Ochoco Bassmasters and ODFW using tire structures near the mouth of Sanford Creek to create artificial reefs. In 1977, 1987, and 1992, the Ochoco Bassmasters, USBR, and ODFW installed artificial bass reefs using junipers and Christmas trees near known spawning areas to provide improved cover and rearing areas for adults and juveniles. Willow shoots were also planted in 1983 and 1985 along much of the shoreline.

Forage and cover crops

Seed and fertilizer is provided to landowners to provide alternative forage and cover areas and improve rangeland for deer, elk and upland game birds in the subbasin.

Guzzlers

Guzzlers provide water for wildlife in arid portions of the subbasin. These fiberglass catch basins have a corrugated metal roof that funnels rain and/or snow into the basin to provide year-round water for wildlife ranging from birds to big game animals. Approximately 110 guzzlers are currently maintained by ODFW in the Crooked River subbasin, mostly on public lands.

Noxious weed control

Control of noxious weeds, such as Scotch thistle, yellow star thistle, goatshead puncture vine, hoary cress, and the knapweeds is an ongoing project in the subbasin. In addition, ODFW assists landowners in juniper management.

Crook County Soil and Water Conservation District

The Crook County Soil and Water Conservation District (SWCD) works with farmers and ranchers to develop conservation plans and administers grants to encourage basic conservation work on private lands in the Crooked River subbasin. Conservation practices include no-till fallow, strip cropping, sediment basins, terraces, grass filter strips and waterways, residue management, and riparian reserves.

Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) is the federal agency within the U.S. Department of Agriculture (USDA) which provides financial, technical and educational assistance to implement conservation practices on privately owned land. Using this help, farmers and ranchers in the Crooked River subbasin apply practices that reduce soil erosion, improve water quality and enhance forest land, grazing land, and wildlife habitat. USDA funded cost-share programs are funded through the Commodity Credit Corporation (CCC) and administered by the Farm Service Agency (FSA), NRCS provides technical support for these programs. All USDA incentive and cost-share programs require

landowner participants to develop a conservation plan for the practice, inspection of the project site to determine that the practice has been installed as planned, and an annual status review. If a landowner installs a practice and does not maintain or continue that practice as outlined in the conservation plan, he is required to pay back the cost-share monies and pay an additional penalty.

Oregon Department of Forestry

Oregon Department of Forestry (ODF) enforces the Oregon Forest Practices Act (OFPA) on all forest lands not federally owned. The OFPA contains guidelines to protect fish bearing streams during logging and other forest management activities. These guidelines include stream buffer zones and riparian management areas.

ODF also provides technical assistance to non-industrial forest land owners concerning insects, diseases, harvest techniques and reforestation. ODF works with forest land owners to develop timber management plans and administers federal cost-share programs to encourage good forest management practices.

Oregon Department of Environmental Quality

The Clean Water Act requires each state to set Total Maximum Daily Load allocations (TMDL) for each water body on the 303(d) list. TMDLs are an analytical process for describing the maximum amount of pollutants from all sources that may enter a specific waterbody without violating water quality standards. Collection of water quality data is a component of the development of TMDLs. Oregon Department of Environmental Quality (DEQ) data collection efforts concentrate on collecting additional data for parameters already included on the 303(d) list. The Crooked River subbasin has not been scheduled for TMDL development, it will likely occur no sooner than 2004.

Crooked River Ecosystem Education Council

The Crooked River Ecosystem Education Council (CREEC) was founded in 1992 to develop watershed level restoration improvement projects and is a consortium of federal and state partners and others, including ODFW, USFS, BLM, Ochoco Chapter of Trout Unlimited, Trout Unlimited Bring Back the Natives, Oregon State University Extension Service, Crook County Soil and Water Conservation District, Jefferson County Soil and Water Conservation District, Cove Palisades State Park, the National Fish and Wildlife Foundation, and private landowners. Willow plantings, riparian pasture and exclosure fences, river cleanups, and instream large woody debris projects have occurred on the North and South forks of the Crooked River, mainstem Crooked River, and many tributaries. Watershed demonstration projects are developed and used by CREEC members for education of Crook County School District students. Recently, the CREEC program has expanded to include the Madras and Culver School districts, where students will be able to learn about and work on projects in Willow Creek, and on Haystack, Billy Chinook, and Simtustus reservoirs. Numerous opportunities exist throughout the Crooked River and Willow Creek subbasins to continue these habitat and riparian restoration projects.

Crooked River Watershed Council

Noxious weed control

The Crooked River Watershed Council piloted a noxious weed control cost-share program in the subbasin in the 2000 field season. The council provided assistance with chemical costs and landowners were responsible for labor and equipment. Funding was provided by the Oregon Department of Agriculture (ODA). Additional grant funding from ODA will continue this program for 2001.

Library Outdoor Learning Center

A collaborative effort by private citizens and representatives of local agencies, government, and organizations to provide public access to riverfront property in the heart of Prineville, the Library Outdoor Learning Center will be used as an applied learning site for students from the Crook County School District and Central Oregon Work Education Program. On-the-ground projects will emphasize the restoration and enhancement of native vegetation, fish and wildlife habitat, and riparian and in-stream river conditions. Projects currently underway include construction of an interpretive trail, noxious weed control, and tree planting.

Riparian planting

The watershed council has facilitated numerous riparian/floodplain tree plantings. Trees are provided by a variety of sources, including SWCD, USFS, BLM, National Tree Trust, Captain Planet Foundation, SOLV, and local nurseries. Labor is provided by landowners, volunteers, Crook County middle and high school students, 4-H members, and the COIC work education program. Several thousand trees and shrubs have been planted in areas along Ochoco, Mill and McKay creeks and the Crooked River.

Fish passage

The watershed council partnered with the Bureau of Reclamation (USBR) and the Oregon Water Resources Department (OWRD) to install a fish passage structure on upper Ochoco Creek. With a grant from USBR, OWRD installed a gauging station, repaired seepage problems at an old diversion and a dam site, and constructed weir boxes with fish screens around the two diversion points. The watershed council funded the installation of a fish ladder with the capacity to function year round.

Stream flow and temperature monitoring

New gauging stations and water temperature monitor stations have been established on Ochoco and Mill creeks.

Riparian protection and enhancement

The watershed council is working with nine landowners in the subbasin to protect and enhance riparian areas with fencing, planting of trees and shrubs, and improved livestock management. The riparian protection and enhancement project is supported by a grant from the Oregon Watershed Enhancement Board, ODFW provides technical assistance and materials.

Instream habitat enhancement

The watershed council is currently working cooperatively with ODFW to implement channel, instream and riparian habitat improvement projects at several sites in the Crooked River subbasin.

Wetlands project

The Created Wetlands Project is creating a 60 acre artificial wetland on land adjacent to the Crooked River. The project will be designed to capture and treat a portion of Lytle Creek seasonal flow, which is known to receive agricultural inputs. Partners in the project include USBR, Deschutes Basin Land Trust, Deschutes Resources Conservancy, Ochoco Irrigation District, Crooked River Ecosystem Education Council, Oregon Department of Fish and Wildlife, Oregon Department of Environmental Quality, and the private landowner.

Oregon Wildlife Coalition

Although no site-specific wildlife mitigation projects have been funded by BPA in the Crooked River subbasin, the Oregon Wildlife Coalition is implementing a programmatic mitigation project that may result in the implementation of mitigation projects within the subbasin. The goals of this project, Securing Wildlife Mitigation Sites – Oregon (Project No. 9705900), are to:

- Fund project coordination activities to identify, plan, propose, and implement wildlife mitigation projects within the Lower Mid-Columbia subregion, including the Crooked River subbasin.
- Prioritize potential mitigation projects within the Crooked River subbasin.
- Acquire or lease lands with priority habitats within the Crooked River subbasin to permanently protect wildlife habitats.
- Enhance acquired or leased lands through alteration of land management practices, active restoration of habitats, control of noxious weeds and other non-native vegetation, control of public access, etc. to provide benefits to target/indicator wildlife species within the Crooked River subbasin.
- Develop and implement a monitoring and evaluation plan with both HEP based and non-HEP based monitoring criteria within the Crooked River subbasin.

Existing and Past Efforts - Upper Deschutes River

U.S. Forest Service

The U.S. Forest Service (USFS) has implemented instream habitat restoration projects at many sites in the upper Deschutes River subbasin. This work has included installation of instream rock and log habitat structures, placement of spawning gravel, and planting of riparian vegetation. In addition, the USFS has closed roads and removed culverts to improve fish passage.

Fish habitat enhancement

Rock pool construction in the Cultus River, an important spawning tributary for Crane Prairie Reservoir, has increased rearing and spawning habitat. A road was closed and culverts removed to facilitate fish passage to spawning areas in the Cultus River. Spawning gravel has been added to Quinn River, another tributary to Crane Prairie Reservoir, to improve spawning habitat. USFS and ODFW have added trees to 1.5 river miles of the Deschutes River above Crane Prairie Reservoir to improve hiding cover, especially for spawning rainbow trout. Approximately 1700 cubic yards of spawning gravel and over 100 trees have been added to the Deschutes River between Crane Prairie Reservoir and Wickiup Reservoir.

The Browns Creek gravel placement project, a cooperative effort with ODFW and local angling groups, added 50 cubic yards of spawning gravel and some small structures for instream cover to this important spawning tributary to Wickiup Reservoir. In addition, USFS deepened a side channel around a small waterfall on Browns Creek to allow brown trout easier access to the upper portions of the creek. In the upper Browns Creek watershed, an abandoned gravel quarry has been converted to a wetland by construction of a pond, addition of topsoil and planting of vegetation.

Partnering primarily with ODFW, USFS has placed over 600 trees and 50 stumps in Wickiup Reservoir to increase fish hiding cover and increase invertebrate habitat in the reservoir. With the assistance of local angling groups, willow trees have been planted around the reservoir. Between Wickiup Reservoir and Pringle Falls, nearly 700 trees have been added to improve fish hiding cover and reduce bank erosion. The two-mile reach below Pringle Falls has received over 200 trees, in addition to willow plantings, to restore fish hiding cover and reduce bank erosion. In addition, instream trees have been anchored to avoid washout at high flows.

Beginning in 1959, hundreds of boulders and trees have been added to Fall River to form pools and increase fish hiding cover. Both ODFW and USFS, as well as private landowners have been involved in these projects.

With the assistance of local angling groups, USFS and ODFW have placed whole trees in Spring River, an important spawning tributary to the Deschutes River, to increase rearing habitat and provide cover for spawning fish. Fish habitat restoration in the Sunriver area has restored approximately 300 trees to the Deschutes River.

A partnership between USFS, ODFW, Trout Unlimited, Central Oregon Flyfishers, Deschutes County, and FishAmerica has added nearly 500 pieces of large woody debris to 2.7 miles of Tumalo Creek that was impacted by the 1979 Bridge Creek Fire. Willow, cottonwood, and spruce trees have also been planted in the riparian area along the creek.

Funded by a grant from OWEB in 2000, the USFS planted over 3000 willow and pine trees at various sites on the Deschutes River below Wickiup Reservoir, lower Browns Creek, and Paulina Creek.

The Big Eddy Riverbank Restoration Project, a partnership between USFS, ODFW, Oregon State Parks, Division of State Lands and local rafting outfitters, rehabilitated and revegetated a popular raft and kayak ramp on the Deschutes River near Bend.

A bioengineering river bank restoration project on the Deschutes River just below Wickiup Dam is planned for 2001. Also planned is additional boulder and tree placement for stream bank erosion control in Tumalo Creek within the Bridge Creek Burn area.

In the Little Deschutes River watershed, large woody debris has been placed in Trapper and Odell creeks. Big Marsh Creek has been rehabilitated by closing drainage ditches along the edges of the marsh and reconnecting the stream channel. Big Marsh Creek is also scheduled for extensive willow plantings in 2001.

Stream surveys

Stream surveys have been conducted on all portions of the Little Deschutes River that are on federal land. Crescent, Big Marsh, Odell, Trapper, Crystal, and Maklaks creeks have also been surveyed.

Monitoring

Stream temperature monitoring is conducted by USFS throughout the upper Deschutes River subbasin. Fine sediment, water chemistry, and freeze core sampling has been done in many of the streams. Crescent Creek and the Little Deschutes River are scheduled for a FLIR flight for water temperature in the summer of 2001.

U.S. Bureau of Reclamation

The U.S. Bureau of Reclamation (USBR) has focused on water conservation activities in the upper Deschutes River subbasin. The Upper Deschutes Water Conservation Study evaluated various water conservation opportunities within eight irrigation districts, and the Canal Lining Demonstration Project is evaluating the effectiveness and durability of various geosynthetic fabric and other lining technologies. Water conservation projects that have resulted in conserved water being dedicated to instream flows include piping of a canal in the North Unit Irrigation District, and piping of the Tumalo Feed Canal and Bend Feed Canal in the Tumalo Irrigation District. The USBR Bend Field Office works with various irrigation districts on canal lining projects and installing telemetry and measuring devices.

U.S. Geological Survey

The U.S. Geological Survey (USGS) is currently conducting a two-phase study to provide a quantitative understanding of the ground-water hydrology in the middle Deschutes River subbasin. This study will provide information to resource managers, planners, and the general public and will include: a compilation of basic ground-water data, a description of the geologic framework of the regional flow system, a quantitative description of the flow system including estimation of the hydrologic budget, an evaluation of ground water/surface water relationships, an analysis of the effects of present canal leakage, and an estimate of the effects of present and future development on ground-water availability and streamflow.

Confederated Tribes of the Warm Springs Reservation of Oregon

On ceded lands in the Deschutes River subbasin, the Confederated Tribes of the Warm Springs Reservation of Oregon provides technical, management, and policy recommendations and comment to public and private land owners, water users, and resource managers. These activities include comment on actions of the Bureau of Land Management, US Bureau of Reclamation, US Fish and Wildlife Service, National Marine Fisheries Service, Northwest Power Planning Council, Portland General Electric, State of Oregon, county soil and water conservation districts, watershed councils, irrigation districts, environmental organizations, various county governments, and many others.

Oregon Department of Fish and Wildlife

The ODFW has worked with public agencies and private landowners to improve existing practices through planning processes and direct habitat improvement projects. Comments are made on federal land use issues through the National Environmental Policy Act process with the USFS, BLM, and Bureau of Reclamation; and on fish, water, riparian, and wetland issues with state agencies such as WRD, DEQ, DOF, DSL, and State Parks; and county and city land use issues with the Deschutes and Klamath County planning departments, city of Bend Planning Department, and Soil and Water Conservation Districts.

In addition, the ODFW coordinates with five Central Oregon Irrigation Districts on water withdrawal from irrigation reservoirs including Crescent Lake, Crane Prairie and Wickiup reservoirs. Occasionally, the ODFW is involved with violations of state regulations and provides inputs where losses or mitigation of fish populations or their habitat is concerned.

Diversion screening

An active program is underway to adequately screen irrigation diversions to prevent fish loss in canal systems. Most mainstem Deschutes River diversions are large in size (120-1,325 cfs), so the cost of screening is very high and technically challenging. Several of the larger diversions were fitted with louver arrays in the 1960's, but these have proven to be ineffective in diverting sufficient numbers of fish back to the river.

A major screen was installed in 1995 on the Central Oregon Irrigation District Canal. In addition, negotiations with Tumalo Irrigation District have been completed to screen all of their diversions in the Deschutes River and Tumalo Creek. A screen is currently being installed on the Arnold Irrigation Canal and will be completed for the 2001 irrigation season. A screen was installed on Indian Ford Creek (Squaw Creek tributary) in 1996, cost shared by the ODFW with a private landowner.

Instream water rights

State legislation passed in 1987 mandated the development of instream water rights to provide for aquatic life, habitat and recreation, for present and future generations. Instream water rights applications were filed with the OWRD in 1990 and 1993 for 27 reaches on 22 streams within the subbasin. These flow recommendations were developed using the Oregon Method from flow data collected in the late 1960's and early 1970's. Instream water rights could only be applied for where there was existing flow data on record from a recognized methodology. Instream water rights have been adopted for most stream reaches and tributaries of the upper Deschutes River subbasin.

Fish habitat enhancement

ODFW has developed partnerships with other agencies, organizations, and private landowners to enhance fish habitat. In recent years, the primary vehicle to accomplish fish habitat restoration in the subbasin has been the Central Oregon Irrigation District Mitigation and Enhancement Program.

In 1987, the Central Oregon Irrigation District (COID) constructed a hydroelectric facility on the Deschutes River near RM 171, upstream from Bend. The facility (known as the Central Oregon Siphon Power Project) was developed in conjunction with COID's existing siphon and canal diversion system. The project was licensed by the Federal Energy Regulatory Commission and further authorized by a Deschutes County Conditional Use Permit.

A condition of both the FERC license and conditional use permit is that COID will provide ODFW with funds to develop and implement a fish and wildlife habitat mitigation and enhancement program for the upper Deschutes River subbasin. COID and the Department entered into an agreement which pays ODFW initial startup funding and continued funding for 32 years.

Since the first project in 1989, the Department has matched the COID funds with other contributors to complete 18 major fish habitat improvement projects in the subbasin.

Contributors have included ODFW Restoration and Enhancement Program, Deschutes National Forest, Bend Metro Parks and Recreation, Fish America, Federation of Fly Fishers, Trout Unlimited, Oregon State Parks, Central Oregon Flyfishers, Sunriver Anglers, STEP, and Coors Pure Water 2000.

Projects have involved improvements such as; adding spawning gravel, placement of whole trees and root wads for trout cover in streams and reservoirs, placing boulders to create pools and anchor wood, and planting of willows in reservoir drawdown zones. In addition to the projects; stream surveys have been completed on 128 miles of streams and rivers in the subbasin, ten stream sites are being monitored for water temperatures, and all projects are being monitored for structural integrity and biological benefits.

On the Little Deschutes River, an old fish ladder at Gilchrist Mill Pond dam was rebuilt in 1993 by the mill owner, Crown Pacific, to reestablish passage for upstream migrant trout.

Biological monitoring

The first comprehensive physical and biological surveys of standing waters in the subbasin were conducted in 1940 by Oregon State Game Commission biologists.

ODFW, through its Restoration and Enhancement Program, conducted a physical stream survey of the river section from Steelhead Falls upstream to Bend in 1993. A habitat survey of Tumalo Creek was conducted by ODFW in 1992 from the mouth to Skyliner Bridge (RM 13.7). ODFW also surveyed lower Squaw Creek in 1995.

Guzzlers

Guzzlers provide water for wildlife in arid portions of the subbasin. These fiberglass catch basins have a corrugated metal roof that funnels rain and/or snow into the basin to provide year-round water for wildlife ranging from birds to big game animals. Approximately 255 guzzlers are currently maintained by ODFW in the upper Deschutes River subbasin, mostly on the Fort Rock Ranger District of the Deschutes National Forest.

Noxious weed control

Control of noxious weeds, such as Scotch thistle, yellow star thistle, goatshead puncture vine, hoary cress, and the knapweeds is an ongoing project in the subbasin.

Oregon Department of Forestry

Oregon Department of Forestry (ODF) enforces the Oregon Forest Practices Act (OFPA) on all forest lands not federally owned. The OFPA contains guidelines to protect fish bearing streams during logging and other forest management activities. These guidelines include stream buffer zones and riparian management areas.

ODF also provides technical assistance to non-industrial forest land owners concerning insects, diseases, harvest techniques and reforestation. ODF works with forest land owners to develop timber management plans and administers federal cost-share programs to encourage good forest management practices.

Oregon Department of Environmental Quality

The Clean Water Act requires each state to set Total Maximum Daily Load allocations (TMDL) for each water body on the 303(d) list. TMDLs are an analytical process for describing the maximum amount of pollutants from all sources that may enter a specific waterbody without violating water quality standards. Collection of water quality data is a component of the development of TMDLs. Oregon Department of Environmental Quality

(DEQ) data collection efforts concentrate on collecting additional data for parameters already included on the 303(d) list. Monitoring has begun in the upper Deschutes River subbasin and has been scheduled for TMDL development in 2002.

Deschutes County

There is a Regional Problem Solving process in place for south Deschutes County (LaPine area) to address septic problems associated with 13,000 residential plats from the t 1960's and 1970's. At least 1,800 of these lots have shallow water tables and building on them would create a groundwater pollution problem. Deschutes County has acquired a piece of BLM land to provide alternate buildable parcels for those private landowners with undeveloped plats with high water tables to trade for their unbuildable lots.

Oregon Water Trust

Oregon's Instream Water Rights Law allows water right holders to donate, lease or sell some or all of their water right for transfer to instream use. Oregon Water Trust (OWT), a private, non-profit group, negotiates voluntary donations, leases or permanent purchases of out-of-stream water rights to convert to instream water rights in those streams where acquisition will provide the greatest potential benefits for fish and water quality. Negotiations led by OWT has permanently converted 1.81 cfs and leased another 1.3 cfs instream on Squaw Creek. The rights are held in trust for the people of Oregon by the Oregon Water Resources Department.

Deschutes Basin Land Trust

The Deschutes Basin Land Trust is a locally based, non-profit organization which conserves private land and natural resources for future generations through acquisition of both fee interest and conservation easements. Funding comes from a combination of local members, foundation grants, corporate support and planned giving. In the five years since its founding, the Land Trust has conserved roughly 4,256 acres through five projects, four in the Squaw Creek watershed, one in the Little Deschutes watershed.

Indian Ford Meadow Preserve

The Land Trust purchased a 63 acre meadow bisected by Indian Ford Creek, tributary to Squaw Creek. This meadow is managed for fish and wildlife habitat and scenic views. Willows and aspen are increasing as the meadow recovers from past channelization and grazing. Thirteen acres of water rights (0.3 cfs) have been returned to instream flows through a partnership with the Oregon Water Trust.

Trout Creek Conservation Area

The Land Trust acquired a conservation easement on 160 acres of forested land west of Sisters. The easement is designed to protect a quarter mile reach of Trout Creek, a subsurface tributary to Indian Ford Creek. The primary purpose is to protect critical habitat for 10% of the known, world-wide population of Peck's penstemon, a rare wild flower. The Land Trust is working with the Sisters School District to develop a management plan and curricula to engage local students and utilize the site as an outdoor research area.

Alder Springs

The Land Trust, in partnership with The Trust for Public Lands, has acquired and transferred into public ownership an 840 acre in-holding within the Crooked River

National Grasslands and Metolius deer winter range. This acquisition prevented significant fragmentation of the winter range and protects the only bull trout habitat on Squaw Creek.

Camp Polk Meadow Preserve

The Land Trust, in partnership with Portland General Electric, acquired 148 acres of wetland/wet meadow habitat on Squaw Creek. This reach of Squaw Creek is believed to have contained more than a third of the historic spawning habitat for historic summer steelhead runs. The restoration focus is on increasing riparian habitat and enhancement of water quality and quantity for the eventual reintroduction of steelhead. Fifty acres of senior water rights (1 cfs) were returned to Squaw Creek, and pushup dams eliminated, through a partnership with the Oregon Water Trust and the Deschutes Resources Conservancy.

Hopkins-Young Special Management Area

The Land Trust acquired a conservation easement which protects 3,045 acres of old-growth forest on seven parcels east of Crescent in northern Klamath County. They are currently working with Crown Pacific to conserve sensitive wildlife habitat and old-growth ponderosa pine through the donated conservation easement. Management of the area will focus on protecting and enhancing white headed woodpecker and northern goshawk.

Deschutes Resources Conservancy

The Deschutes Resources Conservancy (DRC) is a non-profit organization whose goal is to improve water quantity and quality in the Deschutes River subbasin. The DRC supports projects in the subbasin, from tributary headwaters to the Columbia River, that result in sustainable economic and environmental benefits. Transactions include conservation easements, water rights trades or purchases, and irrigation system improvements.

Streamflow restoration projects

The DRC has participated in seven water conservation projects in the upper Deschutes River subbasin. When complete, these projects will return over 15 cfs of senior water rights to the Deschutes River. To date, the DRC has worked with all six of the major irrigation districts of Central Oregon to reduce water seepage from open canals. The DRC has also supported the Oregon Water Trust's purchase of water rights from willing sellers on Squaw Creek.

Annual water leasing

The DRC works with irrigation districts to sponsor the Annual Water Leasing Program, which allows irrigators to protect their water rights and improve instream flows. This voluntary program loans water to instream flow, allowing irrigators to preserve their water right by receiving a beneficial use from the Oregon Water Resources Department for temporarily signing their water over to instream flow purposes. This program has resulted in five cfs of protected instream flows annually from 1998 through 2000.

Water quality projects

The DRC is working with various subbasin stakeholders to improve water quality throughout the upper Deschutes River subbasin. Projects include bank stabilization efforts below Wickiup Dam and Pringle Falls on the mainstem Deschutes River, road removal and reseeding near Alder Springs on Squaw Creek, as well as restoration of wetland and riparian habitat on Squaw Creek.

Upper Deschutes River Watershed Council

Water quality monitoring

The Upper Deschutes Watershed Council has just completed a two-year instream water quality and fish monitoring effort in Squaw Creek. Funded by the Oregon Watershed Enhancement Board (OWEB) and Deschutes National Forest, Forward Looking Infra Red (FLIR) data collection methods were utilized to provide a profile of stream temperatures throughout Squaw Creek.

Partnering with the BLM, USFS, OWRD, ODEQ, ODFW, CTWS, PGE, and City of Bend, the watershed council has worked closely with the U.S. Geological Survey to define water quality monitoring goals and objectives for the upper Deschutes River. Project partners are working to establish an ongoing monitoring team responsible for implementing the Regional Coordinated Water Quality Monitoring Plan and preparing for TMDL planning in 2001/02. The OWEB and U.S. Geological Survey provided funding for the project.

The Upper Deschutes Watershed Council has also been a partner on instream water right projects and continues to negotiate with landowners on additional projects. The council negotiated with the landowner on the Camp Polk Meadow Preserve prior to acquisition by the Oregon Land Trust.

Stream bank stabilization

The watershed council is assisting three private landowners to develop and implement a bank stabilization project on the Deschutes River near Sunriver. The project is located on a reach of river where banks have been steeply eroded by fluctuating river flows, boat wake, and past stabilization actions. The project will restore 285 feet of bank through the removal of improper fill materials, bank resloping, tree revetments at the toe of slop, and vegetation plantings using bioengineering techniques. The project is in the planning and fund raising phase.

Noxious weed control

The watershed council works to raise awareness and educate upper Deschutes subbasin residents on the ecological and economic impacts of alien plants on the desert landscape. Working in partnership with the Deschutes National Forest and Deschutes SWCD, funding has been secured to conduct noxious weed control activities. Completed activities include weed pulls, slide show presentations, weed tours, newspaper inserts, print and broadcast media contacts, video airing on a local cable station, and workshops. Funding has been provided by OWEB, USFS, Sunriver Owners Association, National Fish and Wildlife Foundation, and Deschutes County.

Present Subbasin Management

Existing Management

Federal, state, tribal, county and city agencies own or manage lands in the Deschutes River subbasin. Most existing plans for each managing agency contain guidelines for protection of streams, riparian areas, fish and other aquatic life, and wildlife. There are additional plans that address protection of streams and stream corridors in the Deschutes River subbasin.

Federal Government

U.S. Forest Service

Management of US Forest Service lands in the Deschutes River subbasin is guided by USFS policies and federal legislation. Management guidelines for the subbasin are contained in Mt. Hood, Deschutes and Ochoco National Forest Land and Resource Management Plans and *Attachment A: Standards and Guidelines for Management of Habitat for Late Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl* of the 1994 *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (*Northwest Forest Management Plan*). These plans provide standards and guidelines for management of the national forest lands in the subbasin. Included in the *Northwest Forest Management Plan* is the Aquatic Conservation Strategy (ACS) which was developed to maintain and restore the ecological health of watersheds and aquatic ecosystems on public lands. The four components of the ACS, riparian reserves, key watersheds, watershed analysis, and watershed restoration are designed to operate together to maintain and restore the productivity and resiliency of riparian and aquatic ecosystems. The ACS provides protection of salmon and steelhead habitat on federal lands by striving to maintain and restore ecosystem health at watershed and landscape scales to protect habitat for fish and other riparian-dependent species and resources, and restore currently degraded habitats. This approach seeks to prevent further degradation and restore habitat over broad landscapes. All proposed and existing projects in the subbasin are designed to meet the intent of the ACS objectives.

Bureau of Land Management

The U.S. Bureau of Land Management (BLM) administers approximately one percent of the Deschutes River subbasin. The forests are managed under guidelines established in the *Northwest Forest Management Plan* (1994) as described for those lands managed by the USFS. Management of BLM lands is also guided by resource management plans specific to portions of the subbasin, including the *Two Rivers Resource Management Plan* (1986), *Lower Deschutes River Management Plan* (1993), *Brothers/LaPine Resource Management Plan*, *Middle Deschutes/Lower Crooked River Wild and Scenic Rivers Management Plan*, and the *Lower Crooked River Chimney Rock Segment Management Plan* (1992).

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) administers the Endangered Species Act as it pertains to resident fish. USFWS reviews and comments on land use activities that affect

fishery resources such as timber harvest, stream alteration, dredging and filling in wetlands and hydroelectric projects.

National Marine Fisheries Service

The National Marine Fisheries Service (NMFS) administers the federal Endangered Species Act (ESA) as it pertains to anadromous fish. NMFS reviews and comments on fill/removal permit applications on streams with anadromous salmonids and on any hydroelectric project proceedings where anadromous fish are involved. Deschutes River wild summer steelhead are included in the Mid-Columbia Ecological Significant Unit (ESU), and were listed as threatened in 1999. Because of their threatened status, any "take" is prohibited under the ESA's 4(d) rule unless permitted by NMFS. Special permits for research and management activities of summer steelhead in the Deschutes River subbasin have been obtained from NMFS under a Section 7 Consultation, Biological Opinion (NMFS 2000).

Federal Energy Regulatory Commission

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

U.S. Bureau of Reclamation

The U.S. Bureau of Reclamation (USBR) assists irrigation districts in preparing and implementing water conservation plans. Project implementation can result in reduced diversions and increased instream flows. USBR is on the Board of Directors for the Deschutes Resources Conservancy (DRC) and receives annual appropriations for implementation of DRC habitat improvement projects.

Natural Resource Conservation Service

The Natural Resource Conservation Service provides technical support to the Soil and Water Conservation Districts (SWCD) and agricultural landowners with distribution of federal cost-share monies associated with reducing soil erosion and increasing agricultural production on privately owned land. The NRCS assists landowners in developing farm conservation plans and provides engineering and technical support for land and water resource development, protection and restoration projects.

U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency is responsible for implementation of the Clean Water Act, including approving Total Maximum Daily Load plans that may be developed in the Deschutes River subbasin.

Deschutes Recovery Unit

The Deschutes Recovery Unit is currently developing a recovery strategy for bull trout in the Deschutes River subbasin for inclusion in the Draft Bull Trout Recovery Plan being compiled by the USFWS. Comprised of fisheries professionals from federal, tribal and state entities, as well as other affected parties, this group focuses efforts on development of a conservation strategy for bull trout in the entire Deschutes River subbasin.

Tribal Government

Confederated Tribes of the Warm Springs Reservation of Oregon

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

Streams running through and bordering the reservation to which the tribes have exclusive fish rights pursuant to Article I of the treaty include the Deschutes, Metolius, and Warm Springs River systems. Streams within the ceded area where the tribes have primary off-reservation rights at usual and accustomed fishing stations include the John Day River, Fifteenmile Creek, and Hood River. Additionally, the tribes claim off-reservation rights at usual and accustomed stations on streams outside of the ceded area, which may be primary, secondary, or co-equal with the treaty rights of other tribes.

The CTWS are co-managers of fish and wildlife resources in the subbasin. On ceded lands in the Deschutes River subbasin, the tribe provides technical, management and policy recommendations and comment to public and private land owners, water users, and resource managers. These activities include comment on actions of the Bureau of Land Management, the Bureau of Reclamation, the United States Forest Service, Natural Resources Conservation Service, United States Fish and Wildlife Service, National Marine Fisheries Service, Northwest Power Planning Council, Portland General Electric, State of Oregon, watershed councils, soil and water conservation districts, irrigation districts, environmental organizations, various county governments, and many others.

State Government

Senate Bill 1010

Under this plan, agricultural water quality issues are identified and addresed through a committee process. Landowners aid in creating individualized farm plans designed to improve water quality throughout the area. Efforts will reduce water pollution from agricultural sources and protect beneficial uses of watersheds.

House Bill 3609

This legislation directs the development of plans for fully seeded, sustainable production of natural anadromous fish runs in Columbia River subbasins above Bonneville Dam, including the Deschutes River subbasin, through consultation among state and tribal entities. Adopted plans will be based on sound science and adaptive management, incorporate monitoring, evaluation, objectives and outcomes benefiting fish and wildlife, and be consistent with State of Oregon efforts to recover salmonid populations under the federal Endangered Species Act.

Oregon Plan

Passed into law in 1997, the *Oregon Plan for Salmon and Watersheds* and the *Steelhead Supplement to the Oregon Plan* (1998) outline a statewide approach to ESA concerns

based on watershed restoration and ecosystem management to protect and improve salmon and steelhead habitat in Oregon. Four key provisions of the Oregon Plan are: 1) inter-agency cooperation and coordination, 2) local participation in Plan development and implementation, 3) monitoring and evaluation, and 4) adaptive management. The Oregon Plan Monitoring Program, successfully implemented in coastal watersheds, provides an approach for rigorous sampling designed to answer key monitoring questions, which will be applied to the Deschutes River subbasin. The Oregon Watershed Enhancement Board (OWEB) facilitates and promotes coordination among state agencies, administers a grant program and provides technical assistance to local watershed councils and others to implement the Oregon Plan through watershed assessments and restoration action plans.

Oregon Department of Fish and Wildlife

The Oregon Department of Fish and Wildlife (ODFW) is responsible for protecting and enhancing Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations. Management of the fish and wildlife and their habitats in the Deschutes River subbasin is guided by ODFW policies, collaborative efforts with the Confederated Tribes of the Warm Springs Reservation of Oregon, and federal and state legislation. Oregon Administrative Rule (OAR) 635 Division 07 – *Fish Management and Hatchery Operation* sets forth policies on general fish management goals, including the *Natural Production Policy* (OAR 635-07-521 to 524), *Wild Fish Management Policy* (OAR 635-07-525 to 538), *Oregon Guidelines for Timing In-Water Work to Protect Fish and Wildlife Resources* (ODFW 1986), *Deschutes River Subbasin Salmon and Steelhead Production Plan* (ODFW & CTWS 1990), and *Lower Deschutes River Subbasin Management Plan* (ODFW 1997b). These plans present systematic approaches to conserving aquatic resources and establishing management priorities within the subbasin. OAR 635 Division 08 – *Department of Wildlife Lands* sets forth management goals for each State Wildlife Area. Policies and plans that pertain to wildlife management in the subbasin include the *Wildlife Habitat Mitigation Policy, Wildlife Integrity Rules, Wildlife Diversity Plan* (ODFW 1993d), *Wildlife Policy,* and management plans for the wildlife areas and many wildlife species in the subbasin. OAR Division 415 – *Fish and Wildlife Habitat Mitigation Policy* establishes mitigation requirements and recommendations, outlines mitigation goals and standards, and provides other mitigation guidelines. *Vision 2006* is a strategic operational plan providing guidance for the ODFW over the next six years.

Oregon State Police

The Oregon State Police (OSP) regularly patrol the Deschutes River subbasin to enforce laws and regulations designed to protect fish and wildlife. OSP coordinates annually with ODFW district staff, through the Cooperative Enforcement Plan, to identify priority fish and wildlife enforcement issues. Annual action plans guide protection efforts for critical species and their habitats, and are implemented through enforcement patrols, public education, and agency coordination.

Oregon Division of State Lands

Oregon Division of State Lands regulates the removal and filling of materials in waterways (ORS 196.800-196.990). Permits are required for projects involving 50 cubic yards or more of material. Applications for permits are reviewed by ODFW, US Army Corps of

Engineers, counties, and landowners, and may be modified or denied based on impacts of the project on fish populations.

Oregon Water Resources Department

The Oregon Water Resources Department (OWRD) regulates water use in the Deschutes River subbasin. Guidelines for appropriation of water (ORS 537) determine the maximum rate and volume of water that can be legally diverted from the streams in the subbasin. OWRD also acts as trustee for instream water rights issued to the state of Oregon and held in trust for the people of the state. Oregon's water law requires that all diverted water be used beneficially and without waste. The OWRD is a partner in the Oregon Plan.

Oregon Department of Forestry

The Oregon Department of Forestry enforces the Oregon Forest Practices Act (OAR 629-Division 600 to 680 and ORS 527) regulating commercial timber production and harvest on state and private lands. The OFPA contains guidelines to protect fish bearing streams during logging and other forest management activities. These guidelines address stream buffers and riparian management areas, as well as road maintenance and construction standards and other topics. The ODF is a partner in the Oregon Plan and uses its guidelines for watershed work and assessments in the Deschutes River subbasin.

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 implementing the 1972 federal Clean Water Act and enforcing state water quality standards for protection of aquatic life and other beneficial uses. DEQ is instrumental in designating 303(d) water quality limited streams and in developing TMDLs in those streams.

Oregon Department of Agriculture

The Oregon Department of Agriculture (ODA) oversees several programs that address soil, water and plant conservation in the Deschutes River subbasin. Soil and Water Conservation Districts and Coordinated Resource Management Planning (CRMP) are under the administrative province of the ODA. Soil and Water Conservation Districts develop long-range and annual plans of work to address local resource issues. The CRMP group addresses watershed management issues within specific subbasins and develops stream restoration goals and objectives.

Oregon Department of Transportation

The Oregon Department of Transportation (ODOT) maintains public highways that cross streams in the Deschutes River subbasin. Under initiative through the Oregon Plan for Salmon and Watersheds, efforts to improve protection and remediation of fish habitat impacted by state highways are ongoing.

Department of Land Conservation and Development

The Department of Land Conservation and Development regulates land use on the state level. County land-use plans must comply with statewide land-use goals. Effective land-use plans and policies are essential tools to protect against permanent fish and wildlife habitat losses and degradation, particularly excessive development along streams, wetlands and floodplains and in sensitive wildlife areas.

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 in the subbasin, including the State Scenic Waterway program.

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 in the subbasin. They assist with enforcement of boating laws and development or improvement of boating facilities.

Local Government

County Planning Departments

The Wasco, Sherman, Jefferson, Crook, Deschutes, Klamath and Lake county planning departments regulate land use on the county level. County comprehensive land use plans establish land use policies, zoning ordinances, and maps defining urban growth boundaries, forest, agricultural and industrial lands according to statewide goals. They address protection of waterbodies, ground water, natural areas, and fish and wildlife resources. These plans have helped minimize impacts to big game habitat, particularly deer and elk winter range.

Soil and Water Conservation Districts

Soil and Water Conservation Districts (SWCD) work with farmers and ranchers to develop farm conservation and resource management plans. The SWCD serves as fiscal agent and sponsor of local watershed groups and administers grants and projects to encourage conservation work on private lands in the Deschutes River subbasin. SWCDs provide local leadership for the USDA Environmental Quality Incentive Program. SWCDs take technical , educational, and financial assistance from a variety of sources and focus and coordinate them to meet local natural resource needs. SWCDs make available NRCS technical assistance within their jurisdiction.

With oversight and funding from Oregon Department of Agriculture, the SWCD is the local management agency for management plans to address agricultural water quality problems as required by State Senate Bill 1010. The Lower Deschutes Local Advisory Committee has developed the *Lower Deschutes Agricultural Water Quality Management Area Plan* (2000) to address agricultural water quality issues in the lower Deschutes River and all streams flowing into the Columbia River between the Hood River and John Day River, which includes the Deschutes River subbasin. It identifies strategies to reduce water pollution from agricultural lands and achieve water quality standards. It applies to lands in current agricultural use and those lying idle or on which management has been deferred.

Local Watershed Councils

Numerous watershed councils work with private landowners to resolve some of the serious cropland erosion and water quality problems in the Deschutes River subbasin. Watershed action plans have been or are in the process of being developed to provide strategies for protection and improvement of upland, riparian and aquatic health throughout the subbasin. These action plans provide strategies to reduce runoff and sediment generation in the uplands, improve grazing systems in the riparian zones and uplands, manage forestlands to

protect watershed values, improve riparian corridors and minimize flood damage to stream banks and riparian vegetation, improve irrigation efficiency, and actively improve the management of the uplands for the benefit of wildlife.

Wy'East Resource Conservation and Development Council

The Wy'East Resource Conservation and Development Council (Wy'East RC&D) is a locally led rural development organization which provides leadership, guidance, and local initiative for land, water, and related natural and human resources management and conservation. The Wy'East RC&D addresses problems and opportunities from a multi-county or watershed perspective by bringing together a diverse group of governmental and private entities to solve social, economic, and environmental resource issues. Most of the Deschutes River subbasin (89.3%) is located in the Wy'East RC&D area.

Municipalities

Twelve incorporated cities are located in the Deschutes River subbasin. In addition, there are over two dozen unincorporated communities in the subbasin.

Existing Goals, Objectives, and Strategies – Subbasin-wide

The Deschutes River has diverse populations of fish and wildlife that are of economic and ecological significance to the people of the State of Oregon and the Northwest, and of special cultural significance to members of the Confederated Tribes of the Warm Springs Reservation of Oregon. The goal for the Deschutes River is to restore the health and function of the ecosystem to ensure continued viability of these important populations.

Numerous federal, state and local entities are charged with maintenance and protection of the natural resources of the Deschutes River subbasin.

US Bureau of Reclamation

Goals:

1. Provide a level of stewardship to ensure and encourage resource protection, conservation and multiple use.
2. Provide for protection of fish, wildlife, and other natural resources, cultural resources, public health and safety, public access, and recreational opportunities.

Oregon Department of Forestry

Goal:

Protect, manage and promote a healthy forest environment which will enhance Oregon's livability and economy for today and tomorrow.

Oregon Department of Environmental Quality

Goal:

Restore, maintain and enhance the quality of Oregon's air, water and land.

Oregon Parks and Recreation Department

Goal:

Provide and protect outstanding natural, scenic, cultural, historic, and recreational sites for the enjoyment and education of present and future generations.

Oregon Division of State Lands

Goals:

1. Manage and protect state trust lands for the maximum long-term benefit of the public schools, consistent with sound stewardship, conservation and business management principles.
2. Manage non-trust lands for the greatest benefit of all the people of the state.

Oregon State Police

Goal:

Develop, promote and maintain protection of the people, property, and natural resources of the state.

Department of Land Conservation and Development

Goals:

1. Establish a framework for all land use decisions and actions.
2. Preserve and maintain all agricultural lands.
3. Conserve forest lands in a manner consistent with sound management of soil, ari, water, and fish and wildlife resources, and to provide for recreational opportunities and agriculture.
4. Protect natural resources and conserve scenic and historic areas and open spaces.
5. Maintain and improve the quality of the air, water, and land resources of the state.
6. Protect life and property from natural disasters and hazards.

Oregon Water Resources Department

Goal:

To serve the public by practicing and promoting wise long-term water management.

Soil and Water Conservation Districts

Goals:

1. Promote and protect the natural resources of the districts and the areas included in their watersheds.
2. Identify and prioritize natural resource concerns within the districts.
3. Maintain current natural resource condition assessments within the districts.
4. Obtain necessary technical, educational and financial resources to address local conservation needs.

Local watershed councils

Goals:

1. Promote stewardship of the watersheds through cooperative and voluntary efforts.
2. Protect and enhance the natural resources in the watersheds.

Wy'East Resource Conservation and Development Council

Goals:

1. Protect, restore and maintain the sustained use of land, water, plants, animals and communities to accelerate watershed health.
2. Reduce unintended adverse effects of natural resource development and use to ensure high quality environment in watersheds.
3. Develop sustainable communities.
4. Evaluate the effectiveness of projects benefits to watershed health.

Objective 1. Build partnerships, networks and coalitions with communities, organizations and agencies to benefit watershed health.

Strategy 1.1 Provide area wide planning and coordinated assistance with the conservation partnership to watershed councils, units of government and others in watersheds with non-point resource pollution problems.

Strategy 1.2 Coordinate technical and financial resources for State and Federal agencies along with foundations to accelerate the resource conservation and development of watershed projects.

Strategy 1.3 Coordinate "resource assessment teams" (RAT), made up of agency resource management professionals. RAT provides technical assistance to the conservation partnership on various approaches to resolve water issues.

Strategy 1.4 Assist the conservation partnership that builds rural leadership capacity through workshops and seminars they need to accomplish effective stewardship. For example, grant writing, conflict resolution, leadership, issues and policy.

Strategy 1.5 Coordinate with the conservation partnership and others to complete watershed assessments that leads to conservation management systems being applied on the ground.

Objective 2. Increase public awareness and understanding of agriculture and natural resource conditions, and trends in watershed resource conservation and development.

Strategy 2.1 Use appropriate communication strategies to educate the public, landowners, land managers and government entities about the role of conservation practices and systems to protect watershed function.

Strategy 2.2 Acquire and deploy information technology needed to ensure easy, rapid, reliable flow of information within the conservation partnership.

Objective 3. Sustain natural resource productivity in watersheds to benefit cropland, grazing land, forest lands, and communities.

Strategy 3.1 Develop restoration strategies that recognize functional linkages between upland (crop, grazing and forest lands) and riparian ecosystems.

Strategy 3.2 Integrate conservation measures that benefit threatened and endangered species, especially salmon conservation objectives into on-going, well established agricultural conservation planning processes and associated conservation practices applied on the ground.

Strategy 3.3 Provide coordinated assistance to improve watershed function. For example, implement watershed scale land treatment programs to reduce soil erosion, minimize the impact of highly erosive runoff events, improve water quality and quantity and improve vegetative cover in upland and riparian areas.

Strategy 3.4	Promote conservation management systems on all land uses that maintains grass and tree buffers that protects, restores and maintains watershed attributes for water quality, fish and wildlife habitat, fiber production and mixed land uses.
Strategy 3.5	Introduce models to evaluate watershed health.
Strategy 3.6	Strengthen inventory and assessment capabilities to improve the ability to determine to status and condition of all watershed land uses and resources.
Strategy 3.7	Promote alternative enterprise diversification to improve economic viability of the farm or ranch.
Strategy 3.8	Promote the use of cropland conservation management systems that improves multiple soil quality factors like erosion control, no-till, direct seeding, crop rotations, reducing use of pesticides and fertilizers, improving soil organic matter content and the chemical balance of the soil.
Strategy 3.9	Work toward long range water management planning to help agriculture and communities develop strategies to address future water needs for irrigation municipal, rural water use and sustained flows in streams for fish and wildlife.
Strategy 3.10	Promote comprehensive irrigation water management systems that increase irrigation efficiency, address nutrient and pest management, and otherwise manage irrigation return flow to reduce potential adverse water quantity and quality.
Strategy 3.11	Promote the installation of fish screens to prevent fish from entering irrigation diversions.
Strategy 3.12	Support new water banking and leasing strategies that leaves water in streams to increase low summer flows in streams that support threatened and endangered fish.
Strategy 3.13	Promote grazing conservation management systems with conservation practices that achieve proper grazing use, maintain plant vigor and diversity of the plant community, discourage invasion of noxious weeds, prevents erosion and protects stream banks and water quality.
Strategy 3.14	Coordinate cooperative efforts to control noxious and invasive weed species across public and private lands.
Strategy 3.15	Enhance efforts in communities developing new areas to undertake comprehensive watershed planning that addresses potential offsite impact of development.
Strategy 3.16	Work with communities to promote technologies and improve practice standards for reducing runoff of toxic materials, nutrients, pesticides, and sediment from communities.
Strategy 3.17	Increase efforts to control invasive and noxious weeds within communities.
Strategy 3.18	Work toward long range water management planning to help communities develop strategies to address future water needs for irrigation, municipal, and domestic water use.

Objective 4. Protect, maintain and restore or enhance riparian watershed ecosystems to sustain an abundant, productive and diverse community of fish and wildlife.

Strategy 4.1	Assist the conservation partnership to develop threatened and endangered species recovery plans that: identify factors for decline; priorities for action objectives for correcting the factors for decline that includes both the upland and riparian ecosystems; identify quantifiable criteria and standards; adopt and implement measures needed to achieve the objectives; insure implementation of the plan; monitor the outcomes after implementation; and utilize adaptive management that actively shapes management decisions.
Strategy 4.2	Assist and support fish and wildlife agencies to restore anadromous and resident native fish populations that are threatened and endangered to sustainable levels.
Strategy 4.3	Protect, restore, and maintain upland ecosystems / habitats that impact riparian corridors' proper functioning condition in terms of biological, physical and chemical characteristics, before riparian corridors are adversely affected. We understand "habitat" as the proper functioning condition of both the upland and riparian parts of the watershed.
Strategy 4.4	Protect, restore and maintain riparian corridor habitats to proper functioning conditions affected by temporary irrigation diversion dams and non-screened diversions, stream channelization, and reduced habitat diversity to name only a few conditions.
Strategy 4.5	After determining that natural regeneration and restoration will not occur, stabilize and restore stream banks in riparian corridors with appropriate plant materials. If required apply integrated bio-engineered bank stabilization systems that substantially reduces sediment load and stream temperature, filters out pollutants and makes streams more resilient and improves fish and wildlife habitat.

Objective 5. Reduce greenhouse gas impairment.

Strategy 5.1	Evaluate the potential to increase carbon sequestration on crop, range and forestlands.
Strategy 5.2	Cooperate with State, Federal and organizations to make carbon sequestration projects a reality.
Strategy 5.3	Identify and validate carbon credits for agriculture and forest conservation practices that enhance carbon sequestration that contributes to improved air quality.
Strategy 5.4	Demonstrate soil carbon measurement models that validate soil carbon.
Strategy 5.5	Develop economical methods to mitigate greenhouse gas emissions with landowners and land manager.

Strategy 5.6 Demonstrate the use of suitable plant materials to sequester carbon plus reduce the movement of eroded soil and attached chemicals into waterways. Promote the use of USDA programs like the National Conservation Buffer Initiative and Conservation Reserve Programs.

Objective 6. Improve the economic vitality of rural communities.

Strategy 6.1. Assist communities and associated economic development organizations to identify value added agricultural and natural resource based industries.

Strategy 6.2 Identify sources of technical and financial assistance for community development projects like water and sewer and facilities to comply with the Safe Drinking Water Act.

Objective 7. Measure outcomes of project activity.

Strategy 7.1 Measure outcome of resource conditions, communication and customer satisfaction. Measure only what is worth knowing to accomplish goals and objectives. Choose indicators that truly measures progress. For example, is the water clean? Is there improved participation.

Strategy 7.2 Where direct measurement of important factors seems impossible or cost prohibitive, select proxy indicators. For example, it may be very expensive to measure sediment entering a stream but it is possible to calculate the amount of soil erosion coming from a field after a conservation management system is applied.

Strategy 7.3 Conduct functional assessments of riparian and upland ecosystems before and after conservation management systems treatment have been applied to validate conservation practices effects in support of outcome measurements.

Strategy 7.4 Apply principals of Adaptive Management to adjust management direction as new information becomes available. These principals include: modify plans using monitoring, technical and social feedback; conduct frequent assessments by using monitoring data and other expertise to make mid-course corrections or alternative actions, and link reporting and monitoring schedules for mid-course corrections. Adaptive Management is not a passive " learning by doing", but rather a directed program aimed at understanding key ecosystem dynamics and the impacts of human actions using scientific experimentation and inquiry.

Federal and state wild and scenic river segments

Several federal and state agencies manage the federal and state Wild and Scenic Rivers segments of the Deschutes River under a number of management plans, including:

Two Rivers Resource Management Plan (BLM 1986)

Brothers/LaPine Resource Management Plan (BLM 1989).
Lower Crooked River Wild and Scenic River Management Plan (BLM and USBR 1992b)
Middle Deschutes/Lower Crooked River Wild and Scenic River's Management Plan (BLM et al. 1992)
Lower Deschutes River Management Plan (BLM and Oregon State Parks 1993)

Goals:
1. Meet the intent of the Wild and Scenic Rivers Act.
2. Maintain forage availability for livestock and wildlife.
3. Provide sustainable annual harvest level of timber.
4. Provide protection of fish and wildlife and other natural resources.
5. Provide protection and management of all special management areas.

Objective 1. Maintain the current character of wild and scenic areas.

Objective 2. Provide long-term protection and enhancement of outstandingly remarkable scenic, recreation and fishery resource values.

Objective 3. Provide public access and recreational use while maintaining the wild and scenic nature of the rivers.

Objective 4. Foster cooperation among landowners, managing agencies, and the public to manage and enhance the remarkable river values.

Fish Goals

Draft bull trout recovery plan

Deschutes Recovery Unit, in press
Goal:
Increase stability and long-term persistence of bull trout in the Deschutes River to the point where they are no longer threatened with extinction.

Objectives to achieve this goal are being developed by the Deschutes Recovery Unit Team to address distribution, abundance, habitat, and genetic diversity. Recovery strategies to date have focused on reintroduction of bull trout into historic habitat in the upper Deschutes basin, restoration of passage at the Pelton/Round Butte Project on the Deschutes River and Opal Springs hydroelectric facility on the Crooked River, habitat protection and enhancement, and improvement in distribution and abundance of existing bull trout populations in the Deschutes River subbasin. Completion of the Deschutes bull trout recovery strategy is expected in 2001.

Deschutes Resources Conservancy

Deschutes Resources Conservancy Strategic Plan, 2001.
Goals:
1. Restore streamflows in critical reaches of the Deschutes River and its tributaries.
2. Restore water quality throughout the Deschutes River subbasin.

Objective 1. The DRC will work to restore the natural hydrograph in all streams to the extent environmentally, socially, and economically practical.

Strategy 1.1	Develop water conservation projects.
Strategy 1.2	Acquire water rights from willing sellers.
Strategy 1.3	Lease water annually for instream flows.
Strategy 1.4	Monitor opportunities for appropriate water storage development.
Strategy 1.5	Develop a water bank.

Objective 2. The DRC will work to meet or exceed applicable state water quality standards in all waterbodies.

Strategy 2.1	Implement wetlands/habitat/floodplain restoration projects.
Strategy 2.2	Implement riparian vegetation and bank stabilization projects.
Strategy 2.3	Control agricultural drainage and irrigation tailwater discharges.
Strategy 2.4	Encourage reuse of treated municipal wastewater.
Strategy 2.5	Improve storm water runoff management.
Strategy 2.6	Assist landowners in meeting new animal feeding permit requirements.
Strategy 2.7	Assist in controlling pollution from failing septic systems.

Wildlife Goals

The overall wildlife mitigation goal for the Columbia River Basin is to achieve and sustain levels of habitat and species productivity in order to fully mitigate for all wildlife and wildlife habitat losses caused by the development and operation of the hydropower system (NWPPC 1995). This goal applies to the Columbia Plateau Province, including the entire Deschutes River subbasin. The wildlife goal for the Deschutes River subbasin includes those target species selected to represent the cover types within the subbasin, and those habitat types considered priorities within the subbasin. The priority habitat types for wildlife in this subbasin are riverine/riparian, wetlands, and shrub-steppe. Agricultural lands are low priority.

Confederated Tribes of the Warm Springs Reservation of Oregon

The CTWS manage their forested and non-forested areas under two integrated resource management plans: IRMP I (forested lands, 1992) and IRMP II (non-forested lands, 1999). These plans contain numerous provisions relating to the protection of fish and wildlife habitat.

Integrated Resources Management Plan for the Forested Area, January 1, 1992 – December 31, 2001. (CTWS 1992)

Goal:

Maintain wildlife populations and habitats that will sustain the cultural and subsistence needs of current and future Tribal members while providing the environmental and ecological requirements to insure wildlife species viability.

Objective 1. Provide for a harvestable population of deer and elk annually.

Objective 2. Protect and enhance threatened and endangered wildlife species.

Objective 3. Provide a diversity of habitat for all wildlife species.

The Tribes are currently updating IRMP I. The current draft of the revised/updated IRMP I includes the following goals, objectives, and strategies, most of which are either the same as or minor revisions of the goals, objectives, and standards contained in the existing plan:

Issue 3 - How should wildlife and wildlife habitat be managed?

Goals:

1. Maintain wildlife populations, habitats and species diversity that will sustain the cultural and subsistence needs of tribal members in perpetuity.
2. Maintain the environmental and ecological components that ensure wildlife species viability and genetic vigor.

Objective 1. Increase deer and elk herds by 50% over the next ten years and comply with standards for herd composition.

Objective 2. Reintroduce native species such as California bighorn sheep and pronghorn antelope.

Objective 3. Establish a species and habitat database during the next five years.

Objective 4. Maintain an effective road-blockage program that promotes public participation and support, and protects sensitive habitats.

Strategy 1	Protect winter roost sites and spring nesting sites utilized by wild turkeys. When sites are located they will be reported to the wildlife biologist as soon as possible.
Strategy 2	Maintain avian habitat for cavity-creating species by providing four quality snags per acre.
Strategy 3	Maintain an average of two green trees or imminent mortality trees per acre throughout the forest for future snag recruitment.
Strategy 4	Raptor nests will be protected from January 1 to August 31. No fuels management projects or disturbing activities will be conducted within one-quarter mile of an active nest site. The buffer will be extended to one mile when loud decibel disturbance occurs.
Strategy 5	Maintain a 40 percent (minimum) cover to 60 percent forage ratio in areas utilized by big game animals. The cover requirements will include 10 percent thermal cover, 20 percent hiding cover, and 10 percent thermal or hiding cover (whichever is the most deficient). Cover areas will be at least 30 acres for elk and at least 5 acres for deer.

Strategy 6	Wet meadows identified as birthing and nurturing areas for deer or elk will be buffered by a one-quarter mile no-cut zone. All roads within these zones will be considered a high priority for closure.
Strategy 7	Winter logging will not be allowed on critical big game winter range located within wildlife management zones unless otherwise approved by a staff wildlife biologist, the Forestry manager and the Natural Resources general manager.

Integrated Resources Management Plan for the Non-Forested and Rural Areas, IRMP and Project Assessment. (CTWS 1999)

IRMP II also includes numerous goals, objectives, strategies, and standards relating to the protection and enhancement of fish and wildlife resources. Among these are the following:

Issue 14. What actions should be taken regarding the protection, enhancement and re-introduction of native plants and animals, including threatened or endangered (T&E) species?

The reservation hosts a variety of native plant and animal species, many of which have special significance to tribal members. Several species of plants and animals have disappeared (including California bighorn sheep and sage grouse) over the past century, and others have been severely reduced (including pronghorn antelope and tule reeds). Tribal members have expressed concern for individual species and the ecology of their respective habitats.

Protection and enhancement of threatened or endangered species is directed by existing tribal ordinances. However, the protection of plant and animal species within the non-forested area is difficult at times, because they are often evaluated within the context of economic and growth factors of the Warm Springs community.

Tribal member preferences regarding the management of plant and animal species need to be identified, so that desirable species and their associated habitats can be maintained within healthy ecological systems.

Goals:

1. Improve wildlife populations through management and reintroduction of native plants and animals.
2. Protect and enhance T&E species and their associated habitats.

Objective 1. Increase local deer and elk herds by 50% over the next ten years and comply with standards for herd composition.

Objective 2. Reintroduce or enhance native species including California bighorn sheep, pronghorn antelope and tule reeds during the next ten years to eventually support harvestable populations.

Objective 3. Inventory and monitor T&E species annually, and sensitive species to ensure compliance with IRMP standards and BMPs. No further loss of species diversity should occur over the next ten years.

Objective 4. Protect and enhance suitable habitat for T&E species. Aid in the recovery goals for T&E species by maintaining at least five suitable bald eagle nesting territories and two peregrine falcon territories reservation-wide.

Objective 5. Establish a species and habitat database during the next five years.

Strategy 1	Hunting regulations will be subject to the Warm Springs Tribal Code, Chapter 350, Hunting and Trapping (Ordinance 65). Wildlife management provisions will be strictly enforced by the Natural Resources Ranger Program and the Warm Springs Police Department.
Strategy 2.	Designated wildlife trees will be marked at the discretion of tribal wildlife biologists. Marked trees must be left in place.
Strategy 3	Habitat management for cavity-creating species will be based on vegetation type.
Strategy 4	Raptor nests will be protected from January 1 to August 31. No fuels management projects or disturbing activities will be conducted within one-quarter mile of an active nest site. The buffer will be extended to one mile when loud decibel disturbance occurs.
Strategy 5	Management of wildlife hiding and thermal cover will be based on management plans for each wildlife zone.
Strategy 6	Critical habitat for culturally significant species will be protected.
Strategy 7	The protection of big game habitat, stream quality and range resources will be emphasized in wildlife areas.
Strategy 8	Activities associated with threatened, endangered or culturally significant wildlife will be directed through consultation and cooperation with federal agencies.
Strategy 9	Native plant communities will be managed to achieve at least a mid-seral condition.
Strategy 10	Sensitive plants, when discovered, will be protected through enforcement efforts.
Strategy 11	Native wildlife species can be reintroduced and other species introduced with committee recommendation and Tribal Council approval.
Strategy 12	Upland game habitat will be enhanced through controlled burns and the installation of wildlife guzzlers (water developments) to increase upland game populations.
Strategy 13	Waterfowl habitat will be enhanced through restoration and the placement of artificial structures such as nesting boxes and platforms. Vegetation will be manipulated at Happy Valley Reservoir to lure and hold waterfowl.

Strategy 14 A ratio of at least 15 bulls per 100 cows will be maintained within the herd composition of elk.

Strategy 15 A ratio of at least 20 bucks per 100 does will be maintained within the herd composition of deer.

Oregon Revised Statute

ORS 496.012

Goals:

The coequal goals of wildlife management in Oregon are:

1. Maintain species of wildlife at optimum levels.
2. Develop and manage the lands and waters of this state in a manner that will enhance the production and public enjoyment of wildlife.
3. Permit an orderly and equitable utilization of available wildlife.
4. Develop and maintain public access to the lands and waters of the state and the wildlife resources thereon.
5. Regulate wildlife populations and the public enjoyment of wildlife in a manner that is compatible with primary uses of the lands and waters of the state.
6. Provide optimal recreational benefits.

Oregon wildlife diversity

Oregon Wildlife Diversity Plan Summary. (ODFW 1993d)

Goal:

Maintain Oregon's wildlife diversity by protecting and enhancing populations and habitats of native non-game wildlife at self-sustaining levels throughout natural geographic ranges.

Objective 1. Protect and enhance populations of all existing native non-game species at self-sustaining levels throughout their natural geographic ranges by supporting the maintenance, improvement or expansion of habitats and by conducting other conservation actions.

Strategy 1.1 Maintain existing funding sources and develop new sources of public, long-term funding required to conserve the wildlife diversity of Oregon.

Strategy 1.2 Identify and assist in the preservation, restoration and enhancement of habitats needed to maintain Oregon's wildlife diversity and non-consumptive recreational opportunities.

Strategy 1.3 Monitor the status of non-game populations on a continuous basis as needed for appraising the need for management actions, the results of actions, and for evaluating habitat and other environmental changes.

Objective 2. Restore and maintain self-sustaining populations of non-game species extirpated from the state or regions within the state, consistent with habitat availability, public acceptance, and other uses of the lands and waters of the state.

Strategy 2.1 Identify, establish standards and implement management measures required for restoring threatened and endangered species, preventing sensitive species from having to be listed as threatened or endangered, and maintaining or enhancing other species requiring special attention.

Strategy 2.2 Reintroduce species or populations where they have been extirpated as may be feasible.

Objective 3. Provide recreational, educational, aesthetic, scientific, economic and cultural benefits derived from Oregon's diversity of wildlife.

Strategy 3.1 Develop broad public awareness and understanding of the wildlife benefits and conservation needs in Oregon.

Strategy 3.2 Increase or enhance opportunities for the public to enjoy and learn about wildlife in their natural habitats.

Strategy 3.3 Seek outside opportunities, resources and authorities and cooperate with other agencies, private conservation organizations, scientific and educational institutions, industry and the general public in meeting Program Objectives.

Strategy 3.4 Maintain and enhance intra-agency coordination through dissemination of Program information, development of shared databases and coordination of activities that affect other Department divisions and programs; identify activities within other programs which affect the Wildlife Diversity program, and develop mutual goals.

Objective 4. Address conflicts between non-game wildlife and people to minimize adverse economic, social, and biological impacts.

Strategy 4.1 Assist with non-game property damage and nuisance problems without compromising wildlife objectives, using education and self-help in place of landowner assistance wherever possible.

Strategy 4.2 Administer the Wildlife Rehabilitation Program.

Strategy 4.3 Administer the Scientific Taking Permits Program.

Strategy 4.4 Administer Wildlife Holding and other miscellaneous permits.

Strategy 4.5 Provide biological input to the Falconry Program for the establishment of raptor-capture regulations.

Strategy 4.6 Update the Wildlife Diversity Plan every five years.

Black bear

Oregon Black Bear Management Plan (ODFW 1993a)

Goal:

Protect and enhance black bear populations in Oregon to provide optimum recreational benefits to the public and to be compatible with habitat capability and primary land uses.

Objective 1. Determine black bear population characteristics.

Strategy 1.1 Implement or cooperate in research to learn more about black bear ecology in Oregon, develop accurate populations estimates and provide a measurement of population trend.

Objective 2. Determine black bear harvest levels.

Strategy 2.1 Obtain improved harvest information through use of combination report card/tooth envelope.
Strategy 2.2 Monitor black bear harvest and implement harvest restrictions if necessary.
Strategy 2.3 Develop an educational program to alert black bear hunters of the need for improved black bear population information.
Strategy 2.4 If necessary, initiate mandatory check of harvested black bear.

Objective 3. Continue current practice of allowing private and public landowners to take damage causing black bear without a permit.

Strategy 3.1 The Department will not seek any changes in current statutes.
Strategy 3.2 Continue to work with other agencies and private landowners in solving black bear depredation problems.
Strategy 3.3 Explore the possibility of using sport hunters for damage control.

Cougar

Oregon's Cougar Management Plan (ODFW 1993b)
Goals:

1. Recognize the cougar as an important part of Oregon's wildlife fauna, valued by many Oregonians.
2. Maintain healthy cougar populations within the state into the future.
3. Conduct a management program that maintains healthy populations of cougar and recognizes the desires of the public and the statutory obligations of the Department.

Objective 1. Continue to gather information on which to base cougar management.

Strategy 1.1 Continue to authorize controlled cougar hunting seasons conducted in a manner that meets the statutory mandates to maintain the species and provide consumptive and non-consumptive recreational opportunities.
Strategy 1.2 Continue to study cougar population characteristics as well as the impact of hunting on cougar populations.
Strategy 1.3 Continue to update and apply population modeling to track the overall cougar population status.
Strategy 1.4 Continue mandatory check of all hunter-harvested cougar and evaluate the information collected on population characteristics for use in setting harvest seasons.
Strategy 1.5 Continue development of a tooth aging (cementum annuli) technique.

Objective 2. Continue to enforce cougar harvest regulations.

Strategy 2.1	Continue to work with OSP to monitor the level of illegal cougar hunting activity.
Strategy 2.2	Implement appropriate enforcement actions and make the necessary changes in regulations to reduce illegal cougar hunting.
Strategy 2.3	Continue to inspect taxidermist facilities and records to discourage and document the processing of cougar hides lacking Department seals.

Objective 3. Document and attempt to eliminate potential future human-cougar conflicts.

Strategy 3.1	Provide information to the public about cougar distribution, management needs, behavior, etc.
Strategy 3.2	Attempt to solve human-cougar conflicts by non-lethal methods.
Strategy 3.3	Consider additional hunting seasons or increased hunter numbers in areas where human-cougar conflicts develop.
Strategy 3.4	Manage for lower cougar population densities in areas of high human occupancy.

Objective 4. Manage cougar populations through controlled hunting seasons.

Strategy 4.1	Base regulation modifications on population trends, as annual fluctuations in the weather can greatly influence recreational cougar harvest.
Strategy 4.2	Continue to regulate cougar hunting through controlled permit seasons.

Objective 5. Continue to allow private and public landowners to take damage-causing cougar without a permit.

Strategy 5.1	No changes will be sought to existing damage control statutes.
Strategy 5.2	Continue to work with landowners to encourage reporting of potential damage before it occurs, with the goal of solving complaints by other than lethal means.
Strategy 5.3	Continue to emphasize that damage must occur before landowners or agents of the Department may remove an offending animal.
Strategy 5.4	Encourage improved livestock husbandry practices as a means of reducing cougar damage on domestic livestock.
Strategy 5.5	Continue to work with other agencies to solve cougar depredation problems.

Objective 6. Manage deer and elk populations to maintain the primary prey source for cougar.

Strategy 6.1 Work with landowners and public land managers to maintain satisfactory deer, elk and cougar habitat.

Strategy 6.2 Evaluate the effects of human activities and human disturbance on cougar.

Strategy 6.3 Take action to correct problems in areas where human access is detrimental to the welfare of cougar or their prey base.

Mule deer

Mule Deer Management Plan (ODFW 1990a)

Goals:

Mule deer populations in Oregon will be managed to:

1. Increase deer numbers in areas that are below management objectives
2. Maintain population levels where herds are at management objectives.
3. Reduce populations in the areas where deer numbers exceed population management objectives.

Population objectives were set by Oregon Department of Fish and Wildlife Commission action in 1982 and are to be considered maximums.

Objective 1. Set management objectives for buck ratio, population and fawn:doe ratio benchmark for each hunt unit and adjust as necessary.

Strategy 1.1 Antlerless harvest will be used to reduce populations which exceed management objectives over a two or three year period.

Strategy 1.2 Harvest tag numbers are adjusted to meet or exceed objectives within 2-3 bucks/100 does.

Strategy 1.3 Population trends will be measured with trend counts, number of deer damage incidents, and harvest data.

Strategy 1.4 Update Mule Deer Plan every five years.

Objective 2. Hunter opportunity will not be maintained at the expense of meeting population and buck ratio management objectives.

Elk

Oregon's Elk Management Plan (ODFW 1992b)

Goal:

Protect and enhance elk populations in Oregon to provide optimum recreational benefits to the public and to be compatible with habitat capability and primary land uses.

Objective 1. Maximize recruitment into elk populations and maintain bull ratios at Management Objective levels. Establish Management Objectives for populations size in all herds, and maintain populations at or near those objectives.

Strategy 1.1 Maintain bull ratios at management objectives.

Strategy 1.2	Protect Oregon's wild elk from diseases, genetic degradation, and increased poaching which could result from transport and uncontrolled introduction of cervid species.
Strategy 1.3	Determine causes of calf elk mortality.
Strategy 1.4	Monitor elk populations for significant disease outbreaks, and take action when and were possible to alleviate the problem.
Strategy 1.5	Improve data collection procedures to attain necessary information at 80% confidence level with a 20% bound on error.
Strategy 1.6	Establish population models for aiding in herd or unit management decisions.
Strategy 1.7	Adequately inventory elk populations in all units with significant number of elk.

Objective 2. Maintain, enhance and restore elk habitat.

Strategy 2.1	Ensure both adequate quantity and quality of forage to achieve elk population management objectives in each management unit.
Strategy 2.2	Ensure habitat conditions necessary to meet population management objectives are met on critical elk ranges.
Strategy 2.3	Prevent elk damage to private land where little or no natural winter range remains.
Strategy 2.4	Maintain public rangeland in a condition that will allow elk populations to meet and sustain management objectives in each unit.
Strategy 2.5	Reduce wildlife damage to private land.

Objective 3. Enhance consumptive and non-consumptive recreational uses of Oregon's elk resource.

Strategy 3.1	Develop a policy that outlines direction for addressing the issues of tag allocation to private landowners and public access to private lands in exchange for compensation to private landowners.
Strategy 3.2	Increase bull age structure and reduce illegal kill of bulls while maintaining recreational management objectives.
Strategy 3.3	Maintain levels of hunter recreation in all units.
Strategy 3.4	Identify, better publicize, and increase the number of elk viewing opportunities in Oregon.

Bighorn sheep

Oregon's Bighorn Sheep Management Plan (ODFW 1992a)

Goal:

Restore bighorn sheep into as much suitable unoccupied habitat as possible.

Objective 1. Maintain geographical separation of California and Rocky Mountain subspecies.

Strategy 1.1 California bighorn will be used in all sites in central and southeast Oregon, as well as the Burnt, Deschutes, and John Day river drainages.

Strategy 1.2 Coordinate transplant activities with adjacent states.

Strategy 1.3 Continue to use in-state sources of transplant stock while seeking transplant stock from out of state.

Strategy 1.4 Historic areas of bighorn sheep range containing suitable habitat will be identified and factors restricting reintroduction will be clearly explained for public review.

Objective 2. Maintain healthy bighorn sheep populations.

Strategy 2.1 Bighorn sheep will not be introduced into locations where they may be reasonably expected to come into contact with domestic or exotic sheep.

Strategy 2.2 Work with land management agencies and private individuals to minimize contact between established bighorn sheep herds and domestic or exotic sheep.

Strategy 2.3 Work with land management agencies to locate domestic sheep grazing allotments away from identified present and proposed bighorn sheep ranges.

Strategy 2.4 Maintain sufficient herd observations to ensure timely detection of disease and parasite problems.

Strategy 2.5 Promote and support aggressive research aimed at reducing bighorn vulnerability to diseases and parasites.

Strategy 2.6 Bighorn individuals that have known contact with domestic or exotic sheep will be captured, quarantined, and tested for disease. If capture is impossible, the bighorn will be destroyed before it has a chance to return to a herd and possibly transmit disease organisms to others in the herd.

Strategy 2.7 Bighorns of questionable health status will not be released in Oregon.

Objective 3. Improve bighorn sheep habitat as needed and as funding becomes available.

Strategy 3.1 Monitor range condition and use along with population characteristics.

Objective 4. Provide recreational ram harvest opportunities when bighorn sheep population levels reach 60 to 90 animals.

Strategy 4.1 To reduce possibility of black-market activity, all hunter-harvested horns will be permanently marked by the Department.

Strategy 4.2 Do not transplant bighorns on those areas where some reasonable amount of public access is not possible.

Strategy 4.3 Consider land purchase in order to put such land into public ownership.

Objective 5. Conduct annual herd composition, lamb production, summer lamb survival, habitat use and condition, and general herd health surveys.

Migratory game birds

Oregon Migratory Game Bird Program Strategic Management Plan (ODFW 1993c)
Goal:
Protect and enhance populations and habitats of native migratory game birds and associated species at prescribed levels throughout natural geographic ranges in Oregon and the Pacific Flyway to contribute to Oregon's wildlife diversity and the uses of those resources.

Objective 1. Integrate state, federal, and local programs to coordinate biological surveys, research, and habitat development to obtain improved population information and secure habitats for the benefit of migratory game birds and other associated species.

Strategy 1.1	Establish an Oregon Migratory Game Bird Committee to provide management recommendations on all facets of the migratory game bird program.
Strategy 1.2	Use population and management objectives identified in Pacific Flyway Management Plans and Programs.
Strategy 1.3	Develop a statewide migratory game bird habitat acquisition, development, and enhancement plan based on flyway management plans, ODFW Regional recommendations, and other state, federal, and local agency programs.
Strategy 1.4	Implement a statewide migratory game bird biological monitoring program, including banding, breeding, production, migration, and wintering area surveys based on population information needs of the flyway and state.
Strategy 1.5	Develop a statewide program for the collection of harvest statistics.
Strategy 1.6	Prepare a priority plan for research needs based on flyway management programs.
Strategy 1.7	Annually prepare and review work plans for wildlife areas that are consistent with policies and strategies of this plan.
Strategy 1.8	Develop a migratory game bird disease contingency plan to address responsibilities and procedure to be taken in the case of disease outbreaks in the state. It will also address policies concerning "park ducks", captive-reared, and exotic game bird releases in Oregon.

Objective 2. Assist in the development and implementation of the migratory game bird management program through information exchange and training.

Strategy 2.1 Provide training for appropriate personnel on biological survey methodology, banding techniques, waterfowl identification, habitat development, disease problems, etc.

Objective 3. Provide recreational, aesthetic, educational, and cultural benefits from migratory game birds, other associated wildlife species, and their habitats.

Strategy 3.1 Provide migratory game bird harvest opportunity.
Strategy 3.2 Regulate harvest and other uses of migratory game birds at levels compatible with maintaining prescribed population levels.
Strategy 3.3 Eliminate impacts to endangered or threatened species.
Strategy 3.4 Reduce impacts to protected or sensitive species.
Strategy 3.5 Provide a variety of recreational opportunities and access, including viewing opportunities, throughout the state.
Strategy 3.6 Provide assistance in resolving migratory game bird damage complaints.
Strategy 3.7 Develop opportunities for private, public, tribal, and industry participation in migratory game bird programs including, but not limited to, conservation, educational, and scientific activities.
Strategy 3.8 Disseminate information to interested parties through periodic program activity reports, media releases, hunter education training, and other appropriate means.

Objective 4. Seek sufficient funds to accomplish programs consistent with the objectives outlined in the plan and allocate funds to programs based on management priorities.

Existing Goals, Objectives, and Strategies – Lower Deschutes River

Fish Goals

Confederated Tribes of the Warm Springs Reservation of Oregon

CTWS Tribal Council Strategic Plan (CTWS 1999)
Goal:
Implement a fisheries program to produce harvestable populations of salmon available for tribal member harvest.

Strategy Work within existing management plans including the Spirit of the Salmon Plan, the Columbia River Fish Management Plan and the Integrated Resources Management Plan. Emphasize natural production and healthy river systems and protection of sovereignty and treaty rights.

WY-KAN-USH-MI WA-KISH-WIT, Spirit of the Salmon. (CRITFC 1995)

Volume One (Columbia Basin)

Goals:

1. Restore anadromous fishes to the rivers and streams that support the historical, cultural and economic practices of the tribes.
2. Emphasize strategies that rely on natural production and healthy river systems to achieve this goal.
3. Protect tribal sovereignty and treaty rights.
4. Reclaim the anadromous fish resource and the environment on which it depends for future generation.

Objectives 1. Within seven years, halt the declining trends in salmon, sturgeon, and lamprey populations originating upstream of Bonneville Dam.

Objective 2. Within 25 years, increase the total adult salmon returns of stocks originating above Bonneville Dam to four million annually and in a manner that sustains natural production to support tribal commercial as well as ceremonial and subsistence harvests.

Objective 3. Within 25 years, increase sturgeon and lamprey populations to naturally sustainable levels that also support tribal harvest opportunities.

Objective 4. Restore anadromous fishes to historical abundance in perpetuity.

Plan also includes many institutional and technical recommendations to achieve the above goals and objectives.

Volume Two (Deschutes Basin)

Goals:

Species	Average Run Size	Annual Harvest
Spring chinook salmon	8,500-12,000	5,500-8,00
Fall chinook salmon	10,000-12,000	4,000-5,000
Sockeye	5,000	1,500
Steelhead	16,000-22,000	5,000-11,000

Objective 1. Maximize the protection and enhancement of aquatic and riparian habitat on all land bordering the Deschutes river and its tributaries to result in a net increase in habitat quantity and quality over time.

Objective 2. Maintain or improve watershed conditions for the sustained, long-term production of fisheries and high quality water.

Objective 3. Maintain or improve flow for fish production in the tributaries of the Deschutes River.

Strategy 1	Support enforcement of existing laws and regulations concerning habitat protection by agencies with enforcement authority.
Strategy 2	Support implementation of existing land and resource management plans.
Strategy 3	The Oregon Department of Fish and Wildlife should apply for instream water rights for fish protection.

The CTWS manage the forested and non-forested areas under two integrated resource management plans: IRMP I (forested lands, 1992) and IRMP II (non-forested lands, 1999). These plans contain numerous provisions relating to the protection of fish and wildlife habitat.

Integrated Resources Management Plan for the Forested Area, January 1, 1992 – December 31, 2001 (CTWS 1992)
Goals:

1. Protect and enhance fish populations, habitats, and water quality, which will sustain the cultural and subsistence needs of current and future generations of Tribal members.
2. Provide the ecological requirements to insure viability of all aquatic species.
3. Provide recreational opportunities to the Tribes.

Objective 1. Maintain or improve watershed conditions for the sustained, long-term production of all aquatic species.

Objective 2. Manage for natural flow regimes and quality waters for aquatic life in the streams and rivers.

Objective 3. Protect and enhance aquatic, riparian, and wetland habitats.

Objective 4. Protect the genetic integrity of wild fish populations.

Objective 5. Optimize habitat and production of anadromous and resident fishes.

Objective 6. Protect fish and aquatic resources for cultural and subsistence uses.

Management strategies relevant to fish and wildlife habitat protection include: Riparian Management Zones (see standards below); Biological Diversity Islands (LTP Islands), which are managed to provide a core area of mature/over-mature age class conifers and their associated floral and faunal species in perpetuity, and Conditional Use Areas, which are maintained in a primitive wilderness or unmanaged condition by allowing only those activities which enhance, promote, or otherwise create a natural landscape with all its accessory benefits and organisms intact.

The Tribes are currently updating IRMP I. The current draft of the revised/updated IRMP I includes the following goals, objectives, and strategies, most of which are either the same as or minor revisions of the goals, objectives, and standards contained in the existing plan:

Issue 1 - How should water resources and riparian areas be managed?

Goals

1. Manage and protect watersheds for the production of perennial, high-quality water.
2. Manage and protect the unique and valuable characteristics of wetlands and riparian areas.

Objective 1. Maintain the natural flow regimes in streams. Natural flow regimes will be determined by analyzing data accumulated over a minimum of 30 years.

Objective 2. Maintain or enhance water quality where standards are being met and strive to meet the standards where water quality is substandard.

Objective 3. Identify short- and long-term trends in water quality and watershed stability.

Objective 4. Manage lands to effectively capture, store and release water in a safe and beneficial manner.

Objective 5. Monitor water quality and quantity to provide baseline and project level information on specific watersheds.

Objective 6. Design management activities that maintain or improve riparian conditions.

Objective 7. Manage riparian and wetland communities for the sustainable production of cultural plants and foods.

Strategy 1	Utilize the Cumulative Impact Analysis System to measure the cumulative runoff acreage (CRA) levels for each watershed and to ensure that established threshold levels are not exceeded. In the event that any watershed exceeds its threshold, mitigation measures will be utilized to reduce the CRA value and bring it into compliance with IRMP standards.
Strategy 2	Spills involving chemical, biological or hazardous material must be reported immediately to the Fire and Safety Department. HAZMAT-trained personnel will supervise the environmental cleanup stage of the event.
Strategy 3	Chemical agents will not be applied or stored within 100 feet of any water body, unless they are being used to trace water movements or to

	control pollution. The Natural Resources general manager may approve other related activities if they are adequately mitigated.
Strategy 4	An approved Water Right Permit will be required before any water appropriation (spring, well, pipeline, irrigation system) can occur. All diversion and pumping stations will be screened to prevent the passage of aquatic organisms.
Strategy 5	A Hydraulic Projects Application (HPA) must be approved before any project work can take place in a body of water or riparian buffer zone.
Strategy 6	All mechanized equipment will be kept out of streams and buffer zones except at designated crossings, or as authorized by the HPA.
Strategy 7	No oil, grease, antifreeze, or any other kind of toxic substance will be changed, sprayed, or exposed in any way within 200 feet of a stream, spring, seep or bog.
Strategy 8	A fish biologist will write specifications for HPA permits when the affected stream is a fish-bearing stream. Stream flows will only be diverted in accordance within specifications written into the permit.
Strategy 9	Stream channel stability will be maintained or improved to achieve no less than a “good” rating, as determined using criteria listed in the “Watershed Management Methods Manual.”
Strategy 10	Riparian buffer zones must achieve at least 60 percent of their vegetative site potential, including trees, shrubs, forbs, sedges and grasses within the next 20 years.
Strategy 11	Riparian buffers will be separated into two zones: the A zone will be excluded from any harvest activities; and the B zone will be protected with a prescription that limits activities so as to maintain a 60 percent canopy cover.
Strategy 12	The minimum A zone riparian buffer will be 100 feet on each side of a class I stream, 60 feet on each side of a class II stream, and 30 feet on each side of a class III stream. Buffer zones will be measured horizontally from both banks of a stream channel or wet area and include the riparian area and floodplain.
Strategy 13	An increase in the minimum buffer width may be imposed when circumstances put the watershed, stream channel stability, or aquatic resources at risk.
Strategy 14	Wetlands, springs, seeps, bogs, spring headwalls and any other wet area will be given the same protection as a class I stream.
Strategy 15	The Riparian Area Stability Rating will be used in determining the condition and stability of stream channels and riparian areas, when an extended riparian buffer zone is needed to protect resources.
Strategy 16	Log decks and landings will not be placed within any riparian buffer.
Strategy 17	Logs must be fully suspended when they are being yarded across any class I, class II, or flowing intermittent stream.
Strategy 18	The tribal hydrologist will conduct a field review to establish specific buffer zones for every stream that could be impacted by a project, before the project is implemented.

Strategy 19 Fires prescribed specifically for areas outside a buffer zone will include measures to protect adjacent riparian vegetation.

Strategy 20 No building will be constructed within 200 feet of a riparian buffer zone. Septic tanks and drain fields will be constructed at least 200 feet from the riparian buffer zone of any classified stream or designated wetland. No new campgrounds will be constructed inside a buffer zone unless they would alleviate resource damage caused by dispersed recreation use.

Issue 2 - How should fish and aquatic resources be managed?

Goals:

1. Maintain or enhance populations of resident and anadromous fish that meet the cultural, subsistence and recreational needs of tribal members.
2. Manage watershed processes to maintain or improve functional aquatic habitats for fish and other water-dependent resources.

Objective 1. Identify priority watersheds and actions needed to achieve stable and functional aquatic habitats.

Objective 2. Maintain or enhance the complexity and stability of all stream channels.

Objective 3. Manage riparian areas, floodplains and wetlands to ensure future sources of large woody debris, gravel recruitment and sediment trapping.

Objective 4. Identify fish passage barriers (such as culverts and bridges) within the forested area, then develop and implement corrective measures.

Strategy 1 No timber harvest, salvage operation, or firewood cutting will occur in riparian zones, unless approved by the Department of Natural Resources General Manager. These trees will be left to provide adequate sources of woody debris recruitment for riparian areas and instream habitat.

Strategy 2 Large woody debris will not be removed from reservation streams unless approved by the Department of Natural Resources general manager.

Strategy 3 Instream work can only be performed on reservation streams between July 1 and August 10.

Strategy 4 Culverts, bridges and stream crossings on fish bearing streams will be designed for passage of adult and juvenile fish of the appropriate species.

Strategy 5 Fine sediments in substrates shall be less than or equal to 20 percent in anadromous and resident fish streams. In the event streams or stream reaches exceed the standard as a result of management activities,

mitigating measures will be implemented to maintain or improve current levels.

Strategy 6 Substrate embeddedness shall be less than or equal to 30 percent in anadromous and resident fish streams. In the event streams or stream reaches exceed the standard as a result of management activities, mitigating measures will be implemented to maintain or improve current levels.

Strategy 7 Stream bank stability will average no less than 90 percent in all streams. In the event streams or stream reaches exceed the standard as a result of management activities, mitigating measures will be implemented to maintain or improve current levels.

Strategy 8 Fish screening criteria for water diversions and pumping stations will be as described in this plan.

- Bypass configuration, hydraulic capacity, entrance and transport velocities, and other details will be dependent upon the design of the screening facility, such that the bypass acts in harmony with the screens to readily attract fish and provide safe passage.
- All fish screening facilities must be installed and operational during times that fish are present at the project.
- The facilities shall be operated and maintained to function properly throughout the full range of flows normally occurring during the fish migration period.
- Fish screens shall be cleaned as frequently as necessary to prevent violation of approach velocity standards or injury to fish. The cleaning method must be effective and reliable, and, in most cases, will be automatic.
- An ongoing inspection, maintenance, and repair program shall be implemented to assure facilities are debris free, and that screen material seals, drive units, bypass entrances and conduits and other components are serviced and functioning properly.

Integrated Resources Management Plan for the Non-Forested and Rural Areas, IRMP and Project Assessment (CTWS 1999)

IRMP II also includes numerous goals, objectives, strategies, and standards relating to the protection and enhancement of fish and wildlife resources. Among these are the following:

Issue 5. How should riparian areas be managed to maintain or enhance water quality and fish/aquatic habitat while meeting the needs of other resources?

The protection and enhancement of watersheds and riparian areas is imperative to maintain or enhance water quality and quantity. Past and present management has impacted riparian areas through forest practices, grazing activities and development associated with recreational, industrial, housing and transportation systems. Concern has been expressed

by tribal members regarding the importance of riparian areas for fish and wildlife habitat, cultural plant and food production, and water quality. Watersheds and riparian areas will have to be protected in order to alleviate these concerns.

Goals:

1. Manage and protect the non-forested watersheds for the production of perennial, high-quality water.
2. Manage and protect the unique and valuable characteristics of riparian areas, including water quality and aquatic habitat.
3. Provide harvestable populations of anadromous and resident fish for tribal members, and explore the feasibility of re-establishing displaced anadromous runs. Harvest levels will be based on anticipated returns and allow adequate escapement to maintain viable populations.

Objective 1. Maintain and manage for natural flow regimes in all streams. Natural flow regimes will be determined by analyzing data accumulated over a minimum of 20 years.

Objective 2. Meet water quality standards in 25 percent of the reservation watersheds within 10 years and 90 percent of the watersheds within 50 years.

Objective 3. Develop enforcement standards and policies to ensure compliance with water quality standards regarding both point and non-point source pollution.

Objective 4. Design management activities in class 1 and class 2 riparian areas to achieve at least 60 percent of vegetative potential within 30 years.

Objective 5. Manage riparian communities for the sustainable production of cultural plants and foods.

Objective 6. Maintain genetic diversity and abundance of wild fish including fall chinook, spring chinook, summer steelhead, rainbow trout, bull trout, mountain whitefish and other indigenous species in the waters on and bordering the reservation.

Objective 7. Provide the following wild fish escapement levels within ten years:

1. **Warm Springs River and tributaries 1,300 adult spring chinook above hatchery.**
2. **Shitike Creek 300 adult spring chinook to creek mouth.**
3. **Deschutes River below Sherars Falls 2,000 adult fall chinook.**
4. **River above Sherars Falls 2,000 adult fall chinook.**
5. **Warm Springs River and tributaries 300 adult summer steelhead to hatchery.**

6. **Shitike Creek 500 adult summer steelhead to creek mouth.**
7. **Eagle Creek 60 adult summer steelhead to creek mouth.**
8. Nena Creek 60 adult summer steelhead to creek mouth.
9. Skookum Creek 40 adult summer steelhead to creek mouth.

Objective 8. Improve riparian areas to meet the following standards within the next ten years:

1. **Water temperature not to exceed 55°F for waters inhabited by bull trout.**
2. **Substrate embeddedness not to exceed 20 percent.**
3. **Bank stability not less than 90 percent.**

Strategy 1 The Cumulative Impact Analysis Method will be used to establish stability threshold levels for each watershed. If a watershed exceeds this threshold, measures will be taken to bring the system into compliance.

Strategy 2 Water quality standards established under Ordinance 80, "Water Quality Standards, Beneficial Uses, and Treatment Criteria," will apply to all waters covered under this plan. Implementation standards listed in Ordinance 81 will also apply.

Strategy 3 Water standard infractions must be reported to the Water Control Board, which has the authority to utilize the enforcement provisions of the Warm Springs Tribal Code, Chapter 430, Water Resource Management Plan (Ordinance 45).

Strategy 4 Spills involving chemical, biological or hazardous material must be reported immediately to the Fire and Safety Department. As soon as safety concerns have been addressed, efforts will concentrate on containing the spill and preventing it from reaching a water source. Cleanup and restoration efforts will be coordinated through the Natural Resources Branch. In the event unnatural debris or solid wastes enter a stream, spring or wetland, the Natural Resource Branch will be notified, so staff can assist in planning clean-up activities.

Strategy 5 Chemical agents will not be applied within 100 feet of any flowing stream, unless they are being used to trace water movements or to control pollution. Other activities may be approved if they are adequately mitigated.

Strategy 6 An approved Water Right Permit will be required before any water appropriation can occur (spring, well, pipeline, irrigation system). A Hydraulic Projects Application must be approved before any project work can take place in a buffer zone or near a body of water. All motorized or mechanized equipment will be kept out of streams or buffer zones except at designated crossings, or as authorized by the permit. Streams designated as important for fisheries will have passage specifications written into the permit. Streamflows will only be

diverted in accordance with specifications in the permit. All diversions and pumping stations will be screened to prevent fish passage.

Strategy 7 Stream channel stability will be improved or maintained to achieve no less than a good rating, as determined using criteria listed in the "Watershed Management Methods Manual."

Strategy 8 Buffer zones must achieve at least 60 percent of their vegetative site potential, including trees, shrubs, forbs, sedges and grasses. The minimum for buffer zones will be 200 feet on each side of a class I stream, 120 feet on each side of a class II stream, and 60 feet on each side of a class III stream. Buffer zones will be measured horizontally from both banks of a stream channel or wet area. Buffer zones will include the riparian area and floodplain. Wetlands (springs, seeps, bogs, spring headwalls and any other wet area) will be given the same protection as a class I stream.

Strategy 9 A field review will be conducted to establish buffer zones for all streams (perennial and intermittent) before any work that could impact a riparian area begins. Fuelwood will not be removed within 200 feet of any classified stream. A management system will be developed to provide permits for on-reservation access to cultural materials. Off-reservation materials will be secured through other agencies.

Strategy 10 Fire prescribed for areas outside a buffer zone will include measures to protect adjacent riparian vegetation.

Strategy 11 No building will be erected within 200 feet of a buffer zone. Septic tanks and drain fields will be constructed at least 200 feet from the buffer zone of any classified stream or designated wetland. No new campgrounds will be constructed inside a buffer zone unless they would alleviate resource damage caused by dispersed recreational use.

Strategy 12 Fish screening of water diversions will be subject to the criteria described in the plan:

- Bypass configuration, hydraulic capacity, entrance and transport velocities, and other details will be dependent upon the design of the screening facility, such that the bypass acts in harmony with the screens to readily attract fish and provide safe passage.
- All fish screening facilities must be installed and operational when fish are present at the project.
- The facilities will be operated and maintained to function properly throughout the full range of flows normally occurring during the fish migration.
- Fish screens will be cleaned as frequently as necessary to prevent violation of approach velocity standards or injury to fish. The cleaning method must be effective and reliable, and, in most cases, will be automatic.
- An ongoing inspection, maintenance and repair program will be implemented to assure facilities are free of debris, and that screen

material seals, drive units, bypass entrances, conduits and other components are functioning properly.

Oregon Department of Fish and Wildlife

Lower Deschutes River Subbasin Management Plan (ODFW 1997b)

Goals:

1. Protect, enhance and restore populations of resident and anadromous fish and lamprey in the lower Deschutes River subbasin.
2. Maintain the genetic integrity of endemic resident and anadromous fish and lamprey in the lower Deschutes River subbasin.

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.

Strategy 1.1 Continue to release 300,000 hatchery spring chinook salmon annually from Round Butte Hatchery to satisfy FERC mandated mitigation, with additional experimental groups released as needed. All 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.

Strategy 1.2 Collect spring chinook salmon samples and perform genetic analysis to determine if the Warm Spring River and Shitike Creek spring chinook are separate populations.

Strategy 1.3 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.

Strategy 1.4 Work with CTWS to collect information on juvenile and adult spring chinook in Shitike Creek.

Strategy 1.5 Monitor returns of wild and hatchery spring chinook salmon adults in the lower Deschutes River subbasin through annual harvest census, capture and tagging at Sherars Falls trap, trap capture at the Pelton trap and WSNFH, redd counts on spawning grounds, and carcass surveys in the mainstem river.

Strategy 1.6 Calculate annual preseason salmon run size estimates using the most accurate methods available.

Strategy 1.7 Continue to improve the accuracy of spawning escapement estimate procedures.

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

Strategy 2.1 Monitor returns of wild fall chinook salmon adults in the lower Deschutes River subbasin through annual harvest census, capture and

tagging at Sherars Falls trap, trap capture at the Pelton trap and WSNFH, redd counts on spawning grounds, and carcass surveys in the mainstem river.

Strategy 2.2 Monitor escapement of wild fall chinook into the lower Deschutes River and escapement upstream of Sherars Falls.

Strategy 2.3 Determine life history and genetic characteristics of the fall chinook salmon run.

Strategy 2.4 Calculate annual preseason salmon run size estimates using the most accurate methods available.

Strategy 2.5 Continue to improve the accuracy of spawning escapement estimate procedures.

Objective 3. Maintain an estimated escapement of 6,575 wild adult summer steelhead over Sherars Falls annually.

Strategy 3.1 Continue to release 160,000 summer steelhead smolts annually from Round Butte Hatchery to satisfy FERC mandated mitigation, with additional experimental groups released as needed. All 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.

Strategy 3.2 Monitor returns of wild and hatchery summer steelhead adults in the lower Deschutes River subbasin through annual harvest census, capture and tagging at Sherars Falls trap, trap capture at the Pelton trap and WSNFH and redd counts on spawning grounds.

Strategy 3.3 Calculate annual preseason steelhead run size estimates using the most accurate methods available.

Strategy 3.4 Continue to improve the accuracy of spawning escapement estimate procedures.

Strategy 3.5 Explore the concept of offsite mitigation to benefit wild summer steelhead populations with the operator of the Pelton/Round Butte hydroelectric complex.

Strategy 3.6 Continue to monitor escapement of wild and stray hatchery summer steelhead adults over Sherars Falls.

Strategy 3.7 Monitor summer steelhead spawning in the mainstem lower Deschutes River and tributaries to determine habitat utilization.

Strategy 3.8 Monitor summer steelhead spawning in the mainstem lower Deschutes River and tributaries to determine the hatchery to wild ratio in the spawning population.

Strategy 3.9 Work with other agencies to reduce straying of hatchery summer steelhead into the lower Deschutes River.

Objective 4. Maintain a population of rainbow trout of 1,500 to 2,500 fish per mile larger than eight 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 eight inches in length in the lower Deschutes River below Sherars Falls.

Strategy 4.1 Monitor the distribution and abundance of redband trout and mountain whitefish in the mainstem lower Deschutes River and tributaries.

Strategy 4.2 Monitor the distribution and abundance of redband trout and mountain whitefish in White River above White River Falls.

Objective 5. 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.

Strategy 5.1 Collect genetic data on redband 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.

Strategy 5.2 Monitor the distribution and abundance of hatchery reared salmonids moving out of upstream impoundments and into the lower Deschutes River.

Strategy 5.3 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.

Strategy 5.4 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.

Strategy 5.5 Monitor bull trout abundance and distribution. Cooperate with CTWS to 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 6. Improve the quality and quantity of aquatic habitat.

Strategy 6.1 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.

Strategy 6.2 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.

Strategy 6.3 Achieve and maintain protective fish screening on all unscreened water diversions or pump intakes within the lower Deschutes River subbasin.

Strategy 6.4 Encourage the USFS to enhance aquatic habitat diversity in lakes, reservoirs, wetlands, and seeps within the Mount Hood National Forest.

Strategy 6.5 Encourage irrigation districts and the BOR to improve aquatic habitat diversity within their reservoirs.

Strategy 6.6 Encourage irrigation districts to implement more efficient measures for delivery and use of irrigation water.

Objective 7. Improve the quality and quantity of riparian habitat.

Strategy 7.1 Support implementation of existing land and resource management plans on public land.

Strategy 7.2 Determine the condition and trend of riparian vegetation along the lower Deschutes River and tributaries.

Strategy 7.3 Encourage public and private land managers to implement riparian protection and/or restoration measures along the Deschutes River and tributaries.

Strategy 7.4 Work with NRCS and SWCD to implement farm conservation plans designed to reduce erosion.

Strategy 7.5 Work with DOF and private timber land owners to minimize erosion from forest management activities.

Strategy 7.6 Work with federal land management agencies to minimize erosion from public lands.

Strategy 7.7 Encourage public and private land managers to implement measures to protect and enhance riparian habitat around lakes, ponds and reservoirs.

Objective 8. Improve fish passage at manmade barriers within the lower Deschutes River subbasin.

Strategy 8.1 Initiate an inventory of manmade fish barriers on subbasin streams.

Strategy 8.2 Assist responsible parties in developing remedial measures to eliminate seasonal and total fish passage barriers.

Strategy 8.3 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 9. Maintain or improve water quality in the lower Deschutes River and tributaries.

Strategy 9.1 Work cooperatively with DEQ, the federal Environmental Protection Agency and CTWS to sample water quality at key sites where pollution problems are suspected.

Strategy 9.2 Monitor water temperatures in the lower Deschutes River and tributaries.

Strategy 9.3 Encourage private landowners, federal land managers, NRCS, and SWCD to resolve sediment runoff problems associated with crop and range lands.

Strategy 9.4 Encourage private landowners, NRCS, and SWCD to resolve agricultural chemical, fertilizer, silt, sediment, and animal waste runoff problems associated with crop and range lands or confined animal feeding operations.

Strategy 9.5 Encourage DEQ to establish a sediment standard in streams that includes a beneficial use protection standard for percent fines in spawning gravel.

Objective 10. Establish and maintain instream water rights on all streams in the lower Deschutes River subbasin which exhibit fish and wildlife values.

Strategy 10.1 Apply for instream water rights on streams with existing flow data.

Strategy 10.2 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.

Strategy 10.3 Conduct instream flow studies, using approved methodologies, on all existing or potential fish bearing streams in the lower Deschutes River subbasin. Where surface flows are identified as inadequate, request that the depleted stream be withdrawn from further appropriations during the critical months.

Strategy 10.4 Review and comment on water right applications.

Strategy 10.5 Measure instream flows for compliance with established instream water rights as necessary. When instream flows are found to be below levels protected by instream water rights, inform the local Watermaster for enforcement. Encourage WRD to monitor consumptive water use to verify that use does not exceed individual rights.

Objective 11. Maintain or improve upland watershed conditions to sustain the long-term production of high quality water.

Strategy 11.1 Implement and enforce provisions of the Lower Deschutes Agricultural Water Quality Plan.

Strategy 11.2 Enforce those portions of the Oregon Forest Practices Act designed to protect water quality and the integrity of fish bearing streams.

Strategy 11.3 Encourage compliance with the Aquatic Conservation Strategy portion of the USDA Forest Service Northwest Forest Plan.

Strategy 11.4 Develop and/or implement other land and resource management plans that will result in improved water quality and stream habitat in the subbasin.

Wasco County Soil and Water Conservation District

Wasco County SWCD is currently involved in three watershed enhancement projects in the lower Deschutes River subbasin. Objectives and strategies have been developed for Buck Hollow Creek, Bakeoven Creek and the White River under subbasin-wide SWCD goals:

1. Promote and protect the natural resources of the districts and the areas included in their watersheds.
2. Identify and prioritize natural resource concerns within the districts.
3. Maintain current natural resource condition assessments within the districts.
4. Obtain necessary technical, educational and financial resources to address local conservation needs.

Buck Hollow Watershed

Objective 1. Evaluate effectiveness of long-term watershed enhancement effort in the Buck Hollow watershed.

Strategy 1.1 Design and implement a monitoring and evaluation program for Buck Hollow Creek.

Strategy 1.2 Monitor trends in watershed health as land treatment activities conclude.

Objective 2. Accelerate habitat and water quality improvements in the Buck Hollow watershed.

Strategy 2.1 Work with private landowners on implementation of riparian buffer systems to accelerate shading of degraded reaches, vegetative stabilization of riparian areas, and reduction in stream width/depth ratios, and corresponding reduction in thermal inputs during summer.

Bakeoven Watershed

Objective 1. Restore fish habitat and reduce high summer water temperatures in the Bakeoven watershed.

Strategy 1.1 Work with private landowners to establish riparian buffer systems on Bakeoven and Deep creeks.

Strategy 1.2 Continue land treatment programs to moderate hydrograph, reducing peak runoffs and enhancing late season stream flows.

Strategy 1.3 Actively revegetate degraded stream reaches in Bakeoven Creek and principal tributaries.

Strategy 1.4 Implement measures to increase quantity of pools in Bakeoven Creek to increase cold water refuges.

White River Watershed and Juniper Flat Area

Objective 1. Reduce sediment inputs to streams in the White River watershed.

Strategy 1.1 Stabilize eroding stream banks using vegetation, rock barbs, and other environmentally friendly soil bio-technical engineering methods.
Strategy 1.2 Assist private landowners in converting from conventional tillage operations to sustainable direct-seed / no-till systems.
Strategy 1.3. Work with private landowners to implement riparian buffer systems.

Objective 2. Develop a watershed restoration plan for the White River watershed.

Strategy 2.1 Conduct watershed assessment.
Strategy 2.2 Involve agencies, landowners, and stakeholders in the planning process.

Objective 3. Improve water quality and quantity in streams in the White River watershed.

Strategy 3.1 Provide technical, financial, and educational assistance to communities in the watershed, aimed at reducing community water quality impacts.
Strategy 3.2 Provide technical, financial, and educational assistance to irrigation districts to improve water use efficiency and measurement accuracy.
Strategy 3.3 Work with irrigation districts and appropriate state agencies to convert portions of water savings to instream water rights.

Lower Deschutes River Local Advisory Committee

Lower Deschutes Agricultural Water Quality Management Area Plan. (2000)
Goal:
Prevent or control water pollution from agricultural activities and to achieve applicable water quality standards.

Objective 1. Control soil erosion on uplands to acceptable rates.

Objective 2. Achieve stable streambanks.

Objective 3. Prevent the following, which are already prohibited under ORS 468B:

- **Activities that cause pollution of any waters of the state, or place or cause to be placed any wastes in a location where such wastes are likely to escape or be carried into the waters of the state by any means.**
- **Discharge of any wastes into the waters of the state if the discharge reduces the quality of such waters below the water quality standards established by rule for such waters by the Environmental Quality Commission.**
- **Violation of conditions of any waste discharge permit issued under ORS 468B or ORS 568. Wastes includes but is not limited to commercial fertilizers, soil amendments, composts, animal wastes, vegetative materials, or any other wastes as defined in ORS 468B.005(7).**

Objective 4. Provide adequate riparian vegetation for streambank stability and stream shading consistent with site capability.

Strategy 1. Work to improve the quality of water in the Management Area through planning and implementation of technically sound and economically feasible conservation practices that contribute to meeting Area Plan objectives.

Strategy 2. Create a high level of awareness and an understanding of water quality issues among the agricultural community and rural public in a manner that minimizes conflict and encourages cooperative efforts through education and technical assistance activities.

Strategy 3. Encourage active participation by the agricultural community and rural public in the process of solving water quality problems.

Strategy 4. Encourage adequate funding and administration of the program to achieve Area Plan goals and objectives by systematic, long-range planning and focusing of coordinated efforts on full-scale, watershed-based approaches, identifying needs, developing projects, actively seeking funding, and ensuring successful implementation of funded projects.

Strategy 5. Enforce compliance with required measures.

Existing Goals, Objectives and Strategies – Pelton/Round Butte Project

Fish Goals

Oregon Department of Fish and Wildlife

Crooked River Subbasin Fish Management Plan (ODFW 1996a)

Goals:

1. Maintain, enhance and restore populations of resident fish in the Pelton/Round Butte Project Area.
2. Maintain genetic integrity of endemic fish species in the Pelton/Round Butte Project Area.
3. Provide recreational angling opportunities for a variety of fish species.

Existing Goals, Objectives and Strategies – Metolius River

Fish Goals

Oregon Department of Fish and Wildlife

Metolius River Subbasin Fish Management Plan (ODFW 1996b)

Goals:

1. Maintain, enhance and restore populations of resident fish in the Metolius River subbasin.
2. Maintain genetic integrity of endemic fish species in the Metolius River subbasin.
3. Provide recreational angling opportunities for a variety of fish species.

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

Strategy 1.1 Expand the current wild trout life history studies to identify other possible spawning and rearing areas and better define population characteristics including size and age at maturity, spawning frequency, and migration patterns.

Strategy 1.2 Monitor fish population trends in the Metolius River and tributaries. Population trends will be determined through actions such as statistical creel surveys, electrofishing (where feasible), trapping, snorkeling, and spawning ground surveys.

Strategy 1.3 Determine the need for additional or modified angling regulations to protect populations of redband trout, bull trout, kokanee salmon, and mountain whitefish by monitoring the production, harvest, catch rate, and hooking mortality in Metolius River fisheries.

Strategy 1.4 Conduct periodic sampling of biochemical and meristic characteristics of redband trout, kokanee salmon, and bull trout. Establish baseline data on these parameters for mountain whitefish.

Strategy 1.5 Work with USFS, BLM, the Confederated Tribes of the Warm Springs Indian Reservation, Portland General Electric, private forest owners, conservation groups, and other interested publics, in the development of a bull trout conservation plan for the Metolius/ Lake Billy Chinook population complex. Determine and prioritize future work on limiting factors for such items as instream habitat, harvest, migration barriers, and interactions with introduced species, i.e. brook trout. Determine the feasibility of returning bull trout to former habitats in the Metolius basin, including areas such as Lake Creek, Link Creek, and Suttle Lake.

Strategy 1.6 Work with USFS, BLM, the Confederated Tribes of the Warm Springs Indian Reservation, Portland General Electric, private forest owners, conservation groups, and other interested publics, in the development of a redband trout conservation plan for the Metolius population complex. Determine and prioritize future work on limiting factors for such items as instream habitat, harvest, migration barriers, and interactions with introduced species.

Objective 2. Manage fish populations to provide angling opportunities for a diverse fishery on naturally produced redband trout, bull trout, brook trout, brown trout, kokanee salmon, and mountain whitefish.

Strategy 2.1 Implement strategies 1.2 and 1.3 to satisfy wild fish population monitoring requirement under this objective.

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

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

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

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

Strategy 2.6 Evaluate current angling regulations to determine opportunities to provide more catch of abundant species such as mountain whitefish, without affecting sustainability of any wild fish species.

Strategy 2.7 Determine the need for additional or modified angling regulations in the Metolius River and downstream in Lake Billy Chinook to protect populations of wild bull trout by monitoring the production, catch rate, harvest, and hooking mortality in Metolius River and Lake Billy Chinook fisheries.

Strategy 2.8 Develop an information and education program to enhance angler awareness of the status and life history requirements of bull trout.

Objective 3. Develop subbasin specific knowledge that integrates fish distribution and abundance information, habitat characteristics, habitat restoration opportunities, and sensitive watershed areas into the Department's Habitat Database system.

Strategy 3.1 Inventory stream and watershed characteristics that affect fish production.

Strategy 3.2 Promote increased interagency sharing of inventory information.

Strategy 3.3 Coordination with USFS, BLM, private landowners, and volunteers, to survey streams to determine specific habitat problems and opportunities for habitat protection projects.

Strategy 3.4 Ensure that all survey information is entered into the Habitat Database system.

Objective 4. Protect, enhance, and restore wild fish habitat in the Metolius River subbasin.

Strategy 4.1 Use USFS surveys and ODFW Physical and Biological surveys to determine the most effective locations and types of restoration activities.

Strategy 4.2 Plan and implement habitat restoration activities in cooperation with USFS, CTWS, PGE and other interested parties, when the USFS Wild and Scenic planning process is complete.

Strategy 4.3 Evaluate restoration work to measure success in increasing fish populations and habitat quality/quantity.

Strategy 4.4 Work with the Sisters Ranger District, Jefferson County, and other property owners to minimize future damage to riparian areas and repair past damage from the impact of campgrounds, river trails, and other development.

Strategy 4.5 Educate the public about the importance of fish habitat protection and restoration in the Metolius River subbasin.

Strategy 4.6 Seek protection of instream flows necessary to maintain wild fish habitat.

Strategy 4.7 Implement fish passage and screening projects on existing barriers and surface water diversions.

Objective 5. Pursue feasible means of restoring anadromous populations of spring chinook and sockeye salmon to the Metolius River.

Strategy 5.1 Conduct a feasibility study to determine if it is physically and biologically possible to restore spring chinook and sockeye salmon to the Metolius River.

Strategy 5.2 Assess risks and impacts of anadromous reintroduction on resident fish populations.

Existing Goals, Objectives and Strategies – Crooked River

Fish Goals

Oregon Department of Fish and Wildlife

Crooked River Subbasin Fish Management Plan (ODFW 1996a)

Goals:

1. Maintain, enhance and restore populations of resident fish in the Crooked River subbasin and Willow Creek.
2. Maintain genetic integrity of endemic fish species in the Crooked River subbasin and Willow Creek.
3. Provide recreational angling opportunities for a variety of fish species.

Objective 1. Protect, restore, and enhance fish habitat in the Crooked River basin, Willow Creek, and reservoirs.

Strategy 1.1 Continue advisory role and support enforcement of existing laws and regulations concerning habitat protection by agencies with enforcement authority such as USFS, Oregon Department of Forestry, Crook, Grant, and Wheeler Counties, ODEQ, BLM, Oregon State Police and Division of State Lands.

Strategy 1.2 Coordinate and provide technical input to provide management of riparian areas, uplands, and water quality along the mainstem Crooked River and its tributaries to achieve vegetative potential to optimize fish production.

Strategy 1.3 Plan and implement habitat restoration and enhancement activities in cooperation with USFS, BLM, Crook County Soil and Water

Conservation District, CREEC, PGE, Ochoco and North Unit irrigation districts, private landowners, volunteers and sportsman organizations such as Trout Unlimited. Identify habitat deficiencies and sites for habitat restoration projects in steams and reservoirs.

Strategy 1.4 Negotiate with BOR, private landowners, irrigation districts, and other water management entities to investigate the feasibility of reducing annual reservoir drawdown and seasonal fluctuations in irrigation reservoirs associated with water releases.

Strategy 1.5 Implement habitat protection and improvement actions listed below under Objectives 2,3, and 4.

Strategy 1.6 Encourage Crook County to enforce its new 1993 Comprehensive County Land Use Plan and abide by the 100 ft. setback required by the plan for new housing developments.

Objective 2. Maintain or improve instream flow for fish production in the Crooked River and tributaries, and Willow Creek.

Strategy 2.1 Identify stream reaches that would benefit from instream water rights and apply to OWRD for designations.

Strategy 2.2 Collect data to evaluate minimum and optimum water flows for fish.

Strategy 2.3 Encourage irrigators (through education and financial assistance where available) to improve water distribution and application techniques in an effort to use less water more efficiently in order to improve instream flow.

Strategy 2.4 Investigate the feasibility of purchasing, gifting or leasing water rights to improve instream flows.

Strategy 2.5 Encourage the OWRD to require legal flow measuring devices on diversions and improved supervision and enforcement.

Strategy 2.6 Encourage and work with landowners, managers and enforcement agencies to improve upland and riparian management to restore the watershed's ability to store and release water.

Objective 3. Maintain or improve instream flows for fish production in the lower Crooked River below Bowman Dam from uncontracted storage in Prineville Reservoir.

Strategy 3.1 Continue to negotiate with OWRD, BOR, OID, NUID, BLM, CREEC, conservation groups, and other interested publics and state agencies, in the development of a strategy to allocate and manage water jointly from Prineville Reservoir for irrigation, reservoir, and river needs.

Strategy 3.2 Collect funds to purchase uncontracted storage and for annual operation and maintenance fees assigned to water for recreation and fish and wildlife.

Strategy 3.3 Encourage irrigators (through education and financial assistance where available) to improve water distribution and application techniques in

an effort to use less water more efficiently in order to improve instream flow.

Strategy 3.4 Once consensus is reached with agencies, publics and irrigation districts, work with elected representative to approve reauthorization of Crooked River Project to provide water for recreation, fish and wildlife.

Strategy 3.5 Encourage the OWRD to require legal flow measuring devices on diversions and improved supervision and enforcement to ensure water allocated to the river is not appropriated.

Strategy 3.6 Work with BOR and OID to improve coordination and communication on gate and spillway inspections. Encourage minimum flows of 25-30 cfs during spillway inspections with a minimal shutoff time for gate inspections. Encourage BOR to test alternative methods of gate and spillway inspections that may not require SCUBA diving.

Objective 4. Improve the water quality of the Crooked River basin, Willow Creek and reservoirs.

Strategy 4.1 Coordinate with state, county and federal land management agencies to improve monitoring and enforcement of water quality standards.

a. Urge ODEQ, Oregon State Police (OSP), USFS, and BLM to increase water quality monitoring and enforcement, especially in important fish production areas.
b. Determine point and non-point pollution sources.
c. Develop a strategy plan to address point and non-point source pollution in cooperation with state and federal agencies.

Strategy 4.2 Promote riparian zone and upland protection as a means of improving water quality for the future.

a. Coordinate with county, state and federal agencies for the establishment and maintenance of quality riparian zones in agricultural, range, urban and forest zones.
b. Coordinate with county, state, and federal agencies to protect upland areas from degrading land management activities.

Objective 5. Improve water quality in the lower Crooked River below Prineville Reservoir, specifically for nitrogen super-saturation during high water runoff and sewage releases from the City of Prineville treatment plant. Improve water quality in Ochoco Creek, specifically for elevated levels of mercury.

Strategy 5.1 Continue to work with BOR and OID to design and modify the outlet structure and spillway at Bowman Dam to reduce or eliminate nitrogen entrainment at high discharge flows.

Strategy 5.2 Continue to work with ODEQ, the City of Prineville, OID, and BOR to regulate flows in the Crooked River to maintain dilution of treatment

wastes. Work with management entities to find alternative ways to eliminate discharge into the river.

Strategy 5.3 Continue to work with the USFS and ODEQ to identify mercury sources and reduce contamination of Canyon and Ochoco creeks.

Strategy 5.4 Coordinate with state, county and federal land management agencies to improve monitoring and enforcement of water quality standards.

a. Urge ODEQ, EPA, and BOR, and BLM to increase water quality monitoring especially in important fish production and angling areas.
b. Develop an action plan to address point source pollution in cooperation with state and federal agencies.

Objective 6. Prevent fish losses at unscreened diversions and provide adequate upstream and downstream passage for fish at dams, culverts and other artificial obstructions in the Crooked River basin and Willow Creek.

Strategy 6.1 Inventory irrigation and other water diversions for adequacy of screening to protect trout in the Crooked River and tributaries, and Willow Creek.

Strategy 6.2 Prioritize unscreened diversions for installation of screens and coordinate this with the screening program (Fish Division, ODFW). Diversions affecting wild trout will have highest priority.

Strategy 6.3 Install screens in priority order.

Strategy 6.4 Evaluate suspected upstream passage problems at Peterson Creek Reservoir and Allen Creek Reservoir and various other smaller impoundments or instream diversions. Recommend and implement improvements.

Strategy 6.5 Inventory road culverts for fish passage problems. Make recommendations to the USFS, BLM or appropriate landowners to improve upstream passage at culverts.

Strategy 6.6 Work with the ODFW Fish Passage Coordinator to identify and prioritize passage barriers and establish an implementation schedule for installation of fishways on private lands.

Objective 7. Protect the genetic diversity, adaptiveness and abundance of wild redband trout in the Crooked River and its tributaries.

Strategy 7.1 Monitor population trends of redband trout and warmwater fish in selected index reaches of the North and South forks, and mainstem Crooked River, Beaver, Bear and Sanford creeks, and tributaries.

Strategy 7.2 Verify and document distribution, abundance, and upper limits of rainbow trout, brook trout, brown trout, smallmouth bass, and brown bullhead in the North Fork and South Fork Crooked River, Beaver

Creek and tributaries. Assess the status of sensitive redband trout populations in the upper Crooked River basin.

Strategy 7.3 Determine the need for additional or modified angling regulations to protect populations of wild redband trout by monitoring production, harvest, and catch rate in upper Crooked River basin fisheries.

Strategy 7.4 Establish baseline data and continue periodic sampling of genetic characteristics of redband trout with the use of biochemical (electrophoresis) and meristic parameters.

Strategy 7.5 Monitor presence and interaction between hatchery and wild rainbow trout according to provisions in the Wild Fish Management Policy (ODFW 1990) by sampling trout composition in rearing and spawning areas. Modify the numbers, locations, frequency, timing and types of hatchery rainbow trout stocked in Prineville and Antelope Flat reservoirs and private impoundments, if necessary to protect the genetic resources of wild fish. Construct screens where feasible to prevent egress of hatchery rainbow trout into streams with wild redband trout.

Strategy 7.6 Monitor presence and interaction between introduced brook and brown trout and native redband populations. Consider angling regulations or feasibility of removing introduced species if necessary to protect wild redband trout.

Strategy 7.7 Work with USFS, BLM, CREEC, private landowners, conservation groups, and other interested publics, in the development of a redband trout recovery plan for the upper Crooked River basin complex. Determine and prioritize future work on limiting factors such as instream habitat, harvest, migration barriers, and interaction with introduced species.

Objective 8. Protect or maintain the genetic diversity, adaptiveness, and abundance of wild redband trout in the Crooked River and tributaries below Prineville Reservoir.

Strategy 8.1 Monitor population trends of trout and warmwater fish distribution and abundance in selected index reaches of the mainstem Crooked River and tributaries below Prineville Reservoir, including Ochoco and McKay Creeks.

Strategy 8.2 Verify and document distribution and upper limits of rainbow trout in the mainstem Crooked River, and tributaries below Prineville Reservoir, including Ochoco and McKay creeks. Assess the status of sensitive redband trout in the mainstem Crooked River, and tributaries below Prineville Reservoir, including Ochoco and McKay creeks.

Strategy 8.3 Determine the need for additional or modified angling regulations to protect populations of wild redband trout by monitoring production, harvest, and catch rate in the lower Crooked River basin fisheries.

Strategy 8.4 Establish baseline data sets on the genetic characteristics of redband rainbow trout with the use of biochemical (electrophoresis), DNA and phenotypic parameters.

Strategy 8.5 Monitor presence and interaction between hatchery and wild rainbow trout according to provisions in the Wild Fish Management Policy (ODFW 1990) through sampling trout composition in rearing and spawning areas. Modify the numbers, locations, frequency, timing and types of hatchery rainbow trout stocked in Prineville and Ochoco reservoirs, Walton Lake and private impoundments, if necessary, to protect the genetic resources of wild fish. Construct screens where feasible to prevent egress of hatchery trout into streams with wild redband trout.

Strategy 8.6 Determine the feasibility of restoring wild redband trout to Ochoco Creek below Ochoco Reservoir.

Strategy 8.7 Monitor presence and interaction between introduced hatchery rainbow and brook trout and native redband trout populations. Consider angling regulations or feasibility of removing introduced species if necessary to protect wild redband trout.

Strategy 8.8 Work with USFS, BLM, CREEC, private landowners, conservation groups, and other interested publics, in the development of a redband trout recovery plan for the lower Crooked River basin complex.

Strategy 8.9 Determine and prioritize future work on limiting factors such as instream habitat, harvest, migration barriers, and interactions with introduced species.

Objective 9. Provide angling opportunities for wild trout in the mainstem Crooked River and its tributaries.

Strategy 9.1 Evaluate angling pressure and harvest rates of wild redband trout through creel surveys on key stream reaches to determine harvest effects on populations.

Strategy 9.2 Develop an information and education program to enhance angler awareness of the sensitive status and life history requirements of wild redband trout.

Strategy 9.3 Develop information brochures of flowing water bodies to highlight diverse angling and recreation opportunities.

Objective 10. Provide harvest and angling opportunities for quality size hatchery rainbow trout in a semi-remote setting along the South Fork Crooked River.

Strategy 10.1 Continue to release 15,000 rainbow fingerling at 40/lb. upstream of the confluence of Twelvemile Creek (RM 20) during summer or early fall.

Strategy 10.2 Evaluate optimum size, stock and time of release of hatchery rainbow trout to better meet this objective.

Strategy 10.3 Monitor abundance, size, and age composition of rainbow trout in South Fork Crooked River by conducting periodic angler creel and electrofishing surveys.

Strategy 10.4 Continue angling restrictions (i.e., two fish limit, exclusive use of flies, and artificial lures with barbless hooks) that allow a greater percentage of the population to reach 15 inches, optimize catch rate, and minimize hooking mortality of fish released.

Strategy 10.5 Investigate feasibility of developing a Crooked River redband trout strain for stocking the South Fork Crooked River.

Strategy 10.6 Continue to monitor the trout population for potential production of native fish.

Objective 11. Provide additional angling access and angling opportunities along the Crooked River and tributaries.

Strategy 11.1 Evaluate opportunities to develop access to private land.

Strategy 11.2 As opportunities become available, form partnerships with landowners or managers to provide access sites or purchase easements throughout the Crooked River and tributaries above Prineville Reservoir.

Strategy 11.3 Evaluate opportunities to develop public access at Upper Falls; Grays, Little Summit, Big Summit and Antler Prairies, and Peterson Creek, Shady Creek, and Allen Creek Reservoirs.

Strategy 11.4 Evaluate opportunities for purchase of private lands with high public fishery and riparian values for management by state or federal entities.

Strategy 11.5 Evaluate feasibility and opportunity to construct additional impoundments on headwater tributaries for lake fishing opportunities.

Objective 12. Provide angling opportunities for wild redband trout, mountain whitefish and introduced rainbow trout in the mainstem Crooked River and tributaries below Prineville Reservoir.

Strategy 12.1 Evaluate angling pressure and harvest rates of wild redband and hatchery rainbow trout through creel surveys on key stream reaches to determine consumptive use and impacts on wild populations.

Strategy 12.2 Develop an information and education program to enhance angler awareness of the sensitive status and life history requirements of wild redband trout.

Strategy 12.3 Develop information brochures of flowing water bodies to highlight diverse angling and recreation opportunities.

Strategy 12.4 Implement a cooperative enforcement, information, and education program with OSP to ensure compliance with regulations.

Strategy 12.5 Publicize information on the desirable attributes of whitefish as a game fish, and associated angling opportunities in the lower Crooked River and lower Ochoco Creek.

Strategy 12.6 Evaluate current angling opportunities to provide more catch of abundant species such as mountain whitefish, without affecting sustainability of wild trout.

Strategy 12.7 Evaluate alternative opportunities for juvenile only fishing areas such as the ponds below Ochoco Reservoir.

Objective 13. Provide additional public boat and bank angling access.

Strategy 13.1 Evaluate opportunities to develop access to private land.

Strategy 13.2 As opportunities become available, form partnerships with landowners or managers to provide access or purchase easements for access sites throughout the Crooked River and tributaries below Prineville Reservoir.

Strategy 13.3 Evaluate opportunities for purchase of private lands with high public fishery and riparian values for management by state or federal entities.

Strategy 13.4 Evaluate feasibility and opportunity to construct additional impoundments on headwater tributaries for lake fishing opportunities.

Strategy 13.5 Evaluate opportunities to develop public access through the City of Prineville.

Existing Goals, Objectives and Strategies – Upper Deschutes River

Fish Goals

Oregon Department of Fish and Wildlife

Upper Deschutes River Subbasin Fish Management Plan (ODFW 1996d)

Goals:

1. Maintain, enhance and restore populations of resident fish in the upper Deschutes River subbasin.
2. Maintain genetic integrity of endemic fish species in the upper Deschutes River subbasin.
3. Provide recreational angling opportunities for a variety of fish species.

Deschutes River and Tributaries – Lake Billy Chinook to Bend

Objective 1. Maintain genetic diversity, adaptiveness, and abundance of redband trout, bull trout, mountain whitefish, brown trout, and brook trout.

Strategy 1.1 Establish baseline data sets on genetic characteristics of redband trout using biochemical (electrophoresis) and phenotypic parameters and compare to existing electrophoretic data from other areas in the Deschutes basin.

Strategy 1.2 Document and establish life histories and monitor population trends of trout and whitefish. Population trends will be determined by periodic creel surveys, snorkel surveys, electrofishing, and spawning ground surveys. Studies will be developed in cooperation with co-managers.

Strategy 1.4 Determine the need for and implement additional or modified angling regulations to protect populations of trout and whitefish by monitoring their production, harvest, and catch rate.

Strategy 1.5 Work to modify the flow regime in this section of river to improve habitat quality and quantity.

Strategy 1.6 Pursue retrofit of irrigation and hydropower diversions with appropriate fish passage and protection facilities to allow fish movement and reduce fish mortality.

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

Strategy 2.1 Conduct periodic inventories to assess size, growth, abundance, and condition of trout and whitefish to ensure that recreational fishery demands are met.

Strategy 2.2 Monitor angler effort and catch through creel surveys.

Strategy 2.3 Publicize information on the desirable attributes of whitefish and opportunities to fish for them.

Strategy 2.4 Based on inventories and creel surveys, determine the need for additional or modified angling regulations to achieve management objectives.

Objective 3. Provide a fishery for large bull trout from Steelhead Falls to Lake Billy Chinook.

Strategy 3.1 Determine the need for additional or modified angling regulations in the Deschutes River and downstream in Lake Billy Chinook to protect populations of bull trout by monitoring the production, catch rate, harvest, and hooking mortality in Deschutes River and Lake Billy Chinook fisheries.

Strategy 3.2 Develop an information and education program to enhance angler awareness of the status and life history requirements of bull trout.

Strategy 3.3 Conduct periodic angler surveys to estimate catch rates and angler effort in order to monitor success of meeting this objective.

Strategy 3.4 Implement a cooperative enforcement and information and education program with OSP to ensure compliance with regulations.

Strategy 3.5 Post signs at popular fishing sites informing anglers of how to identify and correctly release bull trout.

Objective 4. Determine feasibility of restoring anadromous fish above Round Butte Dam into the river between Lake Billy Chinook and Steelhead Falls.

Strategy 4.1 A feasibility study will be conducted to determine if it is possible to restore spring chinook and summer steelhead to this section of the Deschutes River.

Objective 5. Protect, enhance, and restore habitat for redband trout, bull trout, and mountain whitefish.

Strategy 5.1 Develop strong partnerships with irrigation districts, irrigators and hydroelectric operators (through education and financial assistance where available) to improve water distribution and application techniques in an effort to use less water more efficiently in order to establish increased minimum flows necessary to maintain aquatic life and retrofit facilities to reduce fish mortality and provide passage.

Strategy 5.2 Add spawning size gravel at suitable locations in the Deschutes River and tributaries to optimize spawning potential.

Strategy 5.3 Add wood and/or rock structure to the Deschutes River and tributaries where appropriate to improve habitat productivity for adult and juvenile fish.

Strategy 5.4 Replant the riparian area with a variety of plant species to provide a source of large and small woody debris, bank stability, and shade.

Strategy 5.5 Seek opportunities such as water leases, water transfers, and off-stream storage or other conservation measures in order to improve instream flow for this section of the river.

Objective 6. Maintain and improve access.

Strategy 6.1 Evaluate opportunities to develop access to private land.

Strategy 6.2 As opportunities become available, form partnerships with landowners or managers to provide foot access or purchase easements for foot access sites throughout this segment of the Deschutes River.

Deschutes River and Tributaries – Bend to Wickiup Dam

Objective 1. Maintain genetic diversity, adaptiveness, and abundance of redband trout and mountain whitefish.

Strategy 1.1 Conduct wild trout life history studies to identify spawning and rearing areas and better define population characteristics including size and age at maturity, spawning frequency, and migration patterns.

Strategy 1.2 Monitor population trends of fishes in the Deschutes River and tributaries. Population trends will be determined through such methods as creel surveys, electrofishing, trapping, snorkeling, and spawning ground surveys.

Strategy 1.3 Establish baseline data sets on genetic characteristics of redband trout using biochemical (electrophoresis) and phenotypic parameters and

compare to existing electrophoretic data from other areas in the Deschutes basin.

Strategy 1.4 Modify the numbers, locations, frequency, timing, and types of hatchery rainbow trout stocked in the Deschutes River above Benham Falls to protect the genetic resources of wild fish. *C. shasta* susceptible stocks of hatchery fish will no longer be stocked.

Strategy 1.5 Monitor survival of hatchery rainbow trout stocked in the mainstem Deschutes to assess potential genetic and ecological risks to redband trout in this section of river.

Strategy 1.6 Implement angling regulations necessary to sustain sensitive populations of redband trout.

Strategy 1.7 Pursue means to restore winter flow and minimize flow fluctuations to maintain habitat quality and reduce habitat damage.

Strategy 1.8 Implement screening and passage projects on unscreened diversions and where passage barriers exist.

Objective 2. Provide diverse angling opportunities for a non-consumptive fishery on redband trout and a consumptive fishery on hatchery rainbow trout, mountain whitefish and naturally-produced brown trout, kokanee, and brook trout above Benham Falls, including Fall and Spring rivers; provide a non-consumptive fishery on redband trout and a consumptive fishery on brown trout, kokanee, and mountain whitefish below Benham Falls.

Strategy 2.1 Stock *C. shasta* resistant, marked hatchery rainbow trout in the mainstem Deschutes River in locations, timing, frequency, and seasons consistent with sustaining wild fish populations. Up to 25,000 fish would be stocked annually.

Strategy 2.2 Annually stock Fall River above the falls with up to 15,000 legal-size hatchery rainbow trout.

Strategy 2.3 Observe spawning areas throughout this section of the Deschutes River during spawning season to monitor hatchery/wild ratio for compliance with WFMP.

Strategy 2.4 Conduct periodic creel surveys to estimate catch rates, species composition, and angler effort in order to monitor success of meeting this objective.

Strategy 2.5 Publicize information on the desirable attributes of whitefish as a game fish and associated angling opportunities.

Strategy 2.6 Develop an information and education program to enhance angler awareness of the status and life history requirements of sensitive species such as redband trout.

Strategy 2.7 Educate Deschutes River anglers on how to catch and release wild fish unharmed. Post signs at popular fishing sites informing anglers of how to identify and correctly release wild trout.

Strategy 2.8 Implement a cooperative enforcement and information and education program with OSP to ensure compliance with regulations.

Objective 3. Protect, enhance, and restore trout and whitefish habitat.

Strategy 3.1 Continue to work with the irrigators, OWRD, US Forest Service, and the public to restore winter flows, minimize flow fluctuations, and reduce the loss of fish habitat.

Strategy 3.2 Add spawning size gravel at suitable locations in the Deschutes River and tributaries to optimize spawning potential.

Strategy 3.3 Add wood and/or rock structure to the Deschutes River and tributaries to improve habitat productivity for adult and juvenile fish.

Strategy 3.4 Replant the riparian area with a variety of plant species to provide a source of large and small woody debris, bank stability, and shade.

Strategy 3.5 Seek opportunities such as water leases, water transfers, and off-stream storage or other conservation measures in order to improve instream flow for this section of the river.

Strategy 3.6 Implement screening and passage projects on unsreened diversions and manmade structures that create fish passage barriers.

Objective 4. Maintain and improve access to the Deschutes River between Wickiup Dam and Bend, Fall River and Spring River for boat and bank anglers.

Strategy 4.1 Seek opportunities to develop river access for the public on private lands.

Strategy 4.2 As opportunities become available, form partnerships with landowners or managers to provide access or purchase easements for bank and boat access sites in the Deschutes River from Wickiup Dam to Bend, Fall and Spring rivers.

Little Deschutes River and Tributaries

Objective 1. Maintain the genetic diversity, adaptiveness, and abundance of redband trout, mountain whitefish and introduced brown and brook trout in the Little Deschutes River drainage.

Strategy 1.1 Establish trout population trends, distribution and abundance in selected index sections of the Little Deschutes River and tributaries.

Strategy 1.2 Verify and document distribution and upper limits of redband, brown, and brook trout and mountain whitefish in the Little Deschutes River and tributaries.

Strategy 1.3 Assess the status of sensitive redband trout in the Little Deschutes River and tributaries.

Strategy 1.4 Establish baseline data on the genetic characteristics of redband trout with the use of biochemical and phenotypic parameters.

Objective 2. Provide diverse angling opportunities for wild trout and whitefish in the Little Deschutes River and tributaries.

Strategy 2.1 Evaluate angling pressure and harvest rates of wild trout through creel surveys on key stream sections to determine consumptive use and impacts on wild populations.

Strategy 2.2 Determine the need for additional or modified angling regulations to protect populations of wild trout by monitoring the production, harvest, and catch rate of wild trout and to provide non-consumptive angling opportunities.

Objective 3. Protect, restore and enhance wild trout and whitefish habitat in the Little Deschutes River and tributaries.

Strategy 3.1 Support enforcement of existing laws and regulations concerning habitat protection by agencies with enforcement authority such as USFS, ODWR, DOF, DEQ, and Klamath and Deschutes counties.

Strategy 3.2 Coordinate and provide technical input in management of all riparian areas along the Little Deschutes River and tributaries to achieve vegetative potential to optimize fish production.

Strategy 3.3 Identify habitat deficiencies and sites for habitat improvement projects.

Strategy 3.4 Develop a habitat improvement plan for the Little Deschutes River and tributaries.

Strategy 3.5 Work with volunteers, sporting clubs, landowners and agencies to implement habitat improvement projects.

Strategy 3.6 Implement habitat protection actions outlined in this document.

Objective 4. Maintain or improve flow for fish production in the Little Deschutes River and tributaries.

Strategy 4.1 Identify stream sections that would benefit from instream water rights and apply to Oregon Department of Water Resources for designations.

Strategy 4.2 Encourage irrigators (through education and financial assistance where available) to improve water distribution and application techniques in an effort to use less water more efficiently.

Strategy 4.3 Encourage the Water Resources Department to require legal flow measuring devices on diversions and improved supervision and enforcement.

Objective 5. Improve the water quality of the Little Deschutes River and tributaries.

Strategy 5.1 Coordinate with state and county agencies to improve monitoring and enforcement of water quality standards.

a. Urge the Department of Environmental Quality to increase water quality monitoring especially in important fish production areas.
b. In joint responsibility with the Department of Environmental Quality, determine point and non-point pollution sources.
c. Develop an action plan to address point and non-point source pollution in cooperation with state and federal agencies.

Strategy 5.2 Promote riparian zone protection as a means maintaining and/or improving water quality for the future.

a. Coordinate with county and state agencies and actively pursue regulations for the establishment and maintenance of quality riparian zones in agricultural and urban lands.
b. Investigate opportunities for purchase or lease of riparian areas.

Objective 6. Prevent fish losses at unscreened diversions in the Little Deschutes River and tributaries.

Strategy 6.1 Inventory irrigation and other water diversions to determine screening needs to protect trout and whitefish in the Little Deschutes River and tributaries.

Strategy 6.2 Prioritize unscreened diversions for installation of screens and coordinate this with the screening program with the Habitat Conservation Division, ODFW. Diversions affecting sensitive wild trout will have highest priority.

Strategy 6.3 Install screens in priority order.

Objective 7. Provide adequate upstream and downstream passage for fish at dams, road culverts, and other artificial obstructions.

Strategy 7.1 Evaluate newly constructed fish ladder at Gilchrist Mill Pond dam for adequate fish passage.

Strategy 7.2 Inventory culverts for fish passage problems. Make recommendations to the USFS or appropriate landowner to improve upstream passage at culverts.

Strategy 7.3 Work with the ODFW Fish Passage Coordinator to establish and implementation schedule for installation of fishways on private lands.

Objective 8. Determine if it is feasible to restore bull trout in the Little Deschutes River and tributaries.

Strategy 8.1 A feasibility study will be conducted to determine if the reintroduction is technically possible and what biological, social, and economic factors would be involved.

Deschutes Soil and Water Conservation District

Deschutes Soil and Water Conservation District Annual Work Plan, 2000-2001.

Goal:
Provide local leadership, education, motivation, and assistance to the citizens of Deschutes County for responsible and efficient stewardship of our soil and water resources.

Objective 1. Strengthen cooperative efforts with producers, government agencies, and the public.

Strategy 1.1 Develop and enhance conservation partnerships to recognize change in conservation priorities, agencies and programs.

Objective 2. Promote water conservation and watershed-level improvements.

Strategy 2.1 Promote water conservation.
Strategy 2.2 Cooperate in watershed improvement projects.

Objective 3. Prevent soil erosion and promote soil quality.

Strategy 3.1 Develop conservation treatments on soils susceptible to wind and water erosion.

Objective 4. Enhance management and protection of vegetation resources.

Strategy 4.1 Encourage sound range and pasture management on public, private, and multiple-use lands where feasible.

Objective 5. Conserve wildlife resources.

Strategy 5.1 Support land and water uses that protect wildlife as compatible with other uses.

Objective 6. Educate the public about conservation of all natural resources and foster a conservation ethic.

Strategy 6.1 Formulate an ongoing media and public relations program on conservation, District roles and accomplishments.
Strategy 6.2 Develop and maintain an educational outreach program with schools.

Objective 7. Accomplish Deschutes SWCD mission efficiently and effectively.

Strategy 7.1 Maintain and improve operations.
Strategy 7.2 Maintain and continue to use partnerships to promote mutual goals.

Strategy 7.3 Secure adequate funding to administer District functions.
Strategy 7.4 Monitor SWCD activities and accomplishments.

Research, Monitoring, and Evaluation Activities

This section describes ongoing research, monitoring and evaluation for the Deschutes River subbasin projects described in Section I. G. Existing and Past Efforts and outlines how progress is being measured in the subbasin.

BPA-funded Research, Monitoring and Evaluation Activities

Restoration of Riparian Habitat in Bakeoven/Deep Creeks, BPA Project # 199900600, is currently in the first year of a three-year riparian effort aimed at boosting natural summer steelhead production in Bakeoven Creek. Implementation of riparian restoration plans with associated fencing, off-stream water developments, and plantings will improve watershed health, improve water quality, restore degraded habitat in-stream and in the riparian corridor, increase summer steelhead production, and benefit other species of wildlife. This project includes implementation of a monitoring plan based on EPA monitoring protocols.

Ongoing monitoring under *BPA Project # 199404200, Trout Creek Habitat Restoration Project*, provides for the collection of baseline data concerning the abundance and life history patterns of juvenile and adult summer steelhead populations in the Trout Creek system:

- One juvenile migrant (screw) trap is used to estimate numbers, temporal distribution, age structure, and selected biological and life history characteristics (i.e., mean fork length, mean weight and condition factor) of downstream migrant summer steelhead smolts.
- A total of 115 riparian photopoints are regularly duplicated to document changes in channel condition and riparian recovery.
- Thermographs are deployed at 18 sites to collect stream temperature data.
- Stream flows are monitored at an established staff gauge.
- Summer steelhead spawning surveys are conducted annually on index reaches totaling up to 54 miles annually.
- In addition, monitoring and maintenance of existing instream structures and riparian fencing is ongoing.

The goals of a multi-year *Trout Creek Watershed Improvement Project, BPA Project # 199802800*, include reduction of fine sediment input, increased riparian shading, reduced summer stream temperatures, improved instream habitat complexity, and increased late season water flows. This project provides for the following activities in the Trout Creek system:

- Improvement of fish passage by elimination of pushup dams and improved irrigation methods.
- Improved uplands management that will increase water retention and control sediment.

- Improved management of riparian buffer zones, including riparian fencing, improved livestock management practices, water development, brush control, and re-vegetation of riparian areas.
- Reestablishment of streambed by working with the Army Corp of Engineers to address berms.
- Evaluation of infiltration galleries previously installed.
- Continued work on watershed assessment and action plan for the watershed.
- Working with other granting sources to accomplish additional watershed-wide habitat enhancement projects.
- This project also funds a full-time watershed coordinator to work with local watershed councils, ODFW, other agencies, and interested entities to implement the plan.

The *Oregon Fish Screens Project, BPA Project # 9306600*, will supplement habitat work on Trout Creek by providing unobstructed passage of adult and juvenile salmonids at 13 gravity diversion structures. Currently, push-up irrigation diversion barriers block adult and juvenile summer steelhead and resident trout passage, resulting in failure to fully seed suitable spawning and rearing habitat. Screening of gravity and/or pump devices will increase survival of juvenile salmonids. Fish passage structures will increase successful steelhead spawning efforts and increase survival of juvenile steelhead and resident trout. Trap boxes in some of the fish screening devices allow monitoring of juvenile fish numbers. Operation and maintenance of these diversions and fish ladders is ongoing.

The Warm Springs River and Shitike Creek, on the Warm Springs Reservation, support the only naturally spawning population of spring chinook salmon in the lower Deschutes River subbasin and one of the last truly wild populations in the region. Threatened summer steelhead and bull trout also utilize the Warm Springs River and Shitike Creek. Funding under *BPA Project # 199802400, Monitor Watershed Conditions on the Warm Springs Reservation*, provides for a monitoring program for adult anadromous and resident fish in conjunction with enhancement activities in the Warm Springs River and Shitike Creek, including:

- Collection of aquatic macro-invertebrate information.
- Inventory of culverts and stream crossings in the forested and non-forested portions of the reservation to assess potential barriers to anadromous and resident fish passage.
- Assessment of quality and composition of anadromous and resident fish spawning gravel in stream reaches on the Reservation using McNeil core sampling.
- Inventory of anadromous and resident fish habitat in the Warm Springs River and its tributaries.

To assist in development of a protection and recovery plan for threatened bull trout stocks, *BPA Project # 199405400, Bull Trout Life History, Genetics, and Habitat Needs on the Warm Springs Reservation*, funds research on bull trout on the Warm Springs Reservation to:

- Determine juvenile bull trout distribution in the Warm Springs River and Shitike Creek.

- Determine relative densities and habitat associations of juvenile bull trout and brook trout in the Warm Springs River and Shitike Creek.
- Characterize migration of juvenile and adult bull trout by monitoring the barrier dam at Warm Springs National Fish Hatchery and an adult fish weir near the mouth of Shitike Creek.
- Monitor bull trout movement and habitat use in the Deschutes and Warm Springs rivers and Shitike Creek using radio tags.
- Establish spawning distribution by conducting bull trout spawning ground surveys annually on the Warm Springs River and Shitike Creek.
- Thermographs are deployed at 18 locations on the Warm Springs River and Shitike Creek.
- Determine genetic characteristics of bull trout in the Warm Springs River and Shitike Creek.

Other Research, Monitoring and Evaluation Activities

Lower Deschutes River

ODFW license dollars and Sport Fish Restoration Funds support operation of the adult fish trap at Sherars Falls, anadromous fish spawning surveys, resident trout population surveys, and anadromous and resident fish harvest surveys within the lower Deschutes River subbasin.

Deer, elk, bighorn sheep, and pronghorn populations throughout the lower Deschutes River subbasin are monitored by ODFW annually through aerial and foot surveys and inventories. Upland game birds, waterfowl and raptor surveys are also conducted annually.

CTWS funds the monitoring of smolt out-migration from the Warm Springs River and Shitike Creek. CTWS also conducts spawning surveys annually for spring chinook salmon, summer steelhead, and bull trout in the Deschutes River and its tributaries on the Warm Springs Reservation. Pacific Salmon Commission funds are used by CTWS for fall chinook salmon monitoring, including aerial redd counts and assistance in operation of the adult fish trap at Sherars Falls.

In the White River drainage, the USFS monitors channel conditions and riparian recovery following stream rehabilitation work in portions of Rock, Threemile and Gate creeks that were impacted by the Rocky Burn forest fire. This monitoring includes shade, bank erosion, stream cross-section and stream substrate. In addition, temperature monitors are deployed by the USFS at 17 sites in the White River subbasin.

Wasco County SWCD monitors temperature and stream cross-sections at four sites in Buck Hollow Creek and four sites in Bakeoven Creek watershed project areas.

Pelton/Round Butte Project

PGE continuously monitors water temperature at nine sites in Lake Billy Chinook, as well monthly monitoring of other water quality parameters at thirteen sites. Wildlife populations in the project area are monitored through annual surveys, including: winter bald eagle, raptor, waterfowl, and mule deer counts; bald eagle, raptor and waterfowl nesting surveys; upland gamebird surveys; raptor, waterbird, and bat surveys; and surveys of animals using the Pelton fish ladder wildlife crossings.

Metolius River

The USFS and ODFW currently monitor juvenile and adult bull trout and adult redband trout populations in the Metolius River and its tributaries. In addition, aquatic invertebrates, stream bank riparian health, and water nutrient and temperature are monitored by USFS personnel at several locations throughout the subbasin.

Deer and elk populations throughout the Metolius River subbasin are monitored by ODFW annually through aerial and foot surveys and inventories. Upland game birds, waterfowl and raptor surveys are also conducted annually.

Crooked River

Gauging stations and water temperature monitoring stations have been established on Ochoco and Mill creeks.

In the South Fork Crooked River, a comprehensive stream channel, water quality, instream habitat, and fish population monitoring project is in its second year. This monitoring program is a cooperative effort between BLM, ODFW, Crooked River Watershed Council, and three landowners.

Deer, elk, and pronghorn populations throughout the Crooked River subbasin are monitored by ODFW annually through aerial and foot surveys and inventories. Upland game birds, waterfowl and raptor surveys are also conducted annually.

Upper Deschutes River

In the upper Deschutes River subbasin, ODFW monitors structural integrity and biological benefits associated with 18 major fish habitat improvement projects which were funded wholly or in part by the Central Oregon Irrigation District as a condition of the FERC license and conditional use permit for the Central Oregon Siphon Power Project. Monitoring of these projects includes stream temperature monitors at 10 sites and stream surveys.

An interagency team has developed a Regional Coordinated Water Quality Monitoring Plan for the upper Deschutes River subbasin. This monitoring will assist in development of TMDLs for 303(d) listed streams in the subbasin. TMDLs are scheduled for completion by the end of 2002 for the upper Deschutes and Little Deschutes rivers. Sites identified that are likely to continue to be monitored on a regular basis include:

Stream temperature:

- U.S. Forest Service – 40 sites
- Bureau of Land Management – 4 sites
- National Grasslands – 4 sites
- Oregon Water Resources Department – 1 site
- Portland General Electric – 1 site
- City of Bend – 1 site

Stream flow:

- U.S. Geological Survey – 1 site
- Oregon Water Resources Department – 18 sites

Turbidity and sediment:

- U.S. Forest Service – 18 sites
- Oregon Department of Environmental Quality – 5 sites
- Portland General Electric – 1 site

- City of Bend – 1 site

Bacteria:

- Oregon Department of Environmental Quality – 4 sites
- City of Bend – 1 site

Nutrients:

- Oregon Department of Environmental Quality – 4 sites
- City of Bend – 1 site

Dissolved oxygen and pH:

- Portland General Electric – 2 sites
- Oregon Department of Environmental Quality – 4 sites

Deer and elk populations throughout the upper Deschutes River subbasin are monitored by ODFW annually through aerial and foot surveys and inventories. Upland game birds, waterfowl and raptor surveys are also conducted annually.

Statement of Fish and Wildlife Needs

Future work in the Deschutes River subbasin must be prioritized according to what will do the most good for the fish and wildlife resources. All projects undertaken in the subbasin should, first, address the needs of those species that are of greatest concern and, second, do no harm to other species in the subbasin. Future projects should be focused in areas of greatest need. The following are needs that have been identified for the entire Deschutes River subbasin:

Coordination needs

- Development of data collection and reporting procedures to ensure consistency from all entities in the subbasin.
- Development and maintenance of a central data repository for the subbasin.
- Continued and enhanced cooperative approach in research, monitoring, and evaluation between federal, tribal, state, and local entities to facilitate restoration and enhancement measures.
- Continued and enhanced public education concerning fish, wildlife and habitat issues in the subbasin.

Wildlife

Biological monitoring

- Assessment of game and non-game wildlife species presence, abundance, life history, distribution, and habitat utilization to identify areas where habitat improvements or acquisitions might provide benefits to wildlife in the subbasin.
- Assessment of non-native wildlife species abundance, distribution, and effects on native species.
- Assessment of continued and potential reintroduction of native wildlife species that have been extirpated from all or parts of the subbasin, such as California bighorn sheep, mountain goat, pronghorn, sage grouse, and sharp-tailed grouse.
- Studies designed to characterize deer and elk movement patterns between winter and summer range.

- Studies designed to monitor known peregrine falcon nesting sites, survey for additional sites, and develop management strategies to protect these sites.

Habitat enhancement and protection

- Assessment of grasslands and shrub-steppe conditions throughout the subbasin.
- Assessment and protection of unique habitat types in the subbasin.
- Maintenance, enhancement and protection of big game winter range and critical upland habitats throughout the subbasin.
- Control of noxious weeds and other invasive non-native vegetation throughout the subbasin.
- More active management of lands on which management has been deferred, such as those enrolled in CRP or CREP, to provide increased benefits to wildlife throughout the subbasin.
- Assessment of need to duplicate historic fire patterns for control of invasion of undesirable native and non-native vegetation throughout the subbasin.
- Assessment of land acquisition opportunities to benefit wildlife throughout the subbasin.
- Road closures, obliteration and other road treatments to minimize poaching and harassment of wildlife and allow more uniform use of habitat by wildlife.

Law enforcement

- Increased law enforcement presence throughout the subbasin to ensure compliance with laws pertaining to wildlife.
- Monitoring and enforcement of federal, state, county and other applicable land use regulations to ensure protection of critical wildlife habitats and habitat functions.

Fish

Biological monitoring

- Continued or expanded studies of life history, genetics, habitat needs, distribution, abundance, and limiting factors for juvenile and adult anadromous salmonid populations in the subbasin, including spawning ground counts and smolt monitoring programs.
- Comprehensive studies of life history, genetics, habitat needs, distribution, abundance exploitation rates, and limiting factors for Pacific lamprey in the subbasin.
- Comprehensive studies of life history, genetics, habitat needs, distribution, and abundance of native game and non-game fish species throughout the subbasin.
- Assessment of non-native fish species abundance, distribution, and effects on native species.
- Comprehensive studies of out-of-basin hatchery summer steelhead straying into the Deschutes River and analysis of need for measures to heighten protection of native summer steelhead populations, including construction of fish weirs near the mouths of tributary creeks to facilitate monitoring and possibly removal of hatchery fish from the spawning population.
- Continued or expanded studies of bull trout life history, population status and interactions with brook trout throughout the subbasin to ensure adequacy of bull trout recovery plan goals.

- Evaluation of utilization of bull trout from Lake Billy Chinook and the Metolius River to reintroduce bull trout into historic habitat in the upper Deschutes River subbasin.
- Continued or expanded studies to develop an improved fall chinook salmon escapement estimate methodology and monitor juvenile to adult survival.
- Continued analysis of effects of planned anadromous fish reintroduction on resident fish species both above and below the Pelton/Round Butte Project.
- Development of native trout broodstock for hatchery programs in the upper subbasin.
- Comprehensive invertebrate and amphibian surveys to determine current biological characteristics of streams and riparian areas throughout the subbasin.
- Comprehensive stream surveys and riparian vegetation surveys to determine current physical and biological characteristics of the streams and riparian areas throughout the subbasin.

Habitat enhancement and protection

- Maintenance of stream habitat enhancement measures installed to date to protect the already substantial investments in the subbasin.
- Maintenance and expansion of riparian fencing projects to protect riparian vegetation and stream bank integrity throughout the subbasin.
- Development of off-stream livestock watering sites, such as solar pump stations and spring developments, to eliminate water gaps and livestock intrusion onto riparian areas throughout the subbasin.
- Restoration of instream and riparian habitat structure, function and diversity through placement of instream habitat structure and stream bank stabilization treatments.
- Removal of U.S. Army Corp of Engineers gravel berms, particularly in the Trout Creek system.
- Restoration of stream channels, where needed throughout the subbasin, through bioengineering techniques (i.e. Rosgen treatments) to reestablish floodplain connectivity and historic stream channel characteristics, and remove a significant sediment source from eroding stream banks.
- Restoration of riparian vegetative corridors through riparian buffer systems and plantings of native shrubs and trees.
- Placement of large woody debris in streams in forested portions of the subbasin to provide much needed fish rearing habitat complexity.
- Placement of spawning gravel in areas lacking sufficient quantities.
- Monitoring and evaluation associated with instream and riparian habitat work, including but not limited to: documentation of effectiveness of instream structure in promoting pool development and habitat complexity; establishment of permanent sites for monitoring changes in channel geometry, slope, and gravel deposition; tracking of downstream and lateral movement of wood and rock structures after flood events; monitoring substrate composition; monitoring fish usage associated with instream structures and riparian improvements.
- Establish conservation easements on private lands in priority streamside and upland areas.
- Assessment of land acquisition opportunities adjacent to priority streams and wetlands throughout the subbasin.

Screening and fish passage

- Inventory fish passage barriers and improve fish passage where impeded by artificial barriers, such as hydroelectric projects, diversion dams, culverts, and other structures, throughout the subbasin.
- Installation of infiltration galleries to eliminate irrigation diversions and push-up dams. This would include associated rehabilitation of abandoned diversion structures and push-up dam berms.
- Screening of all irrigation and other diversions on all fish bearing streams in the subbasin.
- Monitoring and evaluation associated with fish passage and screening projects, including but not limited to: pre- and post-project fish salvage data collection; post-project hydraulic and biological testing; periodic physical and/or hydraulic inspection to insure proper operation; spawning ground surveys above improvements to assess habitat utilization; and other methods as appropriate.

Water quality and quantity

- Continued and expanded water quality and quantity monitoring throughout the subbasin.
- Monitoring and enforcement of instream flows and consumptive water rights throughout the subbasin, including inventory of location and condition of all diversions.
- Restoration of stream flows through water conservation measures, such as improved diversion measurement systems, water use efficiency, and conveyance efficiency.
- Continued or expanded leasing, buying or banking of water rights with willing water right holders.
- Reduction of sediment input from uplands and roading through road closures, obliteration, and other treatments, and increased implementation of practices designed to reduce soil erosion on forest and agricultural lands.
- Reduction of effects of storm water input by managing it in a manner protective of surface and groundwater quality.
- Reduction of waste water input by ensuring that municipal sewerage facilities are operated in a manner protective of water quality and on-site sewage disposal systems are installed in accordance with DEQ standards.
- Reduction of input of non-point source pollutants through modification of irrigation water return regimes and confined animal feeding operations.
- Assessment of wetland locations and status throughout the subbasin.
- Restoration and increased protection of floodplain areas, especially wetlands.

Technical assistance

- Funding for technical assistance for completion of watershed assessments and action plans.
- Funding for technical assistance to landowners for development of land use and farm plans, and conversion from conventional tillage operations to sustainable direct seed/no till systems.

Law enforcement

- Increased law enforcement presence throughout the subbasin to ensure compliance with laws pertaining to fish.
- Monitoring and enforcement of federal, state, county and other applicable land use regulations to ensure protection of critical fish habitats and habitat functions.

References

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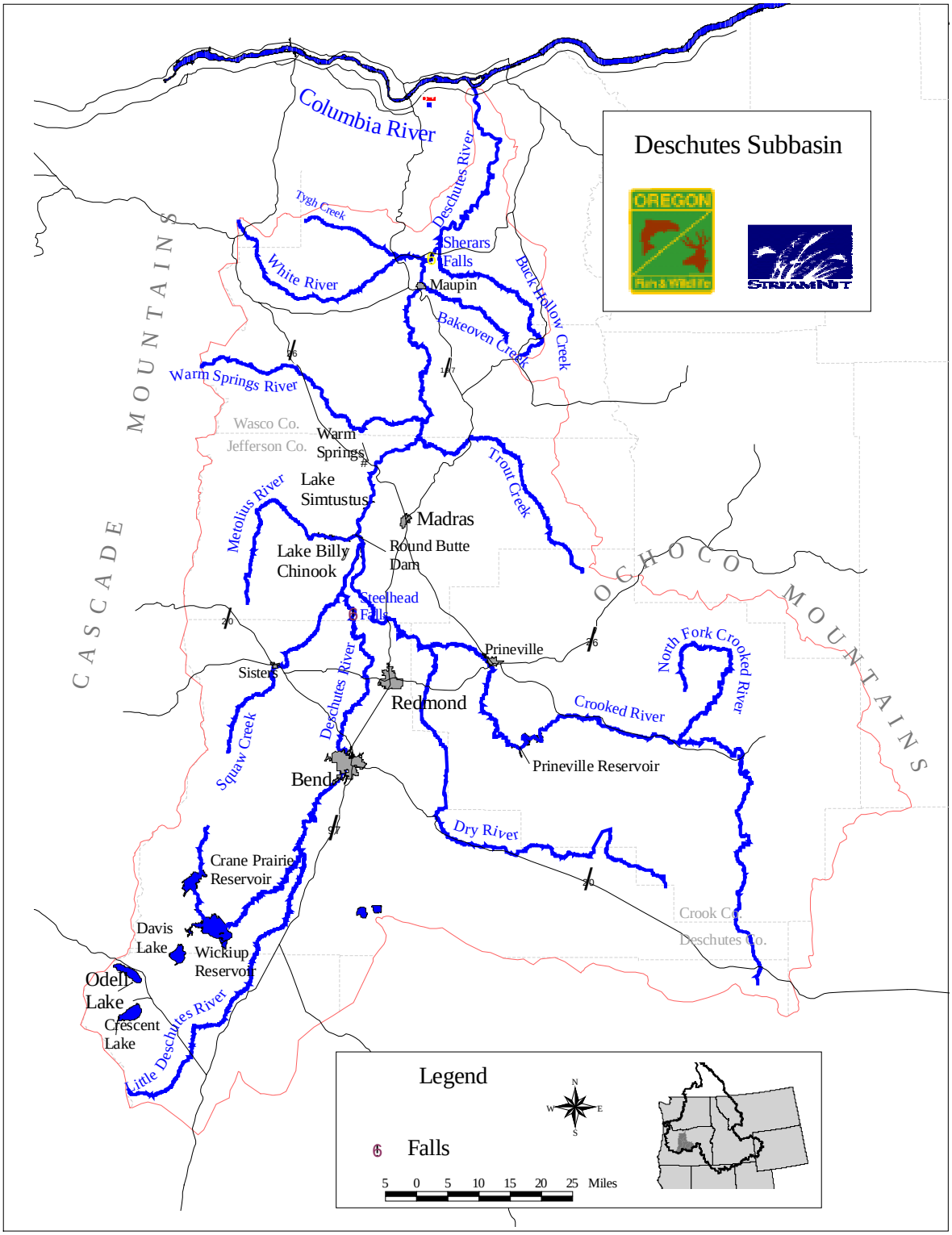

Figure 1. Deschutes River subbasin.

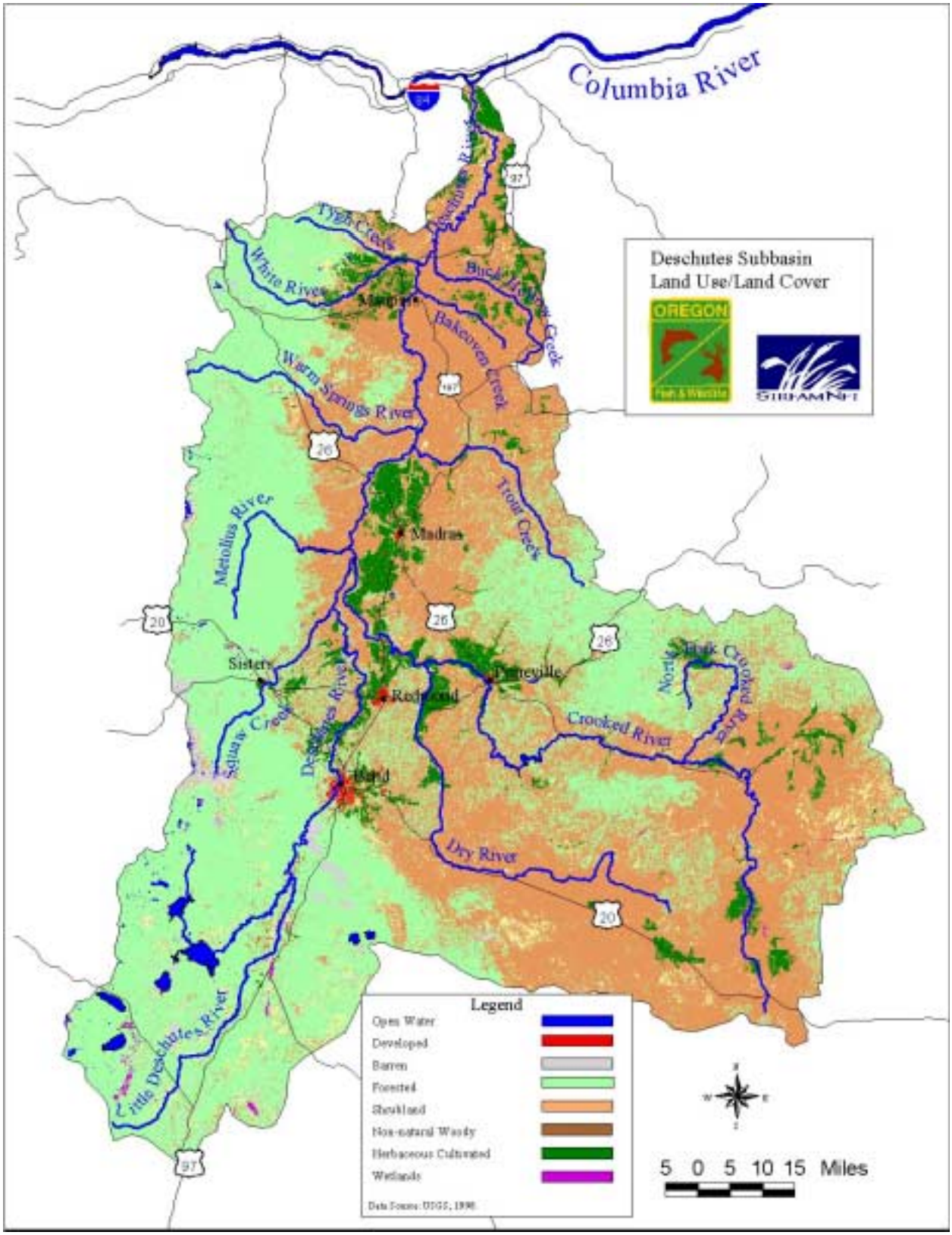

Figure 2. Vegetation types in the Deschutes River subbasin.

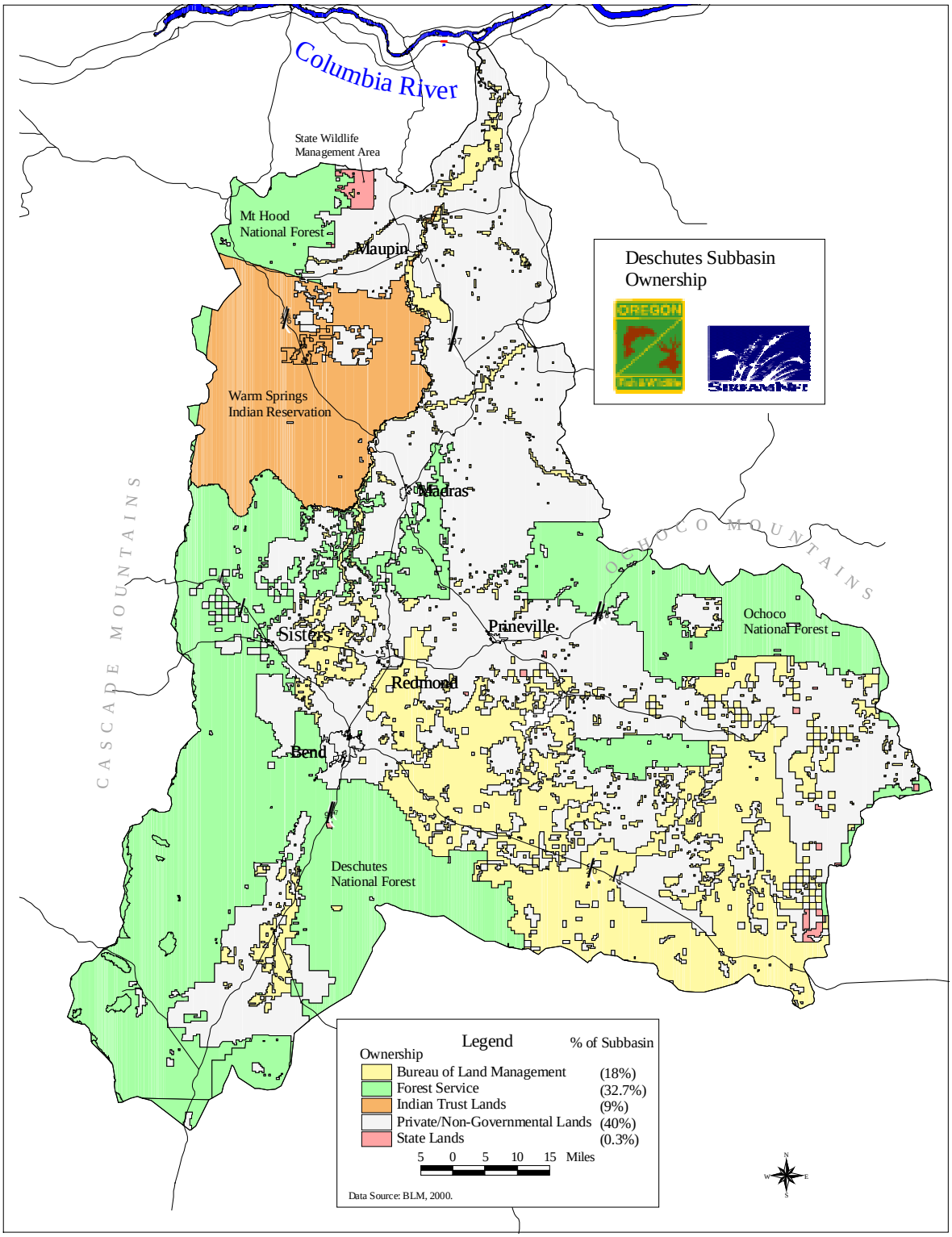

Figure 3. Land ownership in the Deschutes River subbasin.

Table 1. Federal and Oregon listing status of wildlife species in the Deschutes River subbasin.

Species	Federal Listing Status	Oregon Listing Status	Lower Deschutes	Pelton/ Round Butte	Metolius	Crooked	Upper Deschutes
Amphibians							
Cascades frog *Rana cascadae*	Species of concern	Sensitive	X	X	X		X
Northern leopard frog *Rana pipiens*		Sensitive	X				
Northern red-legged frog *Rana aurora aurora*	Species of concern	Sensitive	X				
Oregon spotted frog *Rana pretiosa*	Proposed threatened	Sensitive	X	X	X	X	X
Tailed frog *Ascaphus truei*	Species of concern	Sensitive	X	X	X		X
Western toad *Bufo boreas*		Sensitive	X	X	X	X	X
Reptiles							
Northern sagebrush lizard *Sceloporus graciosus graciosus*	Species of concern		X	X	X	X	X
Western pond turtle *Clemmys marmorata*	Species of concern	Sensitive	X				
Birds							
*American Peregrine falcon *Falco peregrinus anatum*	Endangered	Endangered	X				
*Bald eagle *Haliaeetus leucocephalus*	Threatened	Threatened	X	X	X	X	X
Bank swallow Riparia riparia		Sensitive	X	X	X	X	X
Barrow's goldeneye *Bucephala islandica*		Sensitive					X
Black-backed woodpecker *Picoides arcticus*		Sensitive			X	X	X
Black tern *Chlidonias niger*	Species of concern			X	X	X	X
Boreal owl *Aegolius funereus*		Sensitive	X		X	X	X
Bufflehead *Bucephala albeola*		Sensitive					X
Ferruginous hawk *Buteo regalis*	Species of concern	Sensitive	X	X	X	X	X

Species	Federal Listing Status	Oregon Listing Status	Lower Deschutes	Pelton/ Round Butte	Metolius	Crooked	Upper Deschutes
Flammulated owl *Otus flammeolus*		Sensitive	X		X	X	X
Great gray owl *Strix nebulosa*		Sensitive					X
Greater sandhill crane *Grus canadensis tabida*		Sensitive					X
Harlequin ducks *Histrionicus histrionicus*	Species of concern	Sensitive	X	X	X		X
Lewis' woodpecker *Melanerpes lewis*		Sensitive	X				
Loggerhead shrike *Lanius ludovicianus*		Sensitive	X	X		X	X
Mountain quail *Oreortyx pictus*	Proposed threatened		X				
Northern goshawk *Accipiter gentilis*	Species of concern	Sensitive	X	X	X	X	X
Northern pygmy owl *Glaucidium gnoma*		Sensitve	X	X	X	X	X
Northern spotted owl *Strix occidentalis caurina*	Threatened	Threatened	X	X	X		X
Olive-sided flycatcher *Contopus cooperi*	Species of concern		X	X	X	X	X
Pileated woodpecker *Drycopus pileatus*		Sensitive	X	X	X	?	X
Pygmy nuthatch *Sitta pygmaea*		Sensitive	X		X	X	X
Swainson's hawk *Buteo swainsoni*		Sensitive	X			X	
Three-toed woodpecker *Picoides tridactylus*		Sensitive			X		X
Tricolored blackbird *Agelaius tricolor*	Species of concern	Sensitive	X				
Western bluebird *Sialia mexicana*		Sensitive	X	X		X	
Western burrowing owl *Speotyto cunicularia hypugea*	Species of concern	Sensitive	X	X	X	X	X

Species	Federal Listing Status	Oregon Listing Status	Lower Deschutes	Pelton/ Round Butte	Metolius	Crooked	Upper Deschutes
Western sage grouse *Centrocercus urophasianus phaios*	Species of concern	Sensitive				X	X
White-headed woodpecker *Picoides albolarvatus*		Sensitive	X	X	X	X	X
Williamson's sapsucker *Sphyrapicus thyroideus*		Sensitive	X		X	X	X
Mammals							
American marten *Martes americana*		Sensitive	X	?	X	?	X
California bighorn *Ovis canadensis californiana*	Species of concern		X			X	
California wolverine *Gulo gulo luteus*	Species of concern	Threatened	X	X	X	X	X
Canada lynx *Lynx ccanadensis*	Threatened			X	X	X	X
Pacific fisher *Mertes pennanti pacifica*	Species of concern	Sensitive	X	X	X		X
Long-eared myotis (bat) *Myotis evotis*	Species of concern	Sensitive	X	X	X	X	X
Long-legged myotis (bat) *Myotis volans*	Species of concern	Sensitive	X	X	X	X	X
Pallid bat *Antrozous pallidus*		Sensitive	X	X	X	X	X
Pale western big-eared bat *Plecotus townsendii pallescens*	Species of concern	Sensitive	X		X	X	X
Pygmy rabbit *Brachylagus idahoensis*	Species of concern	Sensitive	X			X	X
Silver-haired bat Lasionycteris noctivagans		Sensitive	X		X	X	X
Small-footed myotis (bat) *Myotis cilolabrum*	Species of concern	Sensitive	X	X	X	X	X

Species	Federal Listing Status	Oregon Listing Status	Lower Deschutes	Pelton/ Round Butte	Metolius	Crooked	Upper Deschutes
Spotted bat *Euderma maculatum*	Species of concern					X	
Yuma myotis (bat) *Myotis yumanensis*	Species of concern	Sensitive	X	X	X	X	X
Western gray squirrel *Sciurus griseus*		Sensitive			X		X
White-tailed jackrabbit *Lepus townsendii*		Sensitive	X				

*Proposed for change in federal listing status

Table 2. Historic and current fish species present in the Deschutes River subbasin

Species	Origin	Lower Deschutes	Lake Simtustus	Lake Billy Chinook	Metolius	Suttle Lake	Blue Lake	Crooked	Ochoco Reservoir	Prineville Reservoir	Upper Deschutes
Pacific lamprey *Lampetra tridentatus*	Native	Moder-ately abundant	Extinct	Extinct	Extinct			Extinct			Extinct
Spring chinook salmon *Oncorhynchus tshawytscha*	Native	Moder-ately abundant	Extinct	Extremely rare	Extinct			Extremely rare	Extinct	Extinct	Extinct
Fall chinook salmon *Oncorhynchus tshawytscha*	Native	Moder-ately abundant									
Coho salmon *Oncorhynchus kisutch*	Native	Extremely rare									Extinct
Sockeye salmon *Oncorhynchus nerka*	Native	Rare			Extinct	Extinct		Extinct			
**Summer steelhead *Oncorhynchus mykiss*	Native	Abundant		Extinct				Extinct	Extinct	Extinct	Extinct
*Redband trout *Oncorhynchus mykiss*	Native	Abundant	Rare	Abundant	Moder-ately abundant	Un-known		Moder-ately abundant	Locally abundant	Extremely rare	Moder-ately abundant
**Bull trout *Salvelinus confluentus*	Native	Rare	Rare	Locally abundant	Locally abundant	Extinct		Rare			Rare
Mountain whitefish *Prosopium williamsoni*	Native	Abundant	Rare	Rare	Abundant	Present	Present	Abundant	Rare	Present	Very abundant
Rainbow trout *Oncorhynchus mykiss*	Introdu ced		Locally abundant			Present	Present	Abundant	Abundant	Abundant	Abundant
Cutthroat trout *Oncorhynchus clarki*	Intro-duced										Moder-ately abundant

Species	Origin	Lower Deschutes	Lake Simtustus	Lake Billy Chinook	Metolius	Suttle Lake	Blue Lake	Crooked	Ochoco Reservoir	Prineville Reservoir	Upper Deschutes
Brook trout *Salvelinus fontinalis*	Intro-duced	Locally abundant			Rare	Un-known	Present	Rare			Abundant
Brown trout *Salmo trutta*	Intro-duced	Unknown	Abundant	Moder-ately abundant	Locally abundant	Present		Locally abundant			Abundant
Kokanee *Oncorhynchus nerka*	Intro-duced		Rare	Abundant	Abundant	Present	Present	Abundant			Abundant
Atlantic salmon *Salmo salar*	Intro-duced							Very rare			Rare
Sucker spp. *Catostomus spp*.	Native	Abundant	Abundant	Abundant	Unknown			Abundant	Locally abundant	Abundant	Locally abundant
Chiselmouth *Acrocheilus alutaceus*	Native	Rare	Abundant	Rare				Abundant		Abundant	Moder-ately abundant
Dace spp. *Rhinichthys* spp.	Native	Unknown		Rare	Unknown	Present		Abundant	Locally abundant	Present	Locally abundant
Sculpin spp. *Cottus* spp.	Native	Unknown	Rare	Rare	Unknown	Un-known		Moder-ately abundant	Unknown	Present	Locally abundant
Northern pikeminnow *Ptychocheilus oregonensis*	Native	Locally abundant	Abundant	Locally abundant				Moder-ately abundant	Extremely rare	Present	
Redside shiner *Richardsonius balteatus*	Native	Unknown						Extreme-ly rare		Present	
Smallmouth bass *Micropterus dolomieui*	Intro-duced		Rare	Abundant				Abundant		Abundant	
Largemouth bass *Micropterus salmoides*	Intro-duced			Rare				Moder-ately abundant	Unknown	Abundant	Moderately abundant
Tui chub *Gila bicolor*	Intro-duced			Rare							Very abundant
Blue chub *Gila coerulea*	Intro-duced										Locally abundant

Species	Origin	Lower Deschutes	Lake Simtustus	Lake Billy Chinook	Metolius	Suttle Lake	Blue Lake	Crooked	Ochoco Reservoir	Prineville Reservoir	Upper Deschutes
Three-spine stickleback *Gasterosteus aculeatus*	Intro-duced										Very abundant
Bluegill *Lepomis macrochirus*	Intro-duced			Rare				Very rare			Moderately abundant
Black crappie *Pomoxis nigromaculatus*	Intro-duced			Rare					Unknown	Present	Rare
Redear sunfish *Lepomis macrochirus*	Intro-duced							Very rare			
Brown bullhead *Ictalurus nebulosus*	Intro-duced								Rare	Abundant	Locally abundant
Common carp *Cyprnus carpio*	Intro-duced							Rare			
Goldfish *Carassius auratus*	Intro-duced			Rare				Rare			

*Listed federal species of concern

**Listed federal threatened species

Table 3. Management goals for anadromous salmonids in the Deschutes River.

Stock	Genetic History / Management Intent	Spawn Escape Goal	Hatchery Take	Harvest	Recent Total Escape
Spring Chinook	Managed as wild and hatchery in mainstem Deschutes and as wild only above WSNFH on Warm Springs River	1,300	RBH 600 WSNFH 700	W 307 H 2,945	W 2,623 H 6,988
Fall Chinook	Managed as wild production only	4,000	N/A		4,388
Summer Steelhead	Managed as wild and hatchery except wild only above WSNFH on Warm Springs River	6,575	550	W 407 H 2,538	W 4,790 H 2,628
			Out of basin stray hatchery		13,785
Lamprey	Management under discussion				

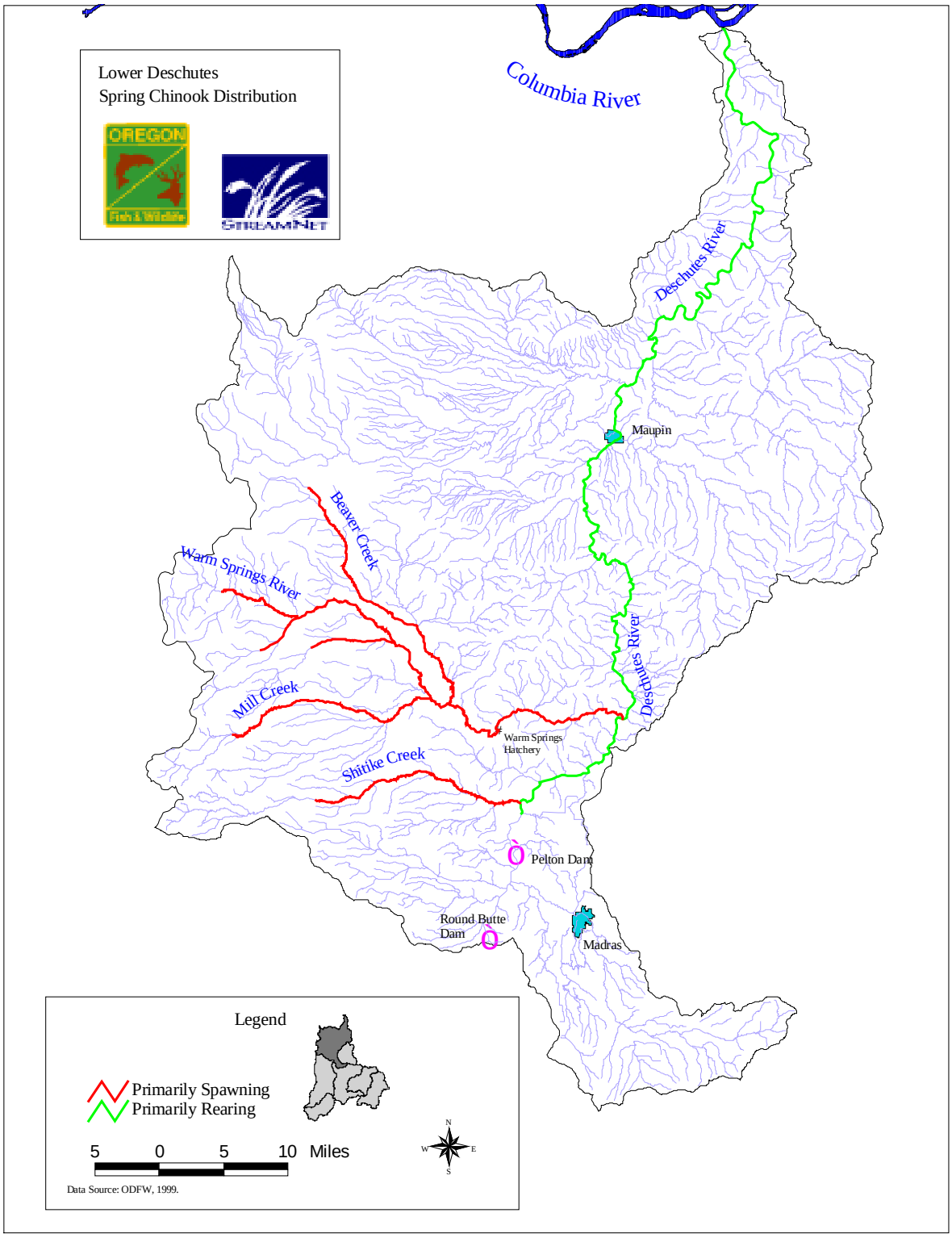

Figure 4. Spring chinook salmon distribution in the lower Deschutes River subbasin.

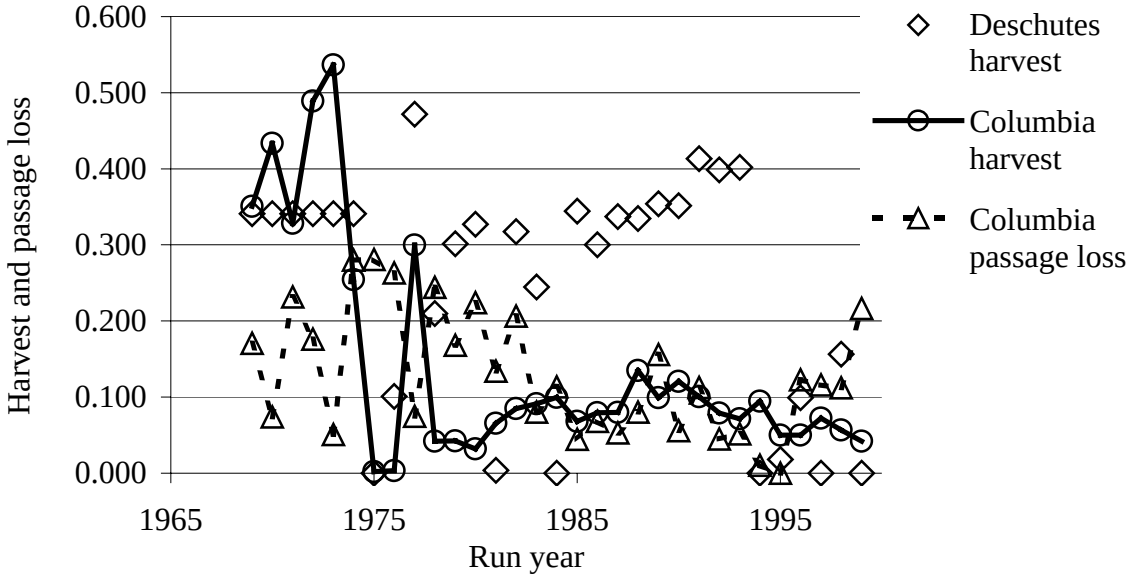

Figure 5. Estimated Deschutes and Columbia mainstem harvest rates and Columbia mainstem passage loss of wild Deschutes River spring chinook salmon, 1969 to 1999.

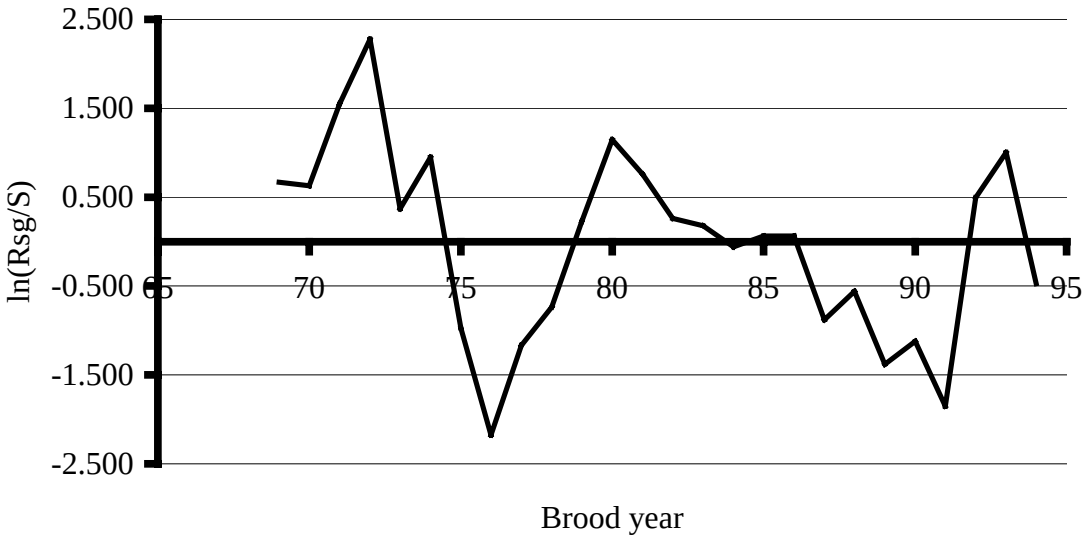

Figure 6. Natural logarithm of adult recruits to the spawning grounds divided by adult spawners, ln(Rsg/S), for wild Deschutes River spring chinook salmon, by brood year, 1969 to 1994.

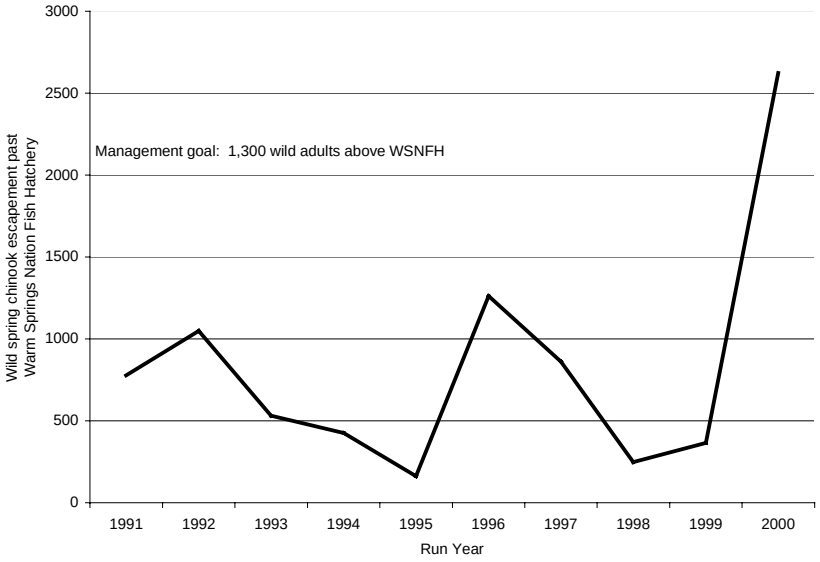

Figure 7. Spring chinook salmon estimated escapement above WSNFH, 1991 to 2000.

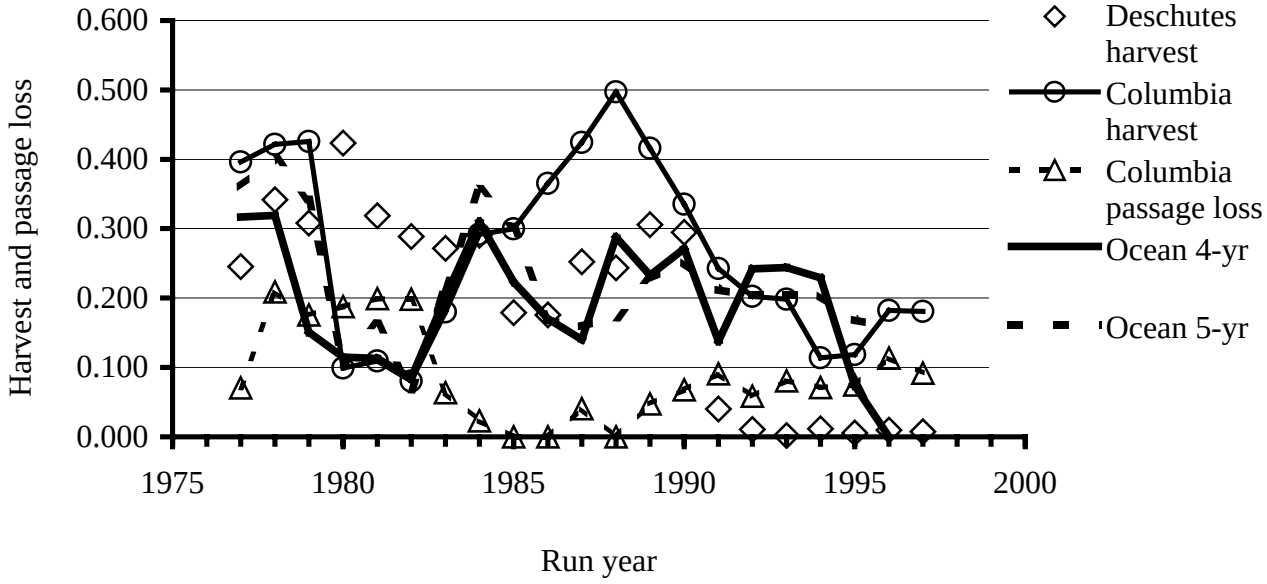

Figure 8. Estimated Deschutes and Columbia mainstem harvest rates and Columbia mainstem passage loss of wild Deschutes River fall chinook salmon, 1977 to 1997.

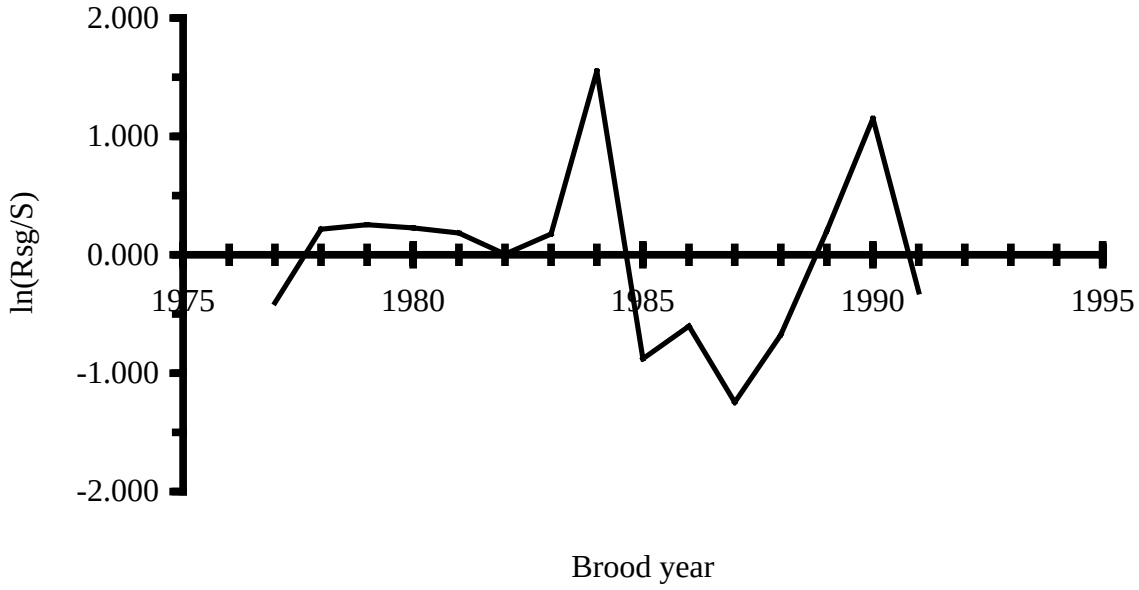

Figure 9. Natural logarithm of adult recruits to the spawning grounds divided by adult spawners, ln(Rsg/S), for wild Deschutes River fall chinook salmon, by brood year, 1977 to 1991.

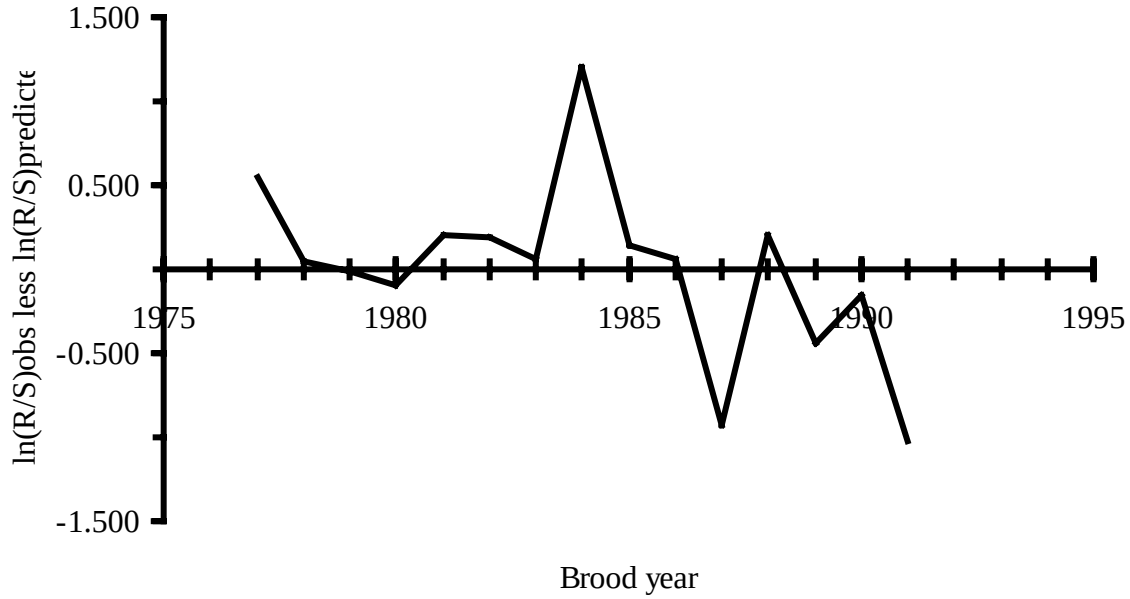

Figure 10. Difference between observed and predicted ln(R/S) by brood year for wild fall chinook salmon in the Deschutes River, by brood year, 1977 to 1991.

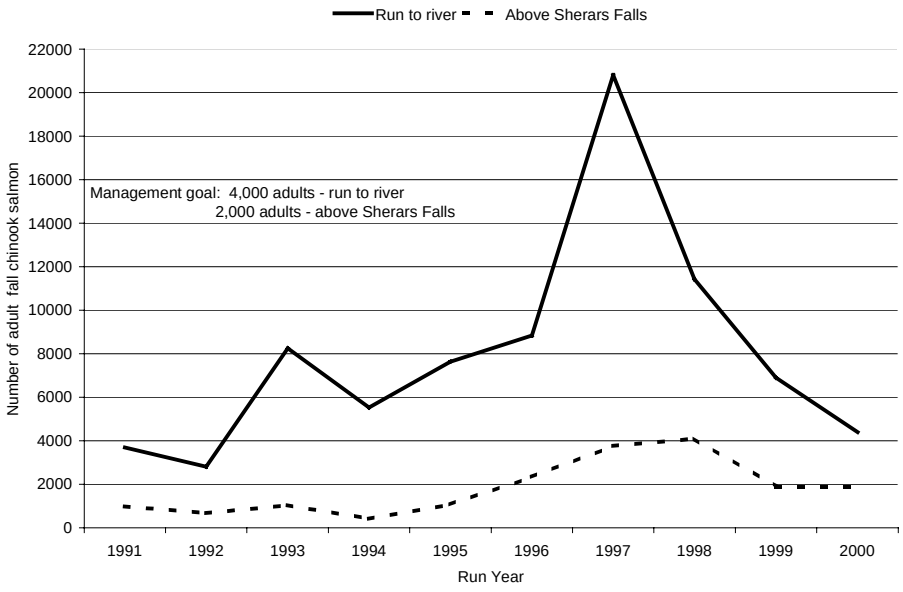

Figure 11. Fall chinook salmon estimated run to river and escapement above Sherars Falls, 1991 to 2000.

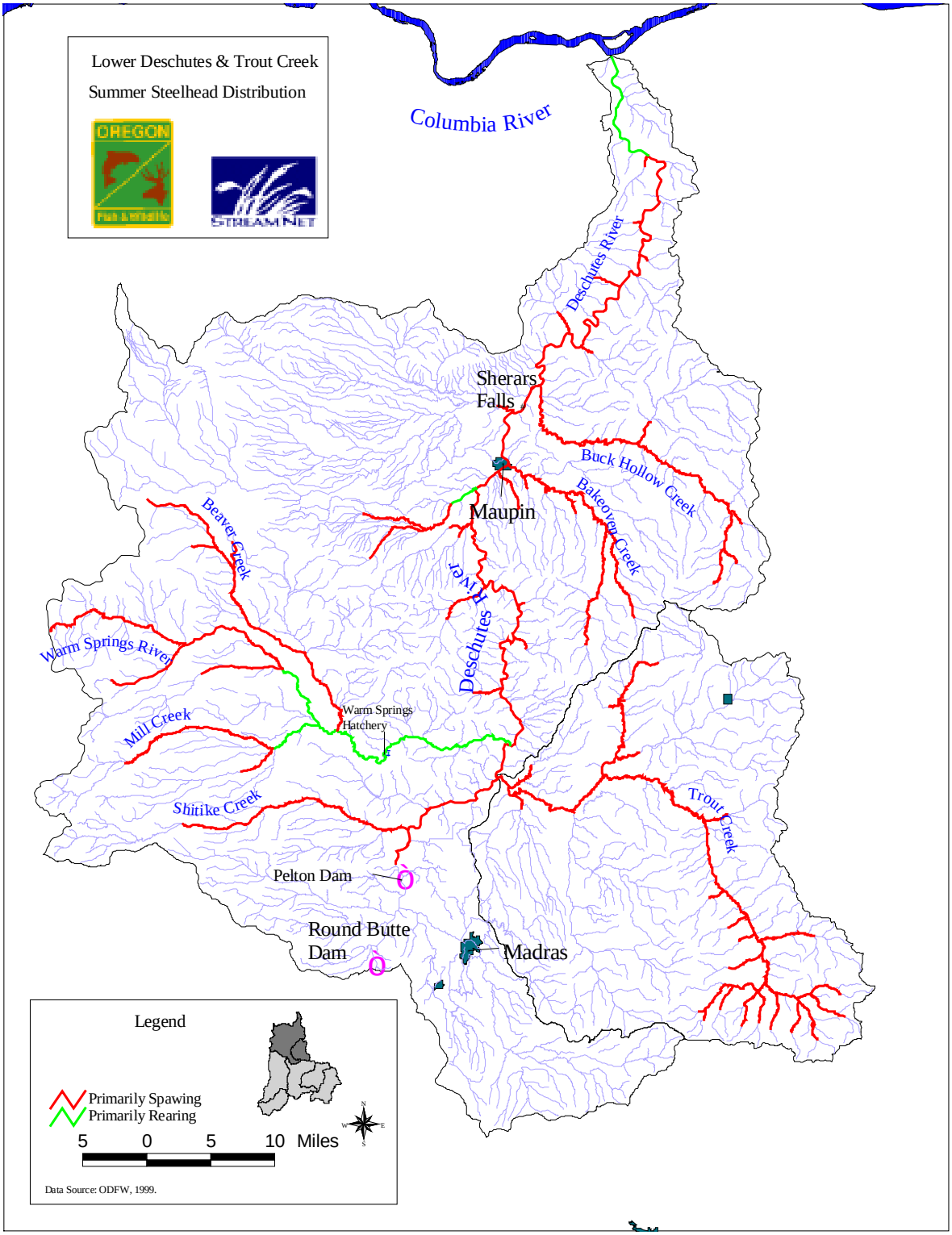

Figure 12. Summer steelhead distribution in the lower Deschutes River subbasin.

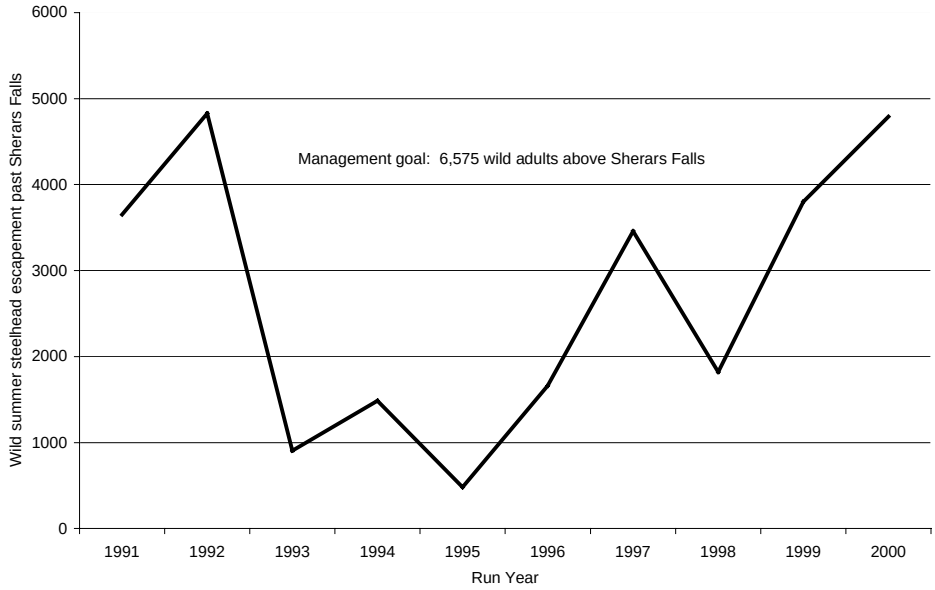

Figure 13. Wild summer steelhead estimated escapement above Sherars Falls, 1991 to 2000.

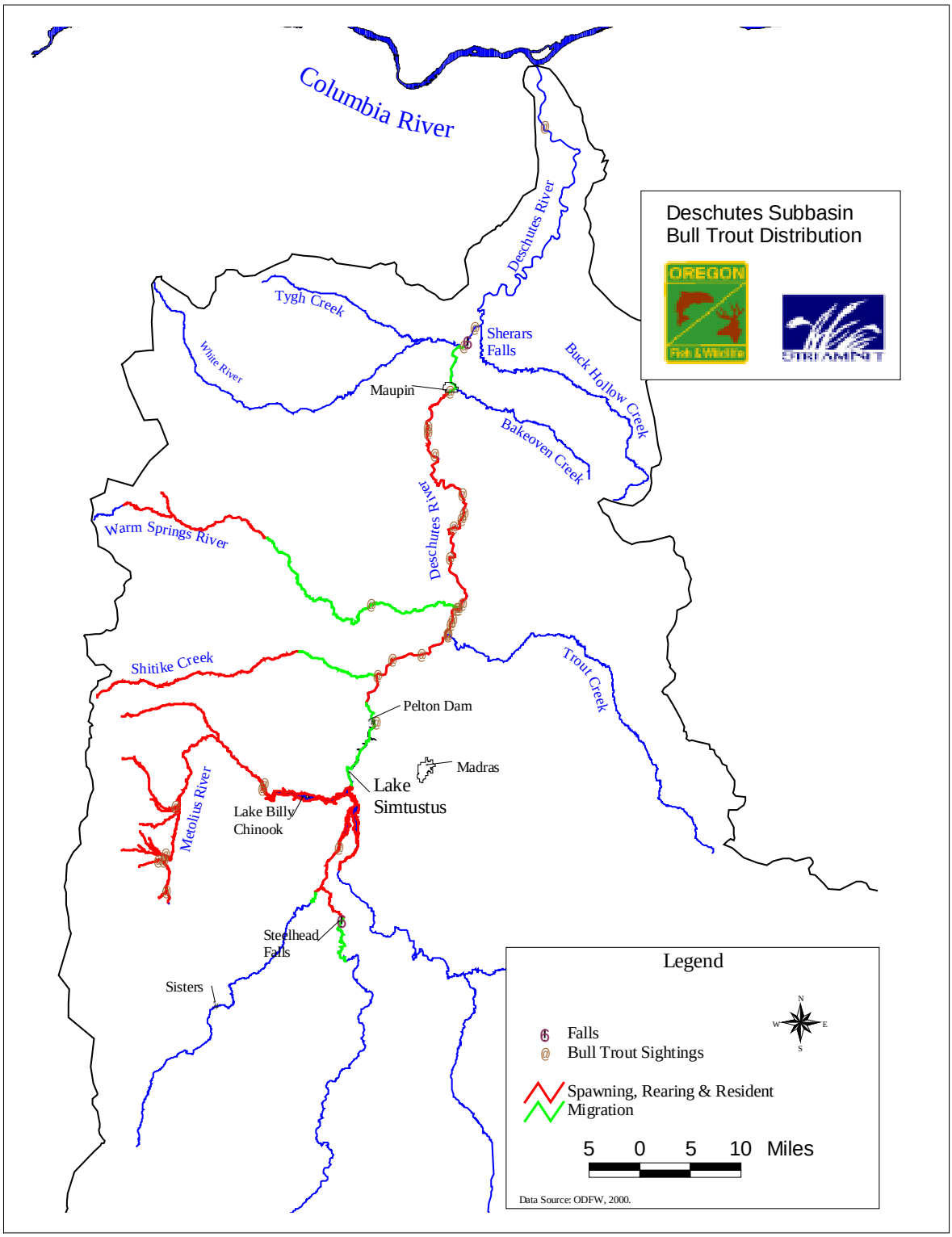

Figure 14. Bull trout distribution in the Deschutes River subbasin.

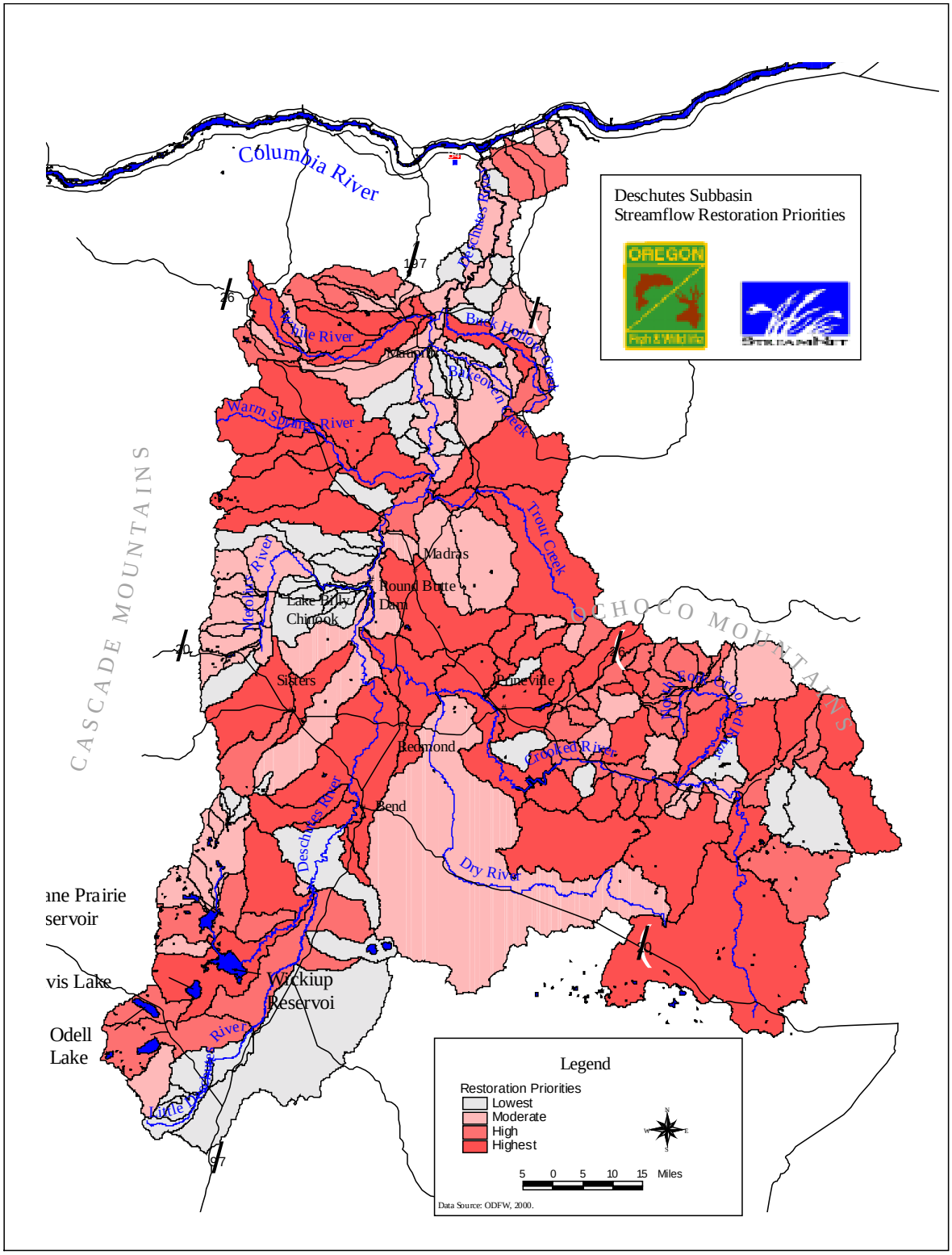

Figure 15. Streamflow restoration priorities in the Deschutes River subbasin.

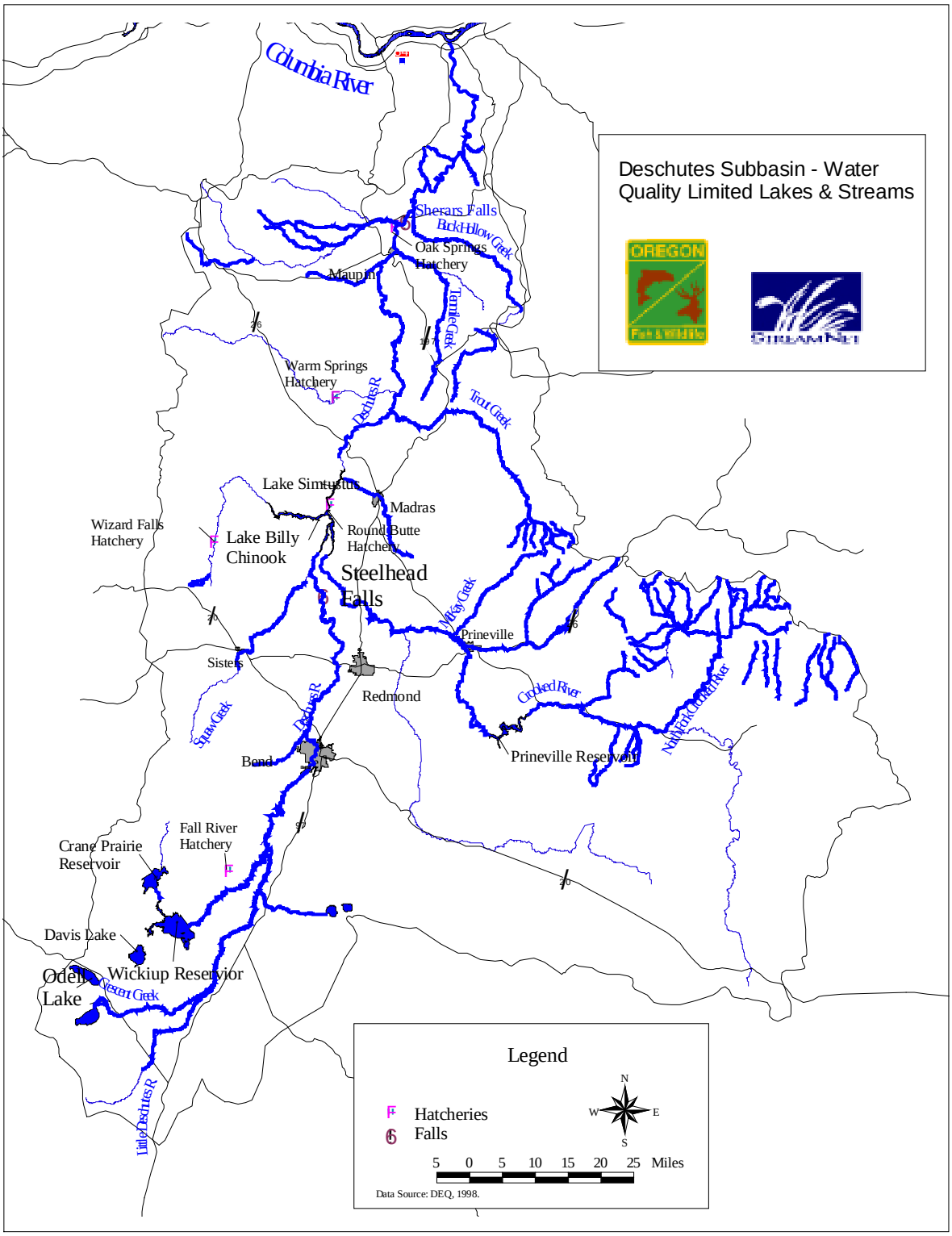

Figure 16. DEQ 303(d) listed water quality limited streams in the Deschutes River subbasin.

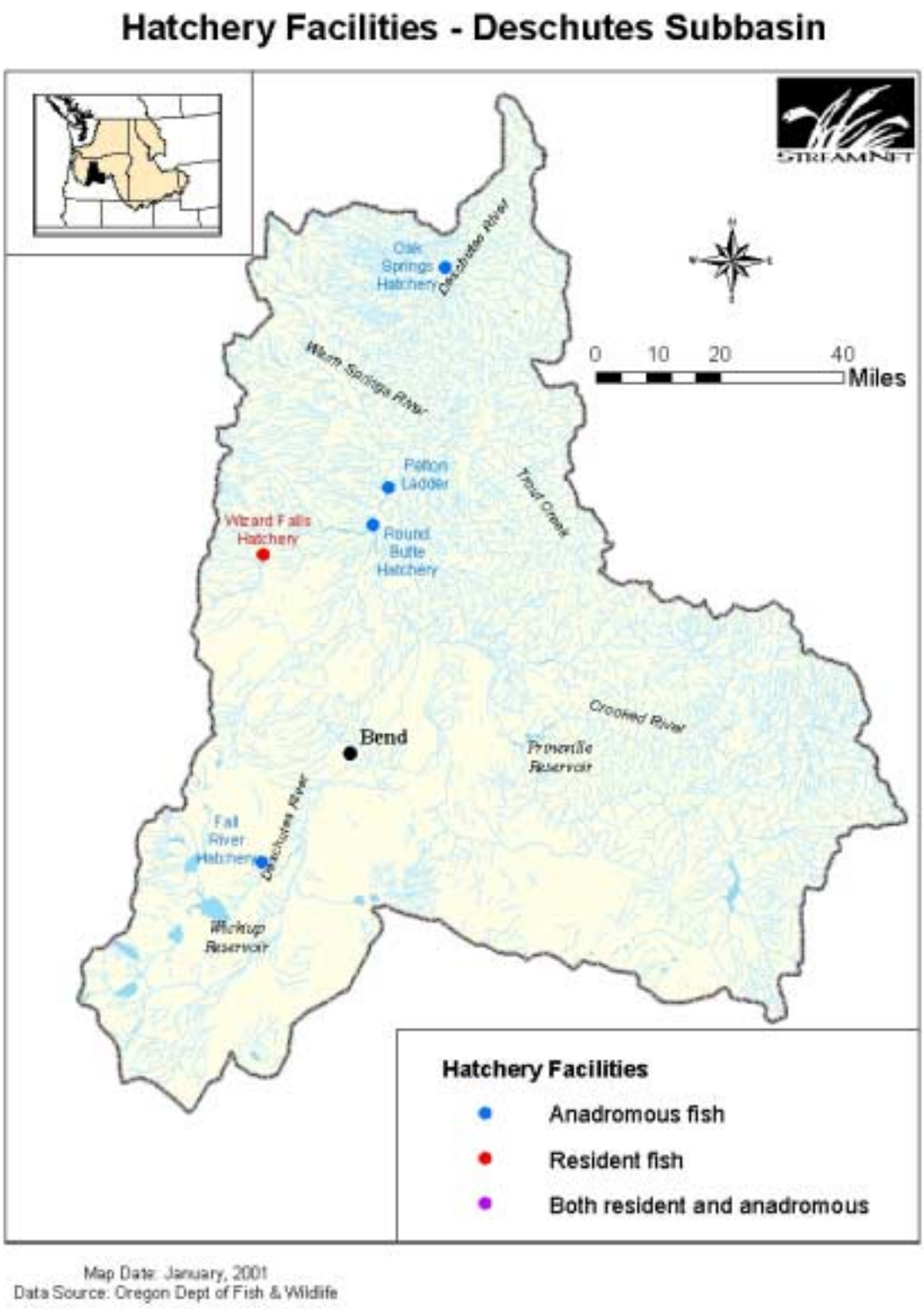

Figure 17. Hatchery facilities in the Deschutes River subbasin.

HATCHERY AND GENETIC MANAGEMENT PLAN

HGMP

Spring Chinook Salmon

Warm Springs National Fish Hatchery

U.S. Fish & Wildlife Service
Columbia River Fisheries Program Office
Warm Springs National Fish Hatchery

December 20, 1999

Warm Springs National Fish Hatchery
Spring Chinook Salmon

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

The purpose of this hatchery and genetic management plan (HGMP) is to provide a single source of hatchery information for comprehensive planning by federal, state, and tribal managers, and for permitting needs under the Endangered Species Act (ESA). (file hgmp#ws.wpd)

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of Program

Warm Springs National Fish Hatchery

1.2) Population (or stock) and species

spring chinook salmon, *Oncorhynchus tshawytscha*

1.3) Responsible organization and individual:

Name(and title): Fred Olney (Fish and Wildlife Administrator)
Organization U.S. Fish and Wildlife Service
Address: 911 NE 11th Ave, Portland, Oregon 97232
Telephone: (503)872-2761
Fax: (503)231-2062
Email:fred_olney@fws.gov

Other organizations involved, and extent of involvement in the program:
Warm Springs National Fish Hatchery - operator
Confederated Tribes of the Warm Springs Reservation of Oregon - management
Columbia River Fisheries Program Office (Fisheries Management Technical Support)
Oregon Department of Fish and Wildlife - co-manager of fisheries

The U.S. Fish and Wildlife Service recognizes that the Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO) have the principal management responsibility for fishery resources on the Warm Springs Reservation. The Service and the Tribe have a MOU and an agreement for operation of the hatchery to be compatible with and compliment the Tribe's fishery management goals (Appendix A).

1.4) Location(s) of hatchery and associated facilities:

Warm Springs NFH is located on the north bank of the Warm Springs River at Rkm 16 within the Warm Springs Indian Reservation in Wasco County, Oregon about nine miles north of the

Town of Warm Springs. The Warm Springs River is a major tributary of the Deschutes River in north central Oregon. The Warm Springs River enters the Deschutes River at river kilometer (Rkm) 135, which enters the Columbia River 329 Rkm from the Pacific Ocean. The hatchery site lies in Section 24, Township 8 South, Range 12 East, Willamette Meridian, Oregon. Exhibit1 from the hatchery master plan illustrates the location, general site features and topography. GIS coordinates and map to be provided by NMFS.

1.5) Type of program: Harvest Augmentation/Integrated Harvest

1.6) Purpose (Goal) of program:

The continuing goal of the Warm Springs Tribe and the U.S. Fish and Wildlife Service is to cooperatively operate the hatchery in a manner that will provide harvest opportunities and protect remaining wild fish populations.

1.7) Specific performance objective(s) of program

OBJECTIVES

Objective 1: Hatchery Production

Produce 750,000 spring chinook smolts for on-station release.

Objective 2: Minimize interactions with other fish populations through proper rearing and release strategies.

Objective 3: Maintain stock integrity and genetic diversity of each unique stock through proper management of genetic resources.

(A) minimum escapement goal for wild spring chinook salmon above the hatchery is 1,300 adults (B) approximately 10% of the hatchery broodstock will be of wild fish origin and (C) only wild (unmarked) steelhead will be passed above the hatchery weir.

Objective 4: Maximize survival at all life stages using disease control and disease prevention techniques. Prevent introduction, spread or amplification of fish pathogens.

Objective 5: Conduct environmental monitoring to ensure that hatchery operations comply with water quality standards and to assist in managing fish health.

Objective 6: Communicate effectively with other salmon producers and managers in the Columbia River Basin.

1.8) List of Performance Indicators designated by "benefits" and "risks"

Benefits:
(1) achieve 3.5:1 adult replacement rates of program fish;
(2) promote wild Warm Springs River spring chinook salmon (not listed) physical and genetic traits in hatchery program;
(3) harvest hatchery fish in sport, commercial, ceremonial and subsistence fisheries;
(4) remove stray hatchery steelhead from upstream spawning population (listed);
(5) monitor wild and hatchery fish escapement and productivity, including listed bull trout populations.

Risks:
(1) decreased trends in spawning abundance of wild fish in Warm Springs River (including listed anadromous summer steelhead trout and listed bull trout) measured by juvenile and adult population estimates, pre-spawning mortality, smolt-to-adult and egg-to-smolt survivals, and adult:adult replacement rates;
(2) reduced genetic fitness in wild fish population as measured by deleterious changes in heterozygosity, DNA analyses, effective population size, length/age/sex composition;
(3) genetic effects on other populations by program fish as measured by stray rates;
(4) ecological effects upon other wild fish populations as determined from predation,competition, behavior and disease.

1.9) Expected size of program

Hatchery production per 1997-2001 hatchery operations plan:
Produce 750,000 spring chinook smolts for on-station release.
(Refer to IHOT performance standards below and Section 2.3 for harvest information)

PERFORMANCE STANDARDS—WARM SPRINGS NATIONAL FISH HATCHERY[1]
Modified from IHOT plan:

Measures	Species	Hatchery Goal	Historic Average	Historic Range	Constraints
Adult Capture	Spring Chinook	630	407	52-791	1
Expected Fish Releases (1998-2001 broods)		750K	572K	179K-1,071K	1
Egg Transfers		0	0	300K	2
Fish Transfers		0	0	100 adults	2
Wild Adults Passed Upstream		1,300	958	160-2,015	1
Percent Survival, Juvenile to Adult		0.5%	0.24%	0.005-0.84%	3
Smolt Size at Release (fish/lb)		15	15	6-22	

Constraints/Comments—Warm Springs National Fish Hatchery

1. Low returns of wild and hatchery fish prevent meeting goals.
   Adults include three, four, and five year old fish.
   Culling of eggs from high titer, BKD adult carriers reduces egg take.
   Concerns over wild fish interactions prevent complete volitional release.

2. Eggs were transferred from Round Butte to Warm Springs in BY 94 and 95.
   Adults were transferred to Round Butte State Hatchery from Warm Springs in BY98 and 99.

3. Low survival is caused by several factors, including high summer water temperatures, untreated water, parasite loads, BKD, Columbia River passage problems past The Dalles and

Bonneville Dams, and ocean conditions. Percent survival is from juvenile release to return to hatchery plus Deschutes River fishery.

1.10) Date program started : 1978

1.11) Expected duration of program: continuing per hatchery operations plan with Tribe.

1.12) Watersheds targeted by program:

The Warm Springs River is a major tributary of the Deschutes River in north central Oregon. The Warm Springs River enters the Deschutes River at river kilometer (Rkm) 135, which enters the Columbia River 329 Rkm from the Pacific Ocean. Headwaters of the Warm Springs River are on the eastern slope of the Cascade Mountain Range. Warm Springs NFH is located on the Warm Springs River at Rkm 16 within the Warm Springs Indian Reservation of Oregon.

Flow and temperature vary seasonally near the hatchery site, with a mean annual flow of 440 cfs and a minimum flow of 220 cfs. River temperature at the hatchery ranges from freezing to 20°C. Climate is semi-arid. A detailed description of the Deschutes River Subbasin can be found in the Deschutes River Subbasin Salmon and Steelhead Production Plan (Oregon Department of Fish and Wildlife and Confederated Tribes of the Warm Springs Indian Reservation 1990).

1.13) Future program direction:

The future direction of this program may change as regional decision makers address salmon and steelhead restoration needs. As changes occur in hydro, habitat and harvest and as hatchery reform is implemented, adaptive management strategies may include redirection of this program. As such changes occur, or where new information becomes available that may potentially effect listed salmon and steelhead species, the Service will reinitiate consultation by supplementing this HGMP.

SECTION 2. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

2.1) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

Hatchery Program is consistent with:
Federal Statute 184
1997-2001 Hatchery Operations Plan
IHOT Standards and Policies

ODFW Lower Deschutes River Management Plan
NPPC Deschutes River Salmon and Steelhead Plan
Wy Kan Ush Me Wa Kush Wit, CRITFC
Intra-Service Section 7 Consultation for bull trout
1999 NMFS Biological Opinion on Columbia River hatcheries
U.S. v Oregon

2.2) Status of natural populations in target area.

The following indigenous species are described in ODFW (1997):
Spring Chinook Salmon, *Oncorhynchus tshawytscha* - depressed
Summer Steelhead, *Oncorhynchus mykiss* - depressed (listed)
Redband Rainbow Trout, *Oncorhynchus mykiss* - stable and healthy in Deschutes River
Bull Trout, *Salmo confluentus* - depressed (listed)
Fall Chinook Salmon, *Oncorhynchus tshawytscha*- stable to increasing below Sherars Falls
Sucker sp., *Catostomus* sp. - stable ?
Mountain Whitefish, *Prosopium williamsoni* - stable & healthy Deschutes, low # Warm Sprs R
Pacific Lamprey, *Lampetra tridentatus* - depressed?
Chiselmouth, *Acrocheilus alutaceus* - low abundance?
Northern Pikeminnow, *Ptychocheilus oregonensis* - stable?
Redside shiner, *Richardsonius balteatus* - stable?
Dace sp., *Rhinichthys* sp. - stable?
Sculpin sp., *Cottus* sp. - ?
Sockeye Salmon, *Oncorhynchus nerka* - not described in ODFW (1997), described as "landlocked" upstream of RM100, in NPPC Subbasin Plan (ODFW and CTWS 1990)

Note: The focus of our HGMP will be on wild and hatchery spring chinook salmon produced from the Warm Springs River. Listed summer steelhead trout, listed bull trout, and other species will also be discussed where pertinent.

2.2.1) Geographic and temporal spawning distribution.

Wild fish, including wild spring chinook salmon and summer steelhead trout, in the Warm Springs River are trapped at and passed upstream of the hatchery. Most of the natural spawning of wild fish occurs upstream of the hatchery. Primary spawning areas include the upper Warm Springs River, Beaver Creek and Mill Creek. Spring-time spawners are anadromous summer steelhead (listed) and redband trout, anadromous pacific lamprey, whitefish, and suckers; Late summer/fall spawners are spring chinook salmon and bull trout (listed). Fall chinook spawn in lower Deschutes River also during the fall season. See descriptions in subbasin plans for more information (ODFW 1997 and ODFW and CTWS 1990).

2.2.2) Annual spawning abundance for as many years as available.

Table 1 from Olson et al. (1995) was updated for spring chinook salmon to include return years 1978 to 1999 (Appendix B). Including jacks, the number of wild spring chinook passed upstream of the hatchery has ranged from 235 to 2,074 fish. From 1979 to 1998, wild summer steelhead returns have ranged from 79 to 822 fish.

Table 1 from Olson and Pastor (1998) shows the number of summer steelhead recoveries at Warm Springs NFH (Appendix C). All un-marked steelhead observed at the hatchery are considered wild fish and are passed upstream. Except for the short-lived hatchery program for steelhead during1978-80, all marked fish are hatchery strays and are sacrificed at the hatchery.

As reported in our Intra-Service Section 7 Biological Evaluation, up to 10 bull trout have been passed upstream of the hatchery annually each year since 1991. Records of other fish passing upstream of the hatchery and observed in the adult fishway (redband rainbow trout, suckers and whitefish) have been documented since 1991 and are available upon request.

Accounting of fish in the mainstem Deschutes River and other tributaries is available from ODFW, The Dalles District Office and the Warm Springs tribal fisheries program office. Also refer to subbasin plans for more information (ODFW 1997 and ODFW and CTWS 1990).

2.2.3) Progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for as many brood years as available.

For Warm Springs River spring chinook salmon, the spawner-recruit relationship has been examined since broodyear 1975. The number of "effective" spawners in the Warm Springs River was determined from the observed number of redds and the sex ratio of wild fish, where each redd was assumed to represent one female. The number of recruits back to the Deschutes River was estimated from combining harvest (creel survey) and returns by age class (scale analysis) to the hatchery. Prespawning mortality was estimated by subtracting the estimated number of effective spawners from the known number of fish passed upstream of the hatchery. This data is collected by collective efforts of ODFW (sport creel), the Tribe (tribal harvest and redd counts), and USFWS (hatchery passage counts and biological sampling of wild fish).

Olson et al. (1995) reported a significant correlation ($r^2 = 0.896$) between the number of wild spring chinook adults spawning and the eventual returns of their progeny, 1975-1988 broodyears. Since this publication, wild spring chinook from broodyears 1989-91 performed quite poorly with recruit per spawner ratios less than 1.0, which is below replacement. Fortunately, broodyears 1992 and 1993 performed much better and similar to the 1975-88 broods, but the spawner:recruitment relationship has been significantly reduced, $r^2=0.21$ (Appendix D, as in Fagan and Olson 1999).

Juvenile production and redd count data for summer steelhead , spring chinook, and bull trout is available from the Warm Springs Tribal Fisheries Office.

2.2.4) Annual proportions of hatchery and natural fish on natural spawning grounds for as many years as possible.

It was originally anticipated that the Warm Springs NFH program for spring chinook salmon would be used to supplement natural production. From 1982 to 1985, 14% to 39% of all adult fish passed upstream were of known hatchery origin (Appendix B). From 1986 to 1994, the trap and weir at the hatchery were operated to allow only wild (unmarked) spring chinook salmon, summer steelhead trout , and other native fish above the weir, keeping hatchery (marked) fish from passing upstream.

In 1997, an automated fish passage system was operated during the spring chinook salmon migration period of mid-April through the end of September. The system is designed to minimize handling of wild fish by separating out returning hatchery spring chinook salmon with coded-wire tags (see Section 6.2.3 for more details). The passage system standards are to allow no more than 10% hatchery spring chinook as part of the upstream spawning population.

2.2.5) Status of natural population relative to critical and viable population thresholds.

Information is not required at this time and, as necessary, will be provided at a later date, per guidance by NMFS on October 5, 1999.

2.3) Relationship to harvest objectives

Spring Chinook Salmon (not listed). All juvenile hatchery spring chinook salmon in the Deschutes River are externally marked prior to release. Harvest rates vary from 0 to 40% depending on abundance, distribution and restrictions in fishery. Harvest, when allowed, is primarily in freshwater and predominately in the Deschutes River (Appendix E as in Pastor 1999; see also Olson et al. 1995). Pre-season and in-season forecasts are used for fisheries management in the Columbia River (Pettit 1999) and Deschutes River (Fagan and Olson 1999). Wild fish abundance drives fishery management decisions by ODFW and the Tribe in the Deschutes River. Columbia River fisheries are managed by parties to U.S. v Oregon and listed fish harvest is regulated by NMFS Biological Opinions to meet jeopardy standards. See also ODFW Lower Deschutes River Fish Subbasin Management Plan (1997).

Summer Steelhead Trout (listed). Catch and harvest of summer steelhead has been estimated in the Deschutes River since 1970 (Appendix F as in ODFW 1997). Juvenile hatchery steelhead in the Columbia River are marked prior to release for the purpose of selective fisheries management. Since 1979, selective sport fisheries have been in place for harvest of marked

hatchery (adipose fin clipped) steelhead in the Deschutes River. Tribal fishers are regulated by the Tribe and can include harvest of both hatchery and wild steelhead. In recent years however, wild steelhead have been released live from tribal dip net fisheries in the Deschutes River as well. Fishery management decisions are made by ODFW and the Tribe in the Deschutes River. Columbia River fisheries are managed by parties to U.S. v Oregon and listed fish harvest is regulated by NMFS Biological Opinions to meet jeopardy standards. For more information see ODFW (1997): Lower Deschutes River Fish Subbasin Management Plan, Section 4. Out of basin strays not harvested but contributing to natural production are a large concern in the Deschutes River (ODFW 1997).

In-River Agreements: State, federal and tribal representatives meet throughout the year to set Columbia River harvests relative to the *U.S. v. Oregon* Columbia River Fish Management Plan. Periodic meetings are also held throughout the year to assess if targets are being met.

2.4) Relationship to habitat protection and recovery strategies.

Factors limiting production (from pages 1-21 to 1-28 of ODFW Lower Deschutes River Management Plan 1997)**:** Water Quantity, Water Quality, Consumptive Water Use, Instream Water Rights, Instream Water Rights Monitoring, Water Rights, Application Review, Water Diversion Screening, Sedimentation, Instream Substrate and Structure, Cover, Barriers and Obstacles. The Tribe is responsible for habitat protection and recovery strategies on the Warm Springs Reservation. Riparian habitat needs to be restored and protected.

The 1997-2001 hatchery operations plan limits spring chinook hatchery origin spawners to 10% of natural production . Warm Springs hatchery spring chinook adults have been used to backfill shortfalls to Round Butte hatchery which is also used for the Hood River supplementation program. Hatchery carcass outplanting to Warm Springs River production areas is being considered by the Tribe.

2.5) Ecological interactions

Species that could negatively impact program. Alien invaders. i.e. zebra mussel, whirling disease, out of basin (Snake River) stray summer steelhead and stray spring chinook salmon.

Predators: A variety of freshwater and marine predators such as northern pikeminnows, Caspian terns, and pinnipeds, can significantly reduce overall survival rates of program fish. Predation by northern pikeminnow poses a high risk of significant negative impacts on the productivity of hatchery chinook (SWIG 1984). Based on PIT tags recovered at a large Caspian tern nesting colony on Rice Island, a dredge material disposal island in the Columbia river estuary, 6-25 million of the estimated 100 million out-migrating juvenile salmonids reaching the estuary were consumed by the terns in 1997 (Roby, et al. 1997). The Fish Passage Center (Berggren 1999) estimates, from about 57,000 PIT tag recoveries from Rice Island, that through 1991, about

0.2% of all PIT tagged fish released into the Columbia River showed up on Rice Island. That percentage had increased by a factor of ten by the 1997 and 1998 juvenile salmonid out-migrations, with hatchery and wild steelhead having been the most effected by the increased predation. A NMFS Working Group (NMFS 1997) determined that California sea lion and Pacific harbor seal populations in the three west coast states have risen by 5-7% annually since the mid-1970s. Their predation on salmonids may now constitute an additional factor on salmonid population declines and can effect recovery of depressed populations in some situations.

Species that could be negatively impacted by program. Listed summer steelhead trout and listed bull trout, wild spring chinook salmon, and all other native species in the Deschutes River subbasin which depend on the riparian and aquatic environment could be impacted.

Co-occurring natural salmon and steelhead populations in the Columbia River mainstem corridor areas may also be effected by Warm Springs NFH program fish. Of primary concern are the ESA listed endangered and threatened salmonids: Snake River fall-run chinook salmon ESU (threatened); Snake River spring/summer-run chinook salmon ESU (threatened); Lower Columbia River chinook salmon ESU (threatened); Upper Willamette River chinook salmon ESU (threatened); Upper Columbia River spring-run chinook salmon ESU (endangered); Columbia River chum salmon ESU (threatened); Snake River sockeye salmon ESU (endangered); Upper Columbia River steelhead ESU (endangered); Snake River Basin steelhead ESU (threatened); Lower Columbia River steelhead ESU (threatened); Upper Willamette River steelhead ESU (threatened); Middle Columbia River steelhead ESU (threatened); and the Columbia River distinct population segment of bull trout (threatened). An additional concern is the Southwestern Washington/Columbia River coastal cutthroat trout ESU proposed for listing as threatened. See the ecological interactions discussion below.

Species that could positively impact program. Wild spring chinook salmon which could be used for hatchery broodstock. Returning chinook and other salmonid species that naturally spawn in the target stream and surrounding production areas may positively impact program fish. Decaying carcasses may contribute nutrients that increase productivity of the overall system.

Species that could be positively impacted by program. Listed summer steelhead trout and listed bull trout, wild spring chinook salmon, and all other native species in the area which depend on the riparian and aquatic environment could be impacted. Predators, including listed bull trout.

A host of freshwater and marine species that depend on salmonids as a nutrient and food base may be positively impacted by program fish. The hatchery program may be filling an ecological niche in the freshwater and marine ecosystem. A large number of species are known to utilize juvenile and adult salmon as a nutrient and food base (Groot and Margolis 1991; and McNeil

and Himsworth 1980). Pacific salmon carcasses are also important for nutrient input back to freshwater streams (Cederholm et al. 1999). Reductions and extinctions of wild populations of salmon could reduce overall ecosystem productivity. Because of this, hatchery production has the potential for playing an important role in population dynamics of predator-prey relationships and community ecology. The Service speculates that these relationships may be particularly important (as either ecological risks or benefits) in years of low productivity and shifting climactic cycles.

In addition, wild co-occurring salmonid populations might be benefitted as schools of hatchery fish migrate through an area. The migrating hatchery fish may overwhelm predator populations, providing a protective effect to the co-occurring wild populations. See the ecological interactions discussion below.

Ecological Interactions in the Deschutes River Subbasin

Specific hatchery practices such as fish size at release, time of release, and the use of volitional release can potentially affect ecological interactions in the Deschutes River subbasin. From 200,000 to 1 million juvenile spring chinook salmon have been released from the hatchery into the Warm Springs River. The current production goal is 750,000 juveniles. All juvenile fish released from the hatchery are marked (coded-wire tagged and adipose fin clipped) to differentiate them from wild fish upon return. Production is typically split into fall subyearling and spring yearling release periods.

The fall release strategy at Warm Springs NFH is a partial volitional release. Starting in early October, fish are allowed to move out on their own volition through early November. Approximately 10% of the fish are estimated to exit on their own during this fall volitional release. Past records indicate that a mixture of sizes exit the hatchery in the fall, but most are between 140mm and 200mm fork length. The remaining fish are reared overwinter then allowed to volitionally exit from late-March through April. Fish remaining at the end of April are forced out to make room for next year's brood. Some ungraded experimental groups of fish are also reared and held over until the typical yearling spring release period with no fall emigration. Rearing density and medicated feed studies are under investigation.

Behavior and Stream Ecology of Juvenile Production Releases. The effect of juvenile fish releases from the hatchery on wild fish needs to be closely examined, especially in regards to the fall release program. From Olson et al. 1995, "All juvenile production at Warm Springs NFH is released at the hatchery into the Warm Springs River. Our goal is to release functional smolts that emigrate quickly to the ocean. Whereas most fish released in the spring (as yearlings) reach the estuary within 3 to 4 weeks, the destination of fish released in the fall is less clear. Fall-release fish have been recovered in the Columbia River in both the fall and spring periods. Scale analysis of fish released from Round Butte State Fish Hatchery indicate that over one-half of adults returning from their fall releases overwintered in the Deschutes River and migrated to the

ocean in the following spring (Lindsay et al. 1989). These overwintering hatchery residuals could displace or compete with wild fish in the Deschutes River. Even though the fall release program, particularly the volitional fall release, may be a good fish cultural practice to maximize adult hatchery return rates, the effects on wild fish need to be assessed."

Since the publication of Olson et al. 1995, we have additional evidence that the fall release fish are overwintering in freshwater before emigrating the following spring. Scale samples were taken from adult fish which returned in 1991-93 and survived from the fall release. Of the 120 scale samples analyzed by Jeff Fryer (CRITFC), 92 showed signs of a yearling freshwater annulus, 6 were possibly subyearling freshwater annulus, and 22 were not readable. From this sample, this indicates that fish surviving from the fall release are overwintering in freshwater before their ocean entry. Other evidence of their overwintering behavior is from trout surveys conducted by Oregon Department of Fish and Wildlife. During February and March of 1997 and 1999, ODFW found a handful of marked (adipose fin clipped) spring chinook salmon in the Deschutes River between North Junction (RM 71) and just upstream of the mouth of Warm Springs River (RM 85). Although no samples were collected and verified, the adipose fin clipped juvenile spring chinook salmon observed by ODFW were likely from Warm Springs NFH fall release.

The fall volitional release from the hatchery mimics one component of the wild fish juvenile migration pattern from the Warm Springs River (Olson et al. 1995). The wild juvenile spring chinook salmon emigration from the Warm Springs River is also split into fall and spring migration periods (Lindsay et al. 1989 and Olson et al. 1995). However, there are two notable differences: 1) The juvenile hatchery fish volitionally released in the fall are, on average, larger than the wild fish during the same fall migration. Wild fish during their fall emigration are typically less than 140mm fork length, range 59mm to 139mm (Olson et al.1995). Whereas most fall volitionally released hatchery fish are larger than 140mm, range=70mm to 229mm (USFWS unpublished data); 2) There are seasonal differences. Wild juveniles emigrating from the Warm Springs River in the fall overwinter in freshwater (Deschutes River) before their spring seaward migration (Lindsay et al. 1989). Hatchery releases in the fall have both a fall and spring seaward migration period. From limited sampling, hatchery fish which were observed at The Dalles Dam in early November and mid-December were all longer than 160mm fork length (Cates 1989). We speculate that most fall release hatchery fish smaller than 160mm either die or overwinter in the Deschutes River. We estimate that 37% of the fall release is less than 160mm and 63% are longer than 160mm (1989 unpublished data). Following this logic, if 50,000 juveniles are released during the fall volitional release, then approximately 63% or 31,500 fish exit the Deschutes River and the other 37% or 18,500 fish potentially remain in the Deschutes River. For those that remain in the Deschutes River, some portion will survive and overwinter prior to their spring downstream migration.

The fall release program is scheduled to continue, but on a limited scale (not to exceed 10% of total hatchery production). Studies need to be developed to better understand the fate of fall migrants and effect upon the aquatic community ecology. Implementation of these projects are

dependent on funding. A number of questions need to be assessed before endorsing or modifying the fall release program. We need to determine if hatchery fall released fish overwintering in the Deschutes River are detrimental to other fish populations. Can the Deschutes River support and overwinter a potential 18,500 hatchery origin juveniles without adversely impacting wild spring chinook, wild steelhead, and other native fish in the Deschutes River? Is the fall release program impacting use of overwintering habitat in the Deschutes River? Is the fall release program impacting food supply, fish health, competition, or predation? Alternatively, the fall release program may be beneficial to the long-term productivity of the hatchery program and spring chinook population.

From the information we have so far, we speculate that the fall release program is not adversely impacting use of overwintering habitat nor food supply. Instead, we hypothesize that the spring chinook from the fall release program are filling a niche in the Deschutes River and not adversely affecting wild fish production. These judgements are based on historical estimates of distribution, abundance, and life history patterns. Prior to completion of Round Butte Dam and other hydro impacts, natural production of spring chinook salmon was more widely distributed in the Deschutes River (Nelson 1995). Abundance estimates are difficult to reconstruct, but would have been more plentiful prior to construction of Round Butte Dam. This is true for other anadromous species of fish in the Deschutes River as well, including natural production of summer steelhead, fall chinook and sockeye (ODFW and CTWS 1990; and ODFW 1997).

The hatchery fish surviving from the fall release program, and returning as an adult, help retain an important component of the wild fish life history trait in the hatchery population. This may also minimize the hatchery impact on the upstream spawning population. The spring chinook hatchery program originated from wild fish passing the hatchery site. Since 1986, up to 10% of the natural spawning population of spring chinook salmon were hatchery fish and up to 10% of the hatchery broodstock included wild fish (See Section 5.2). We continue to incorporate wild fish in the hatchery broodstock, up to 10%. Our goal is to retain the wild fish population characteristics in both the stream and hatchery environment. Fish which are released in the fall, overwinter in the Deschutes River, and survive to adult, may help retain natural fish production characteristics and minimize impacts to the upstream spawning population.

The ecological effects from juvenile hatchery production on predation are not easy to quantify. NMFS (1999a and 1999b) discuss the potential effects of juvenile fish released from hatcheries on predation of other fish and also by attraction of predators. Factors which could lead to predation by hatchery fish on naturally produced fish, have not been extensively documented, nor are the effects consistent (Steward and Bjornn 1990).

Refer to discussions that follow for more information on potential effects from predation. The following sections also discuss potential impacts of the hatchery program on fish health, on listed summer steelhead, wild fall chinook salmon, and listed bull trout, as well as ecological interactions in the Columbia River mainstem, estuary, and Pacific Ocean.

Fish Health Ecology and Pathogens. Fish health may affect natural production but is probably not a major concern of the fall release program. An assessment of BKD impact was made by our previous fish health lab director in 1995. “There is BKD in the Warm Springs River already. Data from collections of wild fish and resident trout in 1993 and 1994 show that the juvenile populations in the river already have an exposure to BKD. They are not naive to the disease.” “Which release strategy will ultimately lead to greater returns should be determined, and evaluations made on that, not on the pathogen level in a population that is not undergoing an epizootic.”

However, rearing conditions at the hatchery could be improved. Daily maximum summer temperatures often hit 20°C because rearing ponds are dependant upon untreated river water at the hatchery site. Piper et al. (1982) indicates that between 10°C and 14°C is more desirable for raising chinook salmon. The river water adjacent to the hatchery site is only used as a migration corridor by the wild fish; water temperatures are cooler in the summer much farther upstream where the natural spawning and rearing occurs. The use of untreated river water and high summer water temperatures during juvenile rearing also creates fish health problems in the hatchery. An advance engineering plan is under development to improve the hatchery water quality. Implementation is pending funding. In addition, as budget allows, the hatchery plans on constructing shade structures over the rearing ponds. These structures will diffuse the direct sunlight on the ponds simulating the natural environment as seen in the forested headwater stream sections.

Recent and past disease classifications of Warm Springs NFH are shown below**.** Enteric redmouth (ERM) has been parenthetical because we import trout which have the disease. In 1984 ERM was found in juvenile chinook. Other disease agents that have been seen at the hatchery include: Columnaris, Costia, Ichthyophthieius, Sanguinicula, etc. Many of these agents will always be present in the system but are not usually the sole causative factors in fish losses.

Fish disease classification of Warm Springs National Fish Hatchery, 1978-91.

Date	Code
02-21-78	C-VE-VP-VH-BR-SW-B-BK-SL
04-08-80	B-BK-BF-VH-VP-SL-(BR)
01-29-81	B-BK-SC (VH-VP-BR-BF)
03-30-82	B-BK-SL (VH-BR)
06-13-83	B-BK-SC (VH)
06-24-84	C-BK-BR [Partial inspection]
09-24-85	C-BK-BR-BF [Partial inspection]
11-10-86	C-BK-BR-BF
10-05-87	C-VH-BK-BF-BR
10-26-88	C-VH-BK-BF-BR
12-18-89	C-VH-VP-BK-BR
11-01-90	C-VH-BK-BF-BR
10-04-91	VH-BK-BF

CODE:		
	B-	Class "B" denotes certifiable diseases have occurred within the last two years.
	C-	Class "C" designation denotes lack of information (unknown disease history)
	BF-	Furunculosis
	BR-	Enteric Redmouth Hatcherium
	BK-	Salmonid Kidney Disease Bacterium
	SC-	Ceratomyxa shasta
	SW-	Myxosoma cerebralis
	VE-	Viral Hemorrhagic Septicemia Virus
	VH-	Infectious Hermatopoetic Necrosis Virus
	VP-	Infectious Pancreatic Nerosis Virus
	( )-	Parenthetical classification demotes past occurrence but not recently found.

Two sources of disease transmission are possible from Warm Springs NFH operations. One is by hatchery effluent contamination and the other is by horizontal transmission between fish. The hatchery effluent goes directly to the river during normal operations. During pond cleaning, the hatchery effluent goes through a primary treatment process (settling pond) before discharge to the Warm Springs River. The settling pond is 11 acre feet in size and has a residence time of approximately five days. Hatchery effluent monitoring meets EPA water quality requirements; however, fish health pathogens are not monitored in the effluent.

Disease transmission and infection between hatchery and wild fish in the natural environment is not well understood (Steward and Bjornn 1990). The effects from disease are most notable in a hatchery environment; in a crowded pond a disease out-break spreads quickly. Recently, a team of state and federal fish health experts in the Columbia River basin prepared a presentation to the Snake River ESA Recovery Team on the impact of fish diseases on production in the Columbia River Basin (Amos et al. 1992). A specific question they addressed was: "What is the impact of diseased hatchery fish on natural production?". The release of hatchery fish is a possible factor in transmitting disease to healthy free ranging fish. Diseased fish can infect healthy fish. But it is usually where the disease was not seen previously, or in a disturbed environment. " Nature does not favor the persistent occurrence of diseases. Seriously diseased individuals die or are taken by predators, therefore over the long term, diseased hatchery fish have little impact on the natural production of free-ranging fish in good environmental conditions. Under adverse environmental conditions disease outbreaks become a more significant factor for all fish regardless of their origin." (Amos et al. 1992).

The guidelines followed by the Pacific Northwest Fish Health Protection Committee will greatly reduce the risk of introducing exotic disease pathogens in the Warm Springs, Deschutes and Columbia Rivers. The USFWS fish health guidelines and policy for each Columbia Basin federal hatchery promotes good fish health and hatchery practices.

Ecological Effects on Summer Steelhead Trout (Listed): From Olson et al. 1995, “As stated earlier, steelhead hatchery production at Warm Springs NFH was terminated in 1981. Since that time, we have sacrificed all known steelhead strays and pass only unmarked fish upstream. All sacrificed fish are distributed to the Tribe. Starting in 1987 a high number of marked strays have been counted and sacrificed at the hatchery. More than 1,500 steelhead returned in 1987, including 692 stray hatchery fish.” Furthermore, Olson and Pastor (1998) reported that most strays which are coded-wire tagged are coming from Snake River hatchery programs. Large numbers of these stray fish are apparently entering the Deschutes River... In a sense through operation of the hatchery weir on the lower Warm Springs River we have created a wild fish refuge for summer steelhead trout in the upper Warm Springs River. However, the number of stray wild steelhead is unknown.

Warm Springs NFH production of spring chinook salmon may affect wild summer steelhead in the Deschutes River. Summer steelhead occur throughout the Deschutes River below Pelton Reregulating Dam (river mile 100) and in most tributaries below the dam, including the Warm

Springs River (ODFW 1997). Managers believe that mainstem spawning accounts for 30% to 60% of the natural production (ODFW 1997). As mentioned earlier, a large number of wild and hatchery steelhead from other Columbia Basin production areas [Snake River] also stray into the Deschutes River. The amount of genetic interchange between strays and wild Deschutes River steelhead is unknown, but presumed to be occurring based on spawning ground surveys. Wild summer steelhead spawn March through June, fry emerge in spring through early summer, and juveniles rear in the Deschutes River for one to four years before migrating to the ocean (ODFW 1997).

Round Butte State Hatchery was built to mitigate the effects of the Pelton/Round Butte hydroelectric project and is the only hatchery releasing summer steelhead in the Deschutes River (ODFW 1997). Round Butte Hatchery also produces spring chinook salmon for release into the Deschutes River. Prior to release, all hatchery steelhead (and spring chinook) are uniquely marked for selective fisheries and broodstock management. Broodstock for the summer steelhead program are currently collected from Round Butte hatchery origin and wild fish returning to the Pelton trap (Steve Pribyl, ODFW, pers. comm.).

From ODFW (1997): "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."

Habitat partitioning by species limits ecological interactions (citations in NMFS 1999 Biological Opinion). As mentioned earlier, prior to completion of Round Butte Dam and other hydro and habitat impacts, spring chinook were much more plentiful in the Deschutes River (Nelson 1995). Best professional judgement is that releases of spring chinook salmon from Warm Springs NFH will not adversely affect listed summer steelhead production. Operations at Warm Springs NFH benefits natural production of listed summer steelhead in the Warm Springs River by removing known hatchery strays from the spawning population.

Ecological Effects on Fall Chinook Salmon. There is no hatchery production of fall chinook salmon in the Deschutes River. Wild fall chinook salmon production in the lower Deschutes River is considered healthy and robust. Best professional judgement is that releases of spring chinook salmon from Warm Springs NFH do not adversely affect fall chinook salmon production.

Ecological Effects on Bull Trout (listed). From Section 7 Biological Evaluation " In our best professional judgement, negligible effects on bull trout occur at the hatchery site. In addition, the information currently collected on adult sized bull trout at the hatchery is useful for biological evaluations."

Ecological Interactions in the Columbia River and Ocean

Competition in reservoirs. Salmon and steelhead smolts actively feed during their downstream migration (Becker 1973; Muir and Emmelt 1988; Sager and Glova 1988). Competition in reservoirs could occur where food supplies are inadequate. However, the degree to which smolt performance and survival are affected by insufficient food supplies is unknown (Muir and Coley 1994). On the other hand, the available data are more consistent with the alternative hypothesis that hatchery-produced smolts are at a competitive disadvantage relative to naturally produced fish in tributaries and free-flowing mainstem sections (Steward and Bjornn 1990).

Competition at mainstem dams. Although limited information exists, available data reveal no significant relationship between level of crowding and condition of fish at mainstem dams. Consequently, survival of natural smolts during passage at mainstem dams does not appear to be affected directly by the number - or density - of hatchery smolts passing through the system at present population levels. While smolts may be delayed at mainstem dams, the general consensus is that smolts do not normally compete for space when swimming through the bypass facilities (Enhancement Planning Team 1986). The main factor causing mortality during bypass appears to be confinement and handling in the bypass facilities, not the number of fish being bypassed.

Competition in the estuary. Juvenile salmon and steelhead, of both natural and hatchery origin, rear for varying lengths of time in the Columbia River estuary and pre-estuary before moving out to sea. The intensity and magnitude of competition in the area depends on location and duration of estuarine residence for the various species of fish. Research suggests, for some species, a negative correlation between size of fish and residence time in the estuary (Simenstad et al. 1982).

While competition may occur between natural and hatchery juvenile salmonids in - or immediately above - the Columbia River estuary, few studies have been conducted to evaluate the extent of this potential problem (Dawley et al. 1986). The general conclusion is that competition may occur between natural and hatchery salmonid juveniles in the Columbia River estuary, particularly in years when ocean productivity is low. Competition may affect survival and growth of juveniles and thus affect subsequent abundance of returning adults. However, these are postulated effects that have not been quantified or well documented.

Competition in the ocean. Ocean rearing conditions are dynamic. Consequently, fish culture programs might cause density-dependent effects during years of low ocean productivity, especially in nearshore areas affected by upwelling (Chapman and Witty 1993). To date, research has not demonstrated that hatchery and naturally produced salmonids compete directly in the ocean, or that the survival and return rates of naturally produced and hatchery origin fish are inversely related to the number of hatchery origin smolts entering the ocean (Enhancement

Planning Team 1986). If competition occurs, it most likely occurs in nearshore areas when (a) upwelling is suppressed due to warm ocean temperatures and/or (b) when the abundance or concentration of smolts entering the ocean is relatively high. However, we are only beginning to understand the food-chain effects of cyclic, warm ocean conditions in the eastern north Pacific Ocean and associated impacts on salmon survival and productivity (Beamish 1995; Mantua et al. 1997). Consequently, the potential for competition effects in the ocean cannot be discounted (Emlen et al. 1990).

Predation by hatchery salmonids. Depending on species and population, hatchery smolts are often released at a size that is greater than their naturally-produced counterparts. In addition, for species that typically smolt at one year of age or older (e.g. steelhead, spring chinook salmon), hatchery-origin smolts may displace younger year classes of naturally-produced fish from their territorial feeding areas. Both factors could lead to predation by hatchery fish on naturally produced fish, but these effects have not been extensively documented, nor are the effects consistent (Steward and Bjornn 1990).

In general, the extent to which salmon and steelhead smolts of hatchery origin prey on fry from naturally reproducing populations is not known, particularly in the Columbia River basin. The available information - while limited - is consistent with the hypothesis that predation by hatchery-origin fish is, most likely, not a major source of mortality to naturally reproducing populations, at least in freshwater environments of the Columbia River basin (Enhancement Planning Team 1986). However, virtually no information exists regarding the potential for such interactions in the marine environment.

Attraction of non-salmonid predators. Releasing large numbers of hatchery fish may also lead to a shift in the density or behavior of non-salmonid predators, thus increasing predation on naturally reproducing populations. Conversely, large numbers of hatchery fish may mask or buffer the presence of naturally produced fish, thus providing sufficient distraction to allow natural juveniles to escape (Park 1993). Prey densities at which consumption rates are highest, such as northern pikeminnow in the tailraces of mainstem dams (Beamesderfer et al. 1996; Isaak and Bjornn 1996), have the greatest potential for adversely affecting the viability of naturally reproducing populations, similar to the effects of mixed fisheries on hatchery and wild fish. However, hatchery fish may be substantially more susceptible to predation than naturally produced fish, particularly at the juvenile and smolt stages (Piggins and Mills 1985; Olla et al. 1993).

Predation by birds and marine mammals (e.g. seals and sea lions) may also be significant source of mortality to juvenile salmonid fishes, but functional relationships between the abundance of smolts and rates of predation have not been demonstrated. Nevertheless, shorebirds, marine fish, and marine mammals can be significant predators of hatchery fish immediately below dams and in estuaries (Bayer 1986; Ruggerone 1986; Beamish et al. 1992; Park 1993). Unfortunately, the degree to which adding large numbers of hatchery smolts affects predation

on naturally produced fish in the Columbia River estuary and marine environments is unknown, although many of the caveats associated with predation by northern pikeminnow in freshwater are true also for marine predators in saltwater.

Disease interactions. Hatchery programs routinely treat fish in response to disease outbreaks that occur, in part, because large numbers of fish are maintained under crowded conditions. Most pathogens now enter hatcheries through returning adult fish, surface water supplies, and other mechanisms involving direct contact with naturally spawning fish. Crowding and stress decrease the physiological resistance of salmonid fishes to disease and increase the likelihood of infection (Salonius and Iwama 1993; Schreck et al. 1993). Consequently, concern exists that the release of hatchery fish may increase the risk of disease in naturally spawning populations.

Fish managers largely understand the kinds, abundance and virulence (epidemiology) of pathogens and parasites in hatchery fish. Recent studies suggest that the incidence of some pathogens in naturally spawning populations may be higher than in hatchery populations (Elliot and Pascho 1994). Indeed, the incidence of high ELISA titers for *Renibacterium salmoninarum*, the causative agent of Bacterial Kidney Disease (BKD), appears, in general, to be significantly more prevalent among wild smolts of spring/summer chinook salmon than hatchery smolts (Congleton et al. 1995; Elliot et al. 1997). For example, 95% versus 68% of wild and hatchery smolts, respectively, at Lower Granite Dam in 1995 had detectable levels of *R. salmoninarum* (Congleton et al. 1995). Although pathogens may cause significant post-release mortality among hatchery fish, there is little evidence that hatchery origin fish routinely infect naturally produced salmon and steelhead in the Pacific Northwest (Enhancement Planning Team 1986; Steward and Bjornn 1990). Many biologists believe disease-related losses often go undetected, and that the impact of disease on naturally spawning populations may be underestimated (Goede 1986; Steward and Bjornn 1990). Nevertheless, we are unaware of any studies or documentation in the scientific literature where hatchery fish have infected a naturally spawning population of salmon or steelhead in the Pacific Northwest (see also Campton 1995).

Although the risk for spreading exotic diseases is greatly reduced and we practice good fish health within the hatchery, the Columbia River is unfortunately a disturbed environment that may be favorable to transmission of disease between fish. Amos et al. (1992) specifically noted the dam bypass and transportation programs as potential problem areas for transmission of diseases. More research is needed. Analyzing the effects of the transportation and bypass programs and hydropower operations on listed stocks is not the purpose of this assessment but needs to be assessed in a separate Biological Assessment by the appropriate agency.

Our general conclusion at this time is that Warm Springs NFH, as are all federal hatcheries in the Columbia River Basin, is currently taking extensive measures to control disease and the release of diseased fish. As a consequence, infection of natural fish by hatchery fish does not appear to be a problem. Based on the relative prevalence of BKD among hatchery and wild chinook salmon (Elliot et al. 1997; Congleton et al. 1995), the crowding and handling of fish at

transportation dams at the time of barging or bypass may have a greater likelihood of increasing the incidence of disease among naturally produced fish than direct infection from hatchery fish.

The 1999 Biological Assessment for the Operation of Hatcheries Funded by the National Marine Fisheries Service under the Columbia River Fisheries Development Program (NMFS 1999a) and the 1999 Biological Opinion on Artificial Propagation in the Columbia River Basin (NMFS 1999b) present more discussion of the potential effects of hatchery programs on listed salmon and steelhead populations. The reader is referred to the discussion in those documents.

SECTION 3. WATER SOURCE

The water source for the hatchery is the Warm Springs River. All water rights on the Warm Springs River are the property of CTWSRO. Nonconsumptive water use is included in the business lease between CTWSRO and the U.S. Fish and Wildlife Service. The intake structure and pumps are located at the hatchery site just upstream of the barrier dam. Water is pumped from the reservoir behind the barrier dam. Prior to being pumped, the water passes through a trash rack, then through a traveling screen. Directly in front of the traveling screen is a fish bypass, which is designed to deposit small fish below the barrier dam. After passing through the traveling screen, the water is pumped to the various locations needed throughout the fish hatchery.

It is suspected that juvenile fish are coming in from the Warm Springs River through the intake structure into the hatchery facility. This is suspected because some wild origin juvenile steelhead (listed), lamprey and sucker sp. have occasionally been observed in the rearing ponds. The intake structure and screens need to be examined to determine corrective action. The screens are currently 3/16th inch mesh and appear to be in good working order. The Integrated Hatchery Operations Team audit process noted that the screens do not meet the 1/10th inch standard for screening facilities (IHOT 1995). The intake structure and screening facilities may have to be improved to meet current standards. Estimated cost for needed improvements have been identified in the USFWS budget; implementation is dependent on funding.

The hatchery site is located in the lower Warm Springs River and is a migration corridor for fish. The best spawning and rearing habitat for salmon and trout in the Warm Springs River is upstream of the hatchery. Summer water temperatures at the hatchery can reach the 70's F. Upstream forested streams and meadows are much cooler. Temperature data available from the Warm Springs Tribal Fisheries Program.

SECTION 4. FACILITIES

A detailed description of the facilities at Warm Springs NFH can be found in the Warm Springs National Fish Hatchery Master Plan (Kramer, Chin and Mayo 1971). Cates (1992) describes modifications to the hatchery facilities since 1977.

Rearing units consist of 2 adult holding ponds, 3 adult catch ponds, 20 Burrows ponds, 20 converted Burrows ponds and 20 starter tanks. The facility is staffed with 6.0 FTE's. All water rights on the Warm Springs River are the property of the CTWSRO. Nonconsumptive water use is included in the business lease between CTWSRO and the U.S. Fish and Wildlife Service (USFWS). The lease specifies use of approximately 100 cfs (44,883 gpm) from the Warm Springs River. Water is supplied by pumping from the Warm Spring River. Water use ranges from 9,000 gpm to 18,000 gpm. All rearing ponds are supplied with single-pass water. An advance engineering plan is being developed for a re-use/ ozone water supply/disinfection system.

A fish barrier dam is located on the Warm Springs River adjacent to the hatchery facility. Fish are directed from the barrier dam into a fish ladder. The fish ladder is used to direct adult fish into the holding ponds, or it can be used to pass fish upstream around the barrier dam. In 1996, an automated fish passage system was installed for use during the spring chinook salmon migration period of mid-April through the end of September. See details of automated fish passage system in Section 6.2.3.

Warm Springs NFH physical description of holding, incubation, and rearing units.

Unit Type	Unit Length (ft)	Unit Width (ft)	Unit Depth (ft)	Unit Vol cuft	Number Units	Total Vol cuft	Const. Material	Age	Cond	Comment
Catch Pond	28	8	3	672	3	2,016	Concrete	18	Good	1 additional pond occupied by a denil pass and tag detector
Brood Pond	48	26	6	4,200	1	4,200	Concrete	15	Good	Oval Shape, slanting sides
Brood Pond	50	26	6	4,400	1	4,400	Concrete	15	Good	Oval Shape, slanting sides
Burrows Raceway	75	16	1.7	2,000	20	40,000	Concrete	25	Good	
Converted Burrows	75	8	1.7	1,000	20	20,000	Concrete	25	Good	
Heath Incubator					16			19	Good	16 stacks X 16 trays
Starter Tanks	13	3	2	78	20	1,560	Fiberglass	15	Good	

SECTION 5. ORIGIN AND IDENTITY OF BROOD STOCK

5.1) Source

First four years (1978-1981), all broodstock were from Warm Springs River wild spring chinook passing hatchery site (Appendix B). From 1982-1988, 15% to 75% were of wild origin. From 1989 to present, up to 10% of the broodstock can be from wild fish, whereas most of the broodstock are from returns of hatchery production. Round Butte hatchery eggs have been used to backfill Warm Springs hatchery production in 1981, 1983, 1994, and 1995. Round Butte stock is also Deschutes River / Warm Springs River origin. In 1998 and 1999, surplus adults from Warm Springs NFH were transferred to Round Butte hatchery to meet their production needs.

5.2) Supporting information

5.2.1) History

From 1978 to 1981, Warm Springs NFH was fully dependant on wild spring chinook salmon from the Warm Springs River for its broodstock. The adult progeny from our first egg takes began supplying most of our broodstock beginning in 1982. Although it has varied yearly, the majority of the broodstock is now of hatchery origin (Appendix B). The use of wild fish in the present program continues primarily because we desire to retain the genetic characteristics of the wild fish in the hatchery stock. The purpose of this wild fish infusion into the hatchery broodstock is to reduce the impact of hatchery fish if they escape detection at the hatchery and spawn in the wild; to maintain the suitability of hatchery fish for outplanting if the wild population becomes depressed; and to reduce chances of inbreeding in the hatchery broodstock.

5.2.2) Annual size

Current broodstock goal is 630 spring chinook, averaging 60% female. Actual broodstock used for the spring chinook program is presented in Appendix B.

5.2.3) Past and proposed level of natural fish in brood stock.

Wild and hatchery spring chinook used for the broodstock is presented in Appendix B. From 1997-2001 hatchery operations plan: " The goal is to have a minimum of 10% of the broodstock be of wild fish origin (63 wild / 630 total broodstock). When less than 1,300 wild adults are projected to be passed above WSNFH, a sliding scale for wild broodstock will be used as follows:
1,300+ = 63 (10%); 1,200-1,299 = 57 (9%); 1,100-1,199 = 50 (8%); 1,000-1,099= 45 (7%); 900-999= 38 (6%); 800-899= 31 (5%)."

5.2.4) Genetic or ecological differences

Although similar patterns exist, there are measurable differences in run timing of adults to the hatchery trap, length/age/sex at return, size of juveniles during first years growth, fishery contribution, egg-to-smolt, and smolt-to-adult survival. Please refer to discussion in Olson et al. (1995) for more detail (Attachment G).

5.2.5) Reasons for choosing

Warm Springs River indigenous stocks.

SECTION 6. BROOD STOCK COLLECTION

6.1) Prioritized goals

1. Spring chinook salmon from the Warm Springs River will be the first choice for broodstock. Deschutes River stock from Round Butte hatchery is second choice to backfill production need. Warm Springs stock will be differentially marked to retain the ability to manage for Warm Springs broodstock lineage.

2. Wild (unmarked) spring chinook will be incorporated into hatchery broodstock, dependant on wild run size (see 5.2.3 above).

3. Retrieval of fish for broodstock will be random and occur throughout run.

4. Between 2% and 5% of broodstock will be jack size fish (< 60 cm).

5. Retain 630 adults for broodstock

6. Spawn one male with one female

7. Each fish spawned will be given a fish health examination.

6.2) Supporting information

6.2.1) Proposed number of each sex.

In proportion to sex at return, typically 60% female.

6.2.2) Life-history stage to be collected Eggs from adults.

6.2.3) Collection or sampling design

As fish swim up the lower Warm Springs River they encounter an instream barrier dam and fish ladder adjacent to the hatchery. The fish ladder is used to direct fish into holding ponds or it can be used to pass fish upstream around the barrier dam. Adult spring chinook salmon arrive at the hatchery from mid-April through September, and broodstock is collected throughout the spawning run. During the first four years of operation, 100% of the broodstock was of wild origin. Initial guidelines (1978-81) were to not exceed one-third of the wild return or about 400 fish for hatchery broodstock (317 to 569 wild fish were actually retained each year). In 1978, broodstock was collected by keeping every third fish each day. In 1979 the procedure was changed to avoid size selection bias by taking all the fish every third day and releasing all fish on other days. Pre-season forecasts and in-season updates are now used for broodstock management. If 630 or fewer adult broodstock is predicted, then all brood fish are retained. When more than 630 brood fish are predicted, fish are retained and distributed so that over 50% of the

broodstock goal is met by May 31, 75% by mid-June, 90% by end of June, and 100% by the end of August. Broodstock collection is being adjusted to match wild spring chinook run timing of: 67% cumulative return by May 31, 86% by mid-June, 91% by end of June, 96% by end of August, and 100% by early September.

In 1996, an automated fish passage system was installed for use during the spring chinook salmon migration period of mid-April through the end of September. The system is designed to minimize handling of wild fish by separating out returning hatchery spring chinook salmon with coded-wire tags. The passage system includes a denil steepass along with a coded-wire tag tube detector which triggers a pneumatic gate. A video system is in place to monitor fish passing upstream of the hatchery. Our intent is to have all fish swim up the denil steepass with coded-wire tagged hatchery fish detected and shunted to a holding pond. All non-tagged fish will be passed to another catch pond and monitored by an underwater video camera as they swim upstream through the ladder and upstream of the hatchery. Implementing a 100% coded-wire tagging program along with installation of a new passage system at the hatchery has allowed us to reduce handling on wild fish. The minimum operating standards for the system are the removal of 95% of the fish with code-wire tags and a 95% accuracy in counting upstream-bound fish. With 95% tag retention and 95% removal of fish with tags, no more than 10% of the total chinook passed upstream should be of hatchery origin.

During efficiency testing of the passage system and when the system is not operated, all fish are trapped in catch ponds after they swim through the ladder. All fish not volitionally passed are held overnight then the next day crowded in groups of one to 20 fish into a trap basin, anesthetized, identified to species, examined for marks and tags, and sorted by hatchery and wild. All wild fish (unmarked) are passed upstream. If the passage system is not operating within minimum operating standards or if hatchery steelhead are passing upstream or if more than 10% of the spring chinook passed upstream are hatchery origin, then either the necessary adjustments will be made or the system will be bypassed and all fish will be trapped and sorted.

6.2.4) Identity

Hatchery fish are identified by having missing or deformed fins, or presence of a coded-wire tag.

6.2.5) Holding

From Olson et al. 1995, “Spring chinook salmon are held for an extended period prior to spawning. Fish are held beginning in early May and are not ready to spawn until late August or early September. During this holding period, water temperatures in the Warm Springs River increase above 13C. As a result, the hatchery’s water chillers must cool water in the holding ponds down to a temperature of 8 to 10C. To accomplish this, a portion of the water is recycled through the chillers and filtered. These procedures are necessary to minimize disease and other problems inherent with holding large numbers of fish.

Problems with bacterial diseases and fungus can be anticipated on a yearly basis. From 1982 to present, all spring chinook salmon being held for broodstock have been injected with erythromycin to curtail prespawning mortalities attributable to bacterial kidney disease (BKD; causative agent Renibacterium salmoninarum). A second injection is given approximately 30 days after the first. For many years, fish were treated with malachite green and are now treated with formalin or salt to control fungus and disease."

6.2.6) Disposition of carcasses

Prior to spawning, surplus fish are distributed to the Tribe. After spawning, fish are buried. The Tribe is assessing the use of carcasses for stream seeding.

SECTION 7. MATING

7.1) Selection method

Randomly collected over entire run and randomly spawned from ripe fish over 3 to 4 week period.

7.2) Males

Of the 630 adults for broodstock, typically 40% of fish >60cm are males. Between 2% and 5% of broodstock will be jack (male) size fish (< 60 cm).

7.3) Fertilization

Spawn one male with one female. The average sex ratio of adult fish is normally 40% male, thus in order to accomplish 1:1 individual matings, some males are used several times with different females. When fewer than 500 broodstock, eggs from each female are also split and fertilized with different males. Each fish spawned will be given a fish health examination.

7.4) Cryopreserved gametes

Not used.

SECTION 8. REARING AND INCUBATION

INCUBATION:

8.1) Number of eggs taken and survival objective to ponding

884,500 egg goal. Green egg to eye up is 95%. Eye up to fry is also 95%.

8.2) Loading density

From Olson et al. 1995, "fertilized eggs from each female are placed in individual incubation units to water harden in iodophor solution. The eggs are then incubated in chilled water until the river water drops to 11°C. The eggs are then incubated in river water between 1°C and 11°C. After the eggs have eyed (about six weeks) they are shocked, sorted and counted. They are then placed into Heath incubators with about 6,500 eggs per tray. Eggs hatch in November and the fry are moved to inside hatchery troughs by late December or early January."

8.3) Influent and effluent gas concentration

Information is not required at this time and will be provided at a later date, as necessary, per guidance by NMFS on October 5, 1999.

8.4) Ponding

Information is not required at this time and will be provided at a later date, as necessary, per guidance by NMFS on October 5, 1999.

8.5) Fish Health monitoring See Section 10.4.3.

REARING:

8.6) Number of fish ponded and survival objective to release

785,000 fry ponded with 750,000 release goal.

8.7) Density and loading. Also see description in Section 4.
8.8) Influent and effluent gas concentrations.
8.9) Length, weight, and condition factor.
8.10) Growth rate, energy reserves.
8.11) Food type and amount fed, and estimates of feed conversion efficiency.
8.12) Health and disease monitoring. See Section 10.4.3
8.13) Smolt development indices, if applicable.

Information is not required at this time and will be provided at a later date, as necessary, per guidance by NMFS on October 5, 1999.

8.14) Use of "natural" rearing methods.

Natural rearing methods are not used at this time. Proposals are being developed.

SECTION 9. RELEASE

9.1) Life history stage, size, and age at release.

Production is typically split into fall subyearling and spring yearling release periods at approximately 15 fish/lb. (Appendix H).

9.2) Life history stage, size and age of natural fish of same species in release area at time of release.

Juveniles produced from Warm Springs NFH are larger than the wild downstream migrants in the Warm Springs River; their length frequency distributions are also significantly different ($P<0.05$). The rearing environment at Warm Springs NFH (like most hatcheries) facilitates faster growth rates than does the stream rearing environment. As we improve our hatchery facilities and fish culture techniques, including control for lower summer rearing temperatures, we should experiment with size at release to mimic the wild juvenile life history. In addition to temperature control, we should also experiment with feeding rates to control growth at the hatchery. Control and treatment groups using coded-wire tags should be used to monitor on-station and smolt to adult performance.

See also previous discussion in Section 2.5.

9.3) Dates of release and release protocols.

90% of production has a volitional release. Releases occur in both fall and spring (Appendix H).

9.4) Location(s) or release.

All releases are on-station into the Warm Springs River.

9.5) Acclimation procedures.

All fish are reared and released on-station.

9.6) Number of fish released

Current production goal is 750,000 juveniles. See Appendix H for actual releases since 1990.

9.7) Marks used to identify hatchery adults.

All hatchery fish released receive an adipose fin clip plus coded-wire tag and/or may have a ventral fin clip.

SECTION 10. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

10.1) Marking

All hatchery releases are marked. Marks can include adipose and ventral fin clips and coded-wire tags. Hatchery production is marked to distinguish hatchery from wild fish at return to the hatchery and in the Deschutes River fisheries. The marking program has made it possible to discriminate broodstock collection, to determine survival rates and to assess contribution to fisheries and other off-station recoveries. We also investigate various release groups to determine which of several treatments maximize adult yield.

Wild juvenile spring chinook salmon were coded-wire tagged in broods 1977-79 (Lindsay et al. 1989).

10.2) Genetic data

Past reports by BPA on stock identification of Columbia River chinook salmon (Schreck et al. 1986). Studies on-going by Reg Reseinbichler and Rusty Rodgriguez, USGS Seattle.

10.3) Survival and fecundity

10.3.1) Average fecundity 2,600 eggs per female

10.3.2) Average Survival

a) Collection to spawning 90%
b) Green eggs to eyed eggs 95%
c) Eyed eggs to release 90%
d) Release to adult, to include contribution 0.5% goal, 0.24% historic average

10.4) Monitoring of performance indicators in Section 1.8

10.4.1) Proportions of hatchery spawners in natural populations in target area (list all populations or spawning areas that are monitored).

Spring chinook and summer steelhead populations are monitored at the hatchery and spawning ground surveys are conducted by Tribe.

10.4.2) Ecological interactions between program fish and natural fish (same and other species) in target area.

Spring chinook salmon life history traits (length, age, size, sex, run timing, spawn timing) and productivity (survival, juvenile and adult production, spawner-recruit ratios) are monitored and compared. In-stream ecological interaction studies need to be developed and projects funded.

10.4.3) Disease control in the hatchery, and potential effects on natural populations.

Aseptic procedures are followed to assure the disinfection of equipment throughout the egg handling process. All spawned adult spring chinook are assigned an individual identification number to assist in sampling and identification of egg lots. As has occurred regularly in the recent past, enzyme linked immunosorbent assay (ELISA) sampling is performed on all spawned adults to assist with the culling or segregation of progeny having a high likelihood of contracting bacterial kidney disease. Additional fish health samples are collected to determine the incidence of infectious hematopoetic necrosis (IHN), erythrocytic inclusion body syndrome (EIBS), other reportable viruses, *Ceratomyxa shasta,* and pathogenic bacteria. Other contributions to improved fish health in the spring chinook at the hatchery include maintaining optimal rearing densities, two prophylactic antibiotic feedings to yearlings, antibiotic injections of the adults, routine monthly fish health examinations, and formalin treatments on an as-needed basis to control external parasites and fungal infections.

<u>General Fish Health Monitoring</u>

After fish are hatched, a 60 fish sample is examined for reportable viruses.

- On at least a monthly basis, both healthy and clinically diseased fish from each fish lot are given a health exam. The sample includes a minimum of **10** fish per lot.

- At spawning, a minimum of 150 ovarian fluids and 60 kidney/spleens are examined for viral pathogens from each species.

- All spawning adults are checked for virus.

- Prior to transfer or release, fish are given a health exam. This exam may be in conjunction with the routine monthly visit. This sample consists of a minimum of 60 fish per lot.

- Whenever abnormal behavior or mortality is observed, the fish health specialist will examine the affected fish, make a diagnosis and recommend the appropriate remedial or preventative measures.

- Reporting and control of specific fish pathogens are conducted in accordance with the Co-Managers Salmonid Disease Control Policy and the USFWS Fish Health Policy and Implementation Guidelines.

Fish and Egg Movements

- Movements of fish and eggs are conducted in accordance with the Co-Managers Salmonid Disease Control Policy and the USFWS Fish Health Policy and Implementation Guidelines.

Therapeutic and Prophylactic Treatments

- At spawning, eggs are water-hardened in iodophor as a disinfectant.

- Juvenile fish are administered antibiotics orally when needed for the control of bacterial infections.

- Formalin (37% formaldehyde) is dispensed into water for the control of fungus on eggs and the control of parasites on juveniles and adult salmon. Treatment dosage and time of exposure varies with species, life-stage and condition being treated.

- Therapeutants approved by the U.S. Food and Drug Administration or those under Investigative New Animal Drug permits are used for treatments. Under special circumstances, extra-label usage of other animal drugs may be prescribed by a veterinarian to control resistant disease organisms.

Sanitation

- All eggs brought to the facility are surface-disinfected with iodophor as per the USFWS Fish Health Policy.

- All equipment (nets, tanks, rain gear) is disinfected with iodophor between different fish/egg lots.

- Different fish/egg lots are kept in separate ponds or incubation units.

- Tank trucks or tagging trailers are disinfected when brought onto the station.

All of the above practices would minimize effect on natural populations of fish by lessening the chance for horizontally transmitted diseases. In-stream ecological interaction studies need to be developed and projects funded.

10.4.4) Behavior (migration, spawning, etc.) of program fish.

Run timing is monitored at the hatchery. Spawning ground surveys are conducted by the Warm Springs Tribal Fisheries Program. Both wild and hatchery populations are sampled at the hatchery for length, age and sex data. The Warm Springs Tribal Fisheries Program monitors downstream migration attributes in the Warm Springs River.

10.4.5) Homing or straying rates for program fish.

Coded-wire tags are recovered at hatcheries, in fisheries, from traps, and spawning ground surveys. Homing and straying is assessed by developing computer programs to retrieve recovery data and produce stock assessment reports.

10.4.6) Gene flow from program fish into natural populations.

A systematic program to annually monitor baseline genetic data of the fish produced at the hatchery and in the stream needs to be developed and funded. This genetic monitoring would include the use of DNA (e.g. microsatellite) markers and evaluation of life history characters (e.g., run timing, age, and size class distribution of adults). For example, the use of DNA markers could entail the sampling and analysis of approximately 50-75 adults each from the early, middle, and late spawn groups, at least initially. At a minimum cost of $50 per fish, the overall cost of initializing such a genetic monitoring program for the hatchery spawners alone would be at least $10,000 per stock. A genetic database for hatchery and natural production would provide needed information to monitor the genetic traits and viability of the stock produced. Genetic profile comparisons between carcasses and naturally produced juveniles, with DNA markers, is highly desired. The information would be available to compare to natural stocks in local tributary systems to monitor any introgression or ecological interactions between program fish and natural fish (section 10.4.2).

10.5) Unknowns or uncertainties identified in Sections 5 through 9

10.6) Other relevant monitoring projects

See Attachment I: “Investigation of rearing & release strategies affecting adult production of spring chinook salmon” Olson (1997).

SECTION 11. RESEARCH

Information is not required at this time and will be provided at a later date, as necessary, per guidance by NMFS on October 5, 1999.

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ATTACHMENT A:

1997-2001 WARM SPRINGS NATIONAL FISH HATCHERY OPERATIONS PLAN

ATTACHMENT B:

ADULT WILD AND HATCHERY SPRING CHINOOK SALMON BROODSTOCK AND NUMBER PASSED UPSTREAM AT WARM SPRINGS NFH, 1978-1999

ATTACHMENT C:

SUMMER STEELHEAD RECOVERIES AT WARM SPRINGS NFH

ATTACHMENT D:

WILD SPRING CHINOOK SPAWNERS IN THE WARM SPRINGS RIVER, TOTAL RECRUITS BACK TO THE DESCHUTES RIVER, AND PREDICTED RETURNS USING STOCK RECRUITMENT

ATTACHMENT E:

WARM SPRINGS NFH STOCK ASSESSMENT (HARVEST) SUMMARY

ATTACHMENT F:

CATCH AND HARVEST OF SUMMER STEELHEAD IN THE DESCHUTES RIVER

ATTACHMENT G:

REPRINT

USE OF A NATIONAL FISH HATCHERY TO COMPLEMENT WILD SALMON AND STEELHEAD PRODUCTION IN AN OREGON STREAM

ATTACHMENT H:

WARM SPRINGS NFH SPRING CHINOOK RELEASES IN THE WARM SPRINGS RIVER

ATTACHMENT I:

REPRINT

INVESTIGATION OF REARING & RELEASE STRATEGIES AFFECTING ADULT PRODUCTION OF SPRING CHINOOK SALMON