Attachment 3

NATIVE FISH CONSERVATION PLAN FOR THE SPRING CHINOOK SALMON ROGUE SPECIES MANAGEMENT UNIT

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Table of Contents

FOREWORD

The purpose of this document is to present a conservation plan for spring chinook salmon (*Oncorhynchus tshawytscha*) that inhabit the Rogue Species Management Unit of southwest Oregon. Conservation plans are to be developed for each Species Management Unit of native fish in the state of Oregon, as outlined by the Native Fish Conservation Policy. This policy was adopted by the Oregon Fish and Wildlife Commission in 2003 in order to ensure the conservation and recovery of native fish in Oregon.

The Native Fish Conservation Policy states that the conservation of native fish is the principle obligation for fish management practices by the Oregon Department of Fish and Wildlife. The policy has three areas of emphasis: (1) avoid serious depletion of native fish, (2) actively restore and maintain native fish at population levels that provide ecological and societal benefits, and (3) ensure that opportunities for fisheries and other societal resource uses are not unnecessarily constrained when consistent with native fish conservation. The following elements are included in this plan, as required by the Native Fish Conservation Policy:

a. Identification of species management unit and the constituent populations.
b. Description of the desired biological status relative to biological attributes.
c. Description of current status relative to biological attributes.
d. Assessment of the primary limiting factors causing the gap between current and desired status.
e. Description of short and long-term management strategies most likely to address the primary limiting factors.
f. Description of monitoring, evaluation, and research necessary to gauge the success of corrective strategies and resolve uncertainties.
g. Process for modifying corrective strategies based on monitoring, evaluation, and research results.
h. Define measurable criteria indicating significant deterioration in status, triggering plan modification to begin or expand recovery actions.
i. Identification of annual and long-term reporting requirements necessary to document data, departures from the plan, and evaluations.
j. A description of potential impacts to other native fish species.

Conservation plans are intended to provide a basis for managing hatcheries, fisheries, habitat, predators, competitors, and pathogens in balance with sustainable production of naturally produced spring chinook salmon in the Rogue Species Management Unit. The policies and objectives within each section define the core management program and describe the fundamental direction that will be pursued. These are implemented through specific actions, which may include (but are not limited to) restoring or improving habitat, developing angling regulations, and hatchery operations. Because of funding uncertainties, a wide variety of actions are described, but not all may be implemented. A draft plan was distributed for a 30 day comment period to the public and to a wide variety of interested parties. Portions of this plan will become Oregon Administrative Rules upon adoption of a final version by the Oregon Fish and Wildlife Commission. Definitions of technical terms can be found in **APPENDIX A**.

This conservation plan complements *The Oregon Plan for Salmon and Watersheds*, which was adopted by the Oregon Legislature in 1997. Primary funds that supported work on the plan originated from the Pacific Coastal Salmon Recovery Fund, which is administered by NOAA Fisheries.

INTRODUCTION

This document constitutes a conservation plan for naturally produced spring chinook salmon (NP CHS) in the Rogue Species Management Unit. A Species Management Unit (SMU) is a group of populations from a common geographic area that share similar life history, genetic, and ecological characteristics. ODFW has identified 33 SMUs of salmon and steelhead in the state of Oregon (ODFW 2006). SMU designations are temporary until conservation plans are developed for each individual SMU. In the coastal area south of Cape Blanco, ODFW (2006) designated an SMU for spring chinook salmon (CHS) that solely covers that portion of the Rogue River basin located upstream of Gold Ray Dam. Gold Ray Dam is located near the city of Central Point, at river mile 126.

Chinook salmon may enter the Rogue River on any given day of the year. Within the text of this document, CHS are defined as those mature chinook salmon that enter freshwater during the period of February through 15 July, and also pass the counting station at Gold Ray Dam before 16 August. Chinook salmon that enter freshwater after 15 July, and also pass Gold Ray Dam after 15 August are defined as fall chinook salmon (CHF).

The following sections of this document are designed to present and discuss issues that are relevant to the historic and current status of these animals, define status, identify limiting factors, identify assessment needs, and to outline a variety of management options to be considered by the Oregon Fish and Wildlife Commission. The second purpose is particularly important as ODFW basin plans are lacking for areas south of Cape Blanco.

CONSTRAINTS

Actions proposed within this conservation plan must be in compliance with a variety of local, state, and federal laws; as well as state statutes and administrative rules, and memoranda of understanding among public agencies. Consequently, there are constraints that limit potential actions by ODFW, and those constraints need to be recognized within conservation plans adopted by the Oregon Fish and Wildlife Commission. A brief description of some of the general constraints, that need to be recognized within the plan, can be found in **APPENDIX B.**

BACKGROUND

Historical Context

Commercial fishing operations for salmon in the Rogue River began in the 1860s. Pack records from R.D. Hume’s cannery near Gold Beach suggest that an average of 27,000 CHS were canned annually between 1877 and 1889. Annual estimates of canned CHS varied greatly, with estimates ranging from a low of 8,200 fish in 1878 to a high of 55,000 fish in 1890 (ODFW unpublished data). These fish were mostly caught with gillnets, although beach seines may have been used at times during low flow years. Some early-run summer steelhead may be included in the cannery pack records, and some CHS were consumed locally or were shipped fresh to markets (Rivers 1964). Gill net fisheries also operated in the Rogue River near Grants Pass. Legislative action terminated commercial fishing in the Rogue River during 1936.

Runs of CHS were probably not present in any of the other coastal river basins in Oregon south of Cape Blanco. Landing records and interviews of operators of commercial fishing gear fail to mention any presence of CHS in the rivers of Curry County, other than in the Rogue River (Collins 1892; Bureau of Fisheries 1911; Cobb 1930).

Directed surveys of fishery resources in the Rogue River Basin began in the 1940s, and were conducted by the Oregon State Game Commission. Findings from this project were reported by Rivers (1946). Included in this work was the construction of a fish counting station at Gold Ray Dam, which began operation in the spring of 1942. More extensive surveys of fish populations, stream habitat, and recreational fisheries were conducted by the OSGC and the United States Fish and Wildlife Service during 1949-1954. Findings from this project can be found in a series of unpublished reports (USFWS 1955a; USFWS 1955b; USFWS 1955c; USFWS 1955d). Fisheries surveys were initiated in the Rogue River Basin during the 1940s and 1950s primarily as a result of regional interest in the construction of reservoirs for the multiple purposes of flood control, hydroelectric power, and water supply.

Interest in the construction of flood control projects intensified after a major flood event in December of 1955. The United States Army Corps of Engineers (USACE) conducted an investigation of concerns related to project development and recommended to the United States Congress that three dams be constructed in the Rogue River Basin. Primary project purposes identified by the USACE included flood control, fish and wildlife enhancement, irrigation, and water supply. Secondary purposes included power generation, recreation, and water quality enhancement. Congress authorized the proposed project in 1962, including the construction of Lost Creek Dam, Applegate Dam, and Elk Creek Dam (United States Congress 1962).

Lost Creek Dam was to be constructed on the mainstem of the Rogue River at river mile 157, while Applegate Dam and Elk Creek Dam were to be constructed on tributaries of the Rogue River (Figure 1). Each dam was to be primarily operated for flood control purposes, with the reservoir levels not to exceed specified elevations on given dates (United States Congress 1962). Storage accrued during reservoir filling was to be dedicated to specific purposes. Lost Creek Dam was completed in 1977, and the reservoir first filled in 1978. Applegate Dam was completed in 1979 and Elk Creek Dam has yet to be completed

Of the three USACE dams authorized by Congress, Lost Creek Dam was projected to have the greatest impact on CHS in the Rogue River. The dam and associated facilities blocked approximately 33% of the spawning habitat of CHS (USACE 1967). To mitigate for the loss of spawning habitat, the USACE built and funds the operation of Cole M. Rivers Fish Hatchery. In addition, planners projected that reservoir operation would also result in the enhancement of anadromous salmonids resources in downstream areas. Fishery benefits were expected to accrue by operating the dam to (1) decrease peak flow in winter, (2) increase flow in summer, and (3) decrease water temperature in summer. Based on the recommendations of federal and state fishery management agencies, no provisions were made for fish passage around Lost Creek Dam or Cole M. Rivers Hatchery, which is located immediately downstream from Lost Creek Dam.

To regulate the outflow temperature from Lost Creek Lake, the USACE designed an intake structure capable of withdrawing water from five different levels of the reservoir. Selective opening of intake ports allows for mixing of water from various temperature strata in the reservoir. Choice of outflow temperature is greatest in early summer when the reservoir is full and thermally stratified. Control of release temperature diminishes in late summer as reservoir level decreases and the highest intake ports become dewatered. Control of release temperature becomes minimal in autumn after the reservoir destratifies (USACE 1983).

Guidelines for the release of stored water from Lost Creek Dam were intended to be flexible, reflecting annual variations in water yield and user demand. When the reservoir fills, 180,000 acre-feet of storage is available for flow augmentation (USACE 1972). Of this total, 125,000 acre-feet were authorized for fishery enhancement (United States Congress 1962). The remaining 55,000 acre-feet of storage was dedicated to other uses: irrigation supply, municipal and industrial supply, and environmental enhancement. Dedicated storage that is not purchased is also available for downstream enhancement of fishery resources (USACE 1972).

The authorizing document also outlined minimum outflow and maximum water temperature to be released from Lost Creek Dam, but clearly stated these guidelines should be modified as additional information became available: "It should also be noted that project operation plans must be sufficiently flexible to permit desirable modifications in scheduled fishery releases, within the limits of storage provided therefore, if experience and further study indicates such action to be desirable for overall project benefits" (United States Congress 1962). Uncertainty related to the scheduling and efficacy of releases to meet fishery allocations lead the USACE to fund the Lost Creek Dam Fisheries Evaluation Project. This project was conducted by ODFW during the period of 1974-96. A completion report for work with CHS was finalized and printed in 2000 (ODFW 2000). A description of the Lost Creek Dam Fisheries Evaluation Project can be found in **APPENDIX C**.

Findings and recommendations outlined in the completion report for CHS (**APPENDIX C**), along with completion reports for other races of anadromous salmonids, are used by ODFW to develop annual and seasonal recommendations for releases from Lost Creek Lake. In relation to the development of reservoir management strategies, ODFW's foremost priority since 1997 has been to protect and enhance NP CHS (Table 1).

Table 1. Current ODFW fishery management objectives as related to reservoir releases from Lost Creek Lake. Objectives are listed in order of priority, and have remained unchanged since 1997.

1. minimize prespawning mortality among adult CHS
2. minimize dewatering losses of young salmonids
3. minimize dewatering of CHS redds
4. minimize early emergence by CHS fry
5. minimize prespawning mortality among adult CHF
6. increase survival rates of juvenile salmonids during the summer
7. minimize the proportion of adult CHF that pass Gold Ray Dam
8. minimize the effects of flow augmentation on the summer steelhead fishery in the canyon.

About one-third of the spawning habitat of CHS was blocked by the construction of Lost Creek Dam. Releases of hatchery fish are designed to mitigate for blocked spawning habitat, with a goal of producing a level of harvest that compensates for a loss of 13,020 natural spawners (USACE 1990). Currently, an average of 1.6 million CHS are raised annually at Cole M. Rivers Hatchery. These fish are released directly into the Rogue River during the period of August through October. Cole M. Rivers Hatchery began operation in 1973, and also releases coho salmon, summer steelhead, and winter steelhead directly into the Rogue River. Prior to 1973, CHS scheduled for release into the Rogue River were reared at Butte Falls Hatchery. A brief history of hatchery operations, as related to releases of CHS in the Rogue River, can be found in **APPENDIX D**.

General Aspects of Life History

Spring chinook salmon in the Rogue SMU exhibit a life history strategy that differs somewhat from other CHS populations within the state of Oregon (ODFW 2000). Adults enter freshwater from late winter through early summer, and migrate upstream at an average rate of about three miles per day. Older adults enter freshwater earlier than younger adults. After passing Gold Ray Dam at river mile 126, the average rate of migration slows to less than one mile per day. Also within this area, adult CHS cease to migrate and will "hold" until the onset of spawning. The period between the end of migration and spawning can be as long as five months. Virtually all adults hold in the Rogue River until onset of spawning, although some enter tributary streams just prior to spawning.

Spawning takes place from the middle of September through the end of October (ODFW 2000). Spawning time is related to time of freshwater entry, with early-run CHS spawning earlier than late-run counterparts. In addition, early-run CHS spawn farther upstream as compared to late-run counterparts. The preponderance of spawning occurs in the Rogue River. Spawners are also consistently found in the lowest mile of Big Butte Creek, and some enter other tributary streams during those infrequent years when flows in tributary streams increase significantly during late September and early October (Rivers 1964).

Eggs and sac-fry incubate in the gravel during the winter and spring (ODFW 2000). Fry emergence from the gravel begins in January and ends in late April or early May. Fry reside primarily in the area upstream of Gold Ray Dam. Juveniles begin to migrate downstream as smolts during summer and smolt migrations continue through autumn. Most smolts enter the ocean during July through September at a length of about 10-12 cm (4-5 inches). A small proportion of juveniles spend the winter in freshwater and enter the ocean during their second year of life (ODFW 2000).

Duration of ocean residence is highly variable (ODFW 2000). Some CHS rear in the ocean for less than one year, returning to freshwater as age 2 fish in their second year of life. The most common life history strategy is three years of ocean residence, with attainment of maturity as age 4 fish in their fourth year of life. A few individuals rear in the ocean for five years, and return to freshwater as age 6 fish.

General Aspects of the Fisheries

Spring chinook salmon contribute to commercial and recreational fisheries in the ocean, and to recreational fisheries in the Rogue River. Coastal landings of hatchery fish marked with coded-wire tags suggest that CHS, produced in the Rogue SMU, rear in the ocean primarily off the coasts of Oregon and northern California (Lewis 2005). Recoveries of coded-wire tagged CHS of hatchery origin indicate that age 3 fish dominate the ocean harvest among CHS of Rogue River origin. Ocean fisheries also harvest some age 4 fish, but very few age 2 or age 5 fish.

Catches in freshwater are also dominated by specific age classes (ODFW 2000). Older age classes contribute to the river fisheries at higher rates than younger age classes. Two factors account for the differential harvest rates within the river fisheries. First, older fish enter the river earlier, and migrate through fisheries near Gold Beach and Grants Pass at a time when water conditions are conducive for catching CHS (ODFW 2000). Second, older CHS migrate past Gold Ray Dam on earlier dates, and thus are exposed to the fishery in the upper river for a longer period of time as compared to younger counterparts (ODFW 2000).

Origin of the fish also affects susceptibility to capture. Hatchery fish are caught at lower rates in the river fisheries as compared to naturally produced fish. Two factors account for the differences in the contribution rates to the fisheries. First, hatchery CHS tend mature at younger ages as compared to NP CHS and accordingly migrate through the fisheries at later dates (ODFW 2000). Second, hatchery CHS leave the river by entering Cole M. Rivers Hatchery, while NP CHS remain resident in the river during the course of the fishery upstream of Gold Ray Dam (ODFW 2000).

Key Biological Attributes Affected by Reservoir Construction and Operation

The construction and operation of Lost Creek Dam has distinctly affected the abundance and life history of NP CHS in the Rogue SMU. Some effects were documented within the first few years of reservoir operation, while other effects were not clearly delineated until the later portion of the 1990s. As the effects of reservoir operation are considered within the context of this conservation plan, an explanatory summary follows. More complete information can be found in **APPENDIX C**, and detailed information can be found in a comprehensive report dedicated to this issue (ODFW 2000).

One of the initial documented impacts was that CHS fry emerged from gravel nests (redds) earlier as a result of reservoir operation. Reservoir outflows were warmer than natural flows would have been (USACE 1991), which accelerated development rates of eggs and sac-fry. The change in emergence timing was most evident for the progeny of adult CHS that spawned early (Table 2). Changes in emergence timing were less evident for the progeny of adult fish that spawned later (Table 2). In addition, attempts to change reservoir outflow temperatures to restore the historic timing of fry emergence were only partially successful (Table 2). Premature emergence is associated with a decrease in the abundance of juvenile NP CHS (ODFW 2000).

Table 2. Average date of fry emergence from the gravel, estimated for the progeny of spring chinook salmon that spawned on three different dates at a site just downstream from Lost Creek Dam.

Parent spawning date	1972-1977[a]	1978-1984[b]	1985-1994[c]
September 15	March 20	February 4	February 17
October 1	April 14	March 8	March 15
October 15	April 29	March 31	April 1

[a] *Before operation of Lost Creek Dam.*
[b] *After initial operation of Lost Creek Dam.*
[c] *After changes were made to reservoir release strategies.*

When the surviving juvenile NP CHS returned as adults, a change in spawning time was also documented. Adult NP CHS produced as juveniles before reservoir operation spawned earlier as compared to counterparts produced as juveniles after reservoir operation (Table 3). This result was not surprising because spawning time is a highly heritable trait in chinook salmon. In other words, progeny spawn at the same time as their parents. The change in spawning time to a later date confirmed that the progeny of early spawning parents survived at lower rates than the progeny of late spawning parents, and that the change was linked to premature emergence of fry (ODFW 2000).

Differential survival rates of fry also affected the migration timing of NP CHS in freshwater. Adults produced as juveniles before reservoir operation migrated earlier as compared to counterparts produced as juveniles after reservoir operation (Table 4). This result was anticipated because migration

Table 3. Average date of spawning for naturally produced spring chinook salmon in two areas downstream of Lost Creek Dam.

Spawning area	Pre-dam broods[a]	Post-dam broods[b]
Elk Creek - Cole M. Rivers Hatchery	September 29	October 6
Shady Cove - Elk Creek	September 29	October 6

[a] *These fish were produced as juveniles before operation of Lost Creek Dam.*
[b] *These fish were produced as juveniles after operation of Lost Creek Dam.*

Table 4. Average date that naturally produced spring chinook salmon passed the fish counting station at Gold Ray Dam.

Fish age (years)	Average length	Pre-dam broods[a]	Post-dam broods[b]
Age 3	24 inches	June 3	June 19
Age 4	30 inches	May 28	June 15
Age 5	34 inches	May 26	June 12

[a] *These fish were produced as juveniles before operation of Lost Creek Dam.*
[b] *These fish were produced as juveniles after operation of Lost Creek Dam.*

timing in chinook salmon is also highly heritable. As an example, progeny of CHS enter freshwater at times similar to their parents, while the progeny of CHF enter freshwater at later dates. The change in migration timing was of concern to fishery managers because, for CHS in the Rogue River, early migrants contribute at greater rates to the river fisheries as compared to late migrants (*see* **Direct Impacts by Humans**, page 28).

Fishery managers were also concerned about a change in the age composition of NP CHS produced in the Rogue SMU, because older fish (early migrants) contribute at greater rates to the river fisheries as compared to younger fish (late migrants). Passage estimates at Gold Ray Dam in the 1980s indicated that the abundance of older fish decreased in relation to the number of younger fish. Initially, managers suspected that increased harvest rates in the ocean fisheries was responsible for a decrease in age at return. Subsequently, a detailed assessment indicated that the maturity rates of NP CHS had changed, and that the change was linked to reservoir operation. Fish produced before reservoir operation matured at older ages as compared to counterparts produced after reservoir operation (Table 5). In contrast, no changes in maturation rates were detected for NP CHF produced in the Rogue River Basin (ODFW 1992).

Table 5. Age composition of naturally produced spring chinook salmon at time of river entry, estimated under a scenario of no age-selective fishing mortality in the ocean or in freshwater.

		Contribution to Returns	
Fish age (years)	Average length	Pre-dam broods[a]	Post-dam broods[b]
Age 2	16 inches	3%	8%
Age 3	24 inches	6%	12%
Age 4	30 inches	36%	49%
Age 5	34 inches	47%	27%
Age 6	37 inches	8%	1%

[a] *These fish were produced as juveniles before operation of Lost Creek Dam.*
[b] *These fish were produced as juveniles after operation of Lost Creek Dam.*

A change in the growth rate of juvenile NP CHS in freshwater appeared to be a primary factor that accounted for the change in maturity rates. Juvenile growth rates increased, and the increase was linked to reservoir construction and operation (ODFW 2000). With the increase in growth rate, juveniles more quickly attained the threshold size that triggers an active downstream migration as smolts. As a consequence of faster growth, juvenile NP CHS produced after reservoir operation entered the ocean earlier as compared to counterparts produced before reservoir operation (Table 6).

Earlier dates of ocean entry were linked to the change in maturity rates among NP CHS in the Rogue SMU (ODFW 2000). During ocean residence, probability of maturation for chinook salmon is known to be affected by three factors:

Table 6. Average date of ocean entry by juvenile naturally produced spring chinook salmon.

Fish age (years)	Pre-dam broods[a]	Post-dam broods[b]
All ages	October 12	August 26
Age 4	September 11	August 20

[a] *These fish were produced as juveniles before operation of Lost Creek Dam.*
[b] *These fish were produced as juveniles after operation of Lost Creek Dam.*

parental age (Hankin et al. 1993), sex of fish, and fish length (ODFW 2000). Among NP CHS in the Rogue SMU, only a small proportion of females mature at age 3 and none mature at age 2. Fish length appears to affect maturation probability through some type of physiological trigger mechanism. Because growth rates are greater in the ocean, as compared to freshwater, an earlier time of ocean entry will cause fish to be larger on any given date during ocean residence. The size of NP CHS in the ocean in late winter and early spring affects maturation probability. During the period, attainment of a larger size leads to a greater chance of maturity at a younger age (ODFW 2000). These findings for NP CHS fish were confirmed by analysis of coded-wire tagged CHS released at Cole M. Rivers Hatchery. Hatchery CHS released in June matured at the youngest ages, followed successively by counterparts released in August, September, October, and December (ODFW 2000). Hatchery CHS released in March as yearlings matured at the oldest ages.

Attempts have been made to try and restore key life history attributes for NP CHS in the Rogue SMU. Restoration measures have centered on adjustments to the temperature of water released from the reservoir because water temperature affected the key biological attributes previously described. In the mid 1980s, the USACE concluded that the design of turbidity conduit at the bottom of Lost Creek Lake allowed for sustained use of the conduit. Continual use of the turbidity conduit resulted in the release of the coldest water possible during the period that eggs and sac-fry of NP CHS incubated in the gravel. In addition, an ODFW research project was extended to determine whether decreased outflow temperatures, during late spring and early summer residence, would restore the historic age structure of NP CHS. Project findings indicated that fishery goals, related restoration of life history attributes of NP CHS, could not be attained because of limited amounts of cold water that could be stored and retained in Lost Creek Lake (ODFW 2000). Because restoration goals of historic timing of fry emergence and historic age structure among adults collectively require more cold water than is available in the reservoir, a comprehensive model of water temperature is needed to identify management strategies that optimize the use of the limited supply of cold water stored in Lost Creek Lake (ODFW 2000).

SPECIES MANAGEMENT UNIT AND CONSTITUENT POPULATIONS

As previously described, the geographical boundaries of the SMU were provisionally identified as being limited only to that portion of the Rogue River basin located upstream of Gold Ray Dam (ODFW 2006). Consideration was given to the possibility that the geographical boundaries should be expanded to include other coastal river basins located between the California border and Euchre Creek, inclusive. Chinook salmon present in these basins are included in the geographical boundaries for the Southern Oregon and Northern California Evolutionarily Significant Unit, as identified by Biological Review Teams (NOAA Fisheries 1999). ODFW has chosen to identify separate SMUs for CHS and CHF due to differences in life history strategies.

Adult CHS have been observed in the Applegate River, in the Pistol River, in the Illinois River, and in the Chetco River, but only on a very sporadic basis (ODFW unpublished observations). No other source of information could be identified that would suggest that other populations of CHS may be present within the area in question. Consequently, within the context of this conservation plan, the geographical boundaries of the Rogue SMU for CHS are limited solely to the area upstream of Gold Ray Dam. However, portions of this plan address issues pertaining to the Rogue River downstream of Gold Ray Dam, as this area is used as a migration corridor by juvenile and adult CHS.

Only one population of CHS appears to be present in the Rogue SMU, under the definition that a fish population is "a group of fish originating and reproducing in a particular time which do not interbreed to any substantial degree with any other group reproducing in a different area, or in the same area at a different time" (OAR 635-007-0501(45)). However, changes in the life history characteristics of NP CHS raised the possibility that multiple populations may be present in the area upstream of Gold Ray Dam. This possibility was partially evaluated by assessments of genetic material obtained from adult chinook salmon trapped at Gold Ray Dam.

In 2004, tissue samples were collected from adult chinook salmon to test two hypotheses: (1) naturally produced fish classified as CHS differ from counterparts classified as CHF, and (2) NP CHS differ from hatchery CHS. The assessment method chosen was a comparison of gene frequencies using microsatellite DNA markers. These highly variable nuclear DNA markers make possible genealogical analyses or genetic discrimination among closely related fish populations. For example, such methods identified different populations of CHS in two tributaries of the upper portion of the Sacramento River (Banks et al. 2000). The genetic assessment of chinook salmon trapped at Gold Ray Dam was conducted by staff with the Marine Fisheries Genetic Laboratory at Oregon State University.

Preliminary findings of the project are:
1. There was no detectable difference between naturally produced chinook salmon trapped during late May and early June as compared to counterparts trapped during late July and early August. Chinook salmon that pass Gold Ray Dam during these periods are currently classified by ODFW as CHS.
2. Naturally produced chinook salmon trapped during late September and early October differed significantly from counterparts trapped during earlier periods. These later migrating fish are currently classified by ODFW as CHF.
3. There was no detectable difference between NP CHS and hatchery CHS trapped during the period of late May and early June.

CURRENT STATUS

Abundance

The abundance of NP CHS in the Rogue SMU decreased during the last 30 years, and reached the lowest levels ever recorded during the 1990s (Figure 2). Passage estimates at Gold Ray Dam averaged about 28,000 fish in the 1940s through the 1960s, 28,000 fish in the 1970s, 24,000 fish in the 1980s, 8,000 fish in the 1990s, and 9,000 fish during 2000-06. During the last ten years, the annual passage of NP CHS at Gold Ray Dam averaged about 8,200 fish and ranged between 3,443 and 19,270 fish (Appendix Table I-1).

In contrast to naturally produced fish, the abundance of CHS of hatchery origin increased during the last 30 years, and reached the highest level ever recorded in the 1990s (Figure 2). Passage estimates of hatchery fish at Gold Ray Dam averaged about 2,000 fish in the 1970s, 22,000 fish in the 1980s, 20,000 fish in the 1990s, and 23,000 fish during 2000-06 (Appendix Table I-1).

While numbers of NP CHS decreased, numbers of NP CHF increased and reached the highest level ever recorded during 2000-2006 (Figure 2). Passage estimates of NP CHF at Gold Ray Dam averaged about 3,000 fish in the 1970s, 6,000 fish in the 1980s, 7,000 fish in the 1990s, and 14,000 fish during 2000-06 (Appendix Table I-1). Few CHF of hatchery origin pass Gold Ray Dam (Figure 2).

Run Composition

Among CHS in the Rogue SMU, the relative abundance of hatchery fish increased sharply during the last 30 years. At Gold Ray Dam, the relative abundance of hatchery fish averaged 7% in the 1970s, 42% in the 1980s, 72% in the 1990s, and 70% during 2000-06. During the last 10 years, hatchery fish accounted for an average of 72% of the annual returns of CHS, with annual estimates that ranged between 54% and 85% (Appendix Table I-1).

Race Composition

The relative abundance of CHF has increased sharply during the last 30 years. Among naturally produced chinook salmon that passed Gold Ray Dam, the relative abundance of CHF averaged 11% in the 1970s, 21% in the 1980s, 48% in the 1990s, and 62% during 2000-06. During the last 10 years, CHF accounted for an average of 56% of the naturally produced chinook salmon that passed Gold Ray Dam, with annual estimates ranging between 33% and 74% (Appendix Table I-1).

Migration Timing

Naturally produced spring chinook salmon migrated later during recent years as compared to historical patterns of migration timing. During the 1940s through the 1970s, naturally produced fish larger than 24 inches ("adults") primarily passed Gold Ray Dam during May and June (Figure 3). In 2003-2006, a greater proportion of this type of fish passed Gold Ray Dam in July (Figure 3). Smaller fish ("jacks") also exhibited a tendency to migrate later in 2003-2006 as compared to earlier years (Figure 3). Differential estimates of migration timing could not be developed for naturally produced CHS during 1980-2002 because unmarked hatchery fish composed a substantial portion of the returns.

Currently, hatchery CHS tend to migrate past Gold Ray Dam at times that are more closely comparable to the migration timing patterns observed historically (Figure 3). Among "adult" NP CHS, an average of 45% (range = 35-55%) passed Gold Ray Dam by 15 June during 2003-2006.

Age Composition

Estimates of age composition for NP CHS are available only for the 1974-1994 return years, and are reported by ODFW (2000). However, jack counts at Gold Ray Dam provide one index of age composition. Jack counts include all of the returning age 2 fish and about one-half of the returning age 3 fish (ODFW 2000). Returning age 4, age 5, and age 6 fish are all larger than 24 inches, and are classified as "adults". In 2003 through 2006, jacks composed an average of 9% (range = 5-13%) of the NP CHS that passed Gold Ray Dam.

Spawning Distribution

Spatial and temporal overlaps in spawning by the spring and fall races makes it difficult to directly estimate the spawning distribution of the spring race. However, only CHS spawn during September, while CHF do not begin spawning until October (ODFW 2000). Currently, NP CHS spawn farther downstream as compared to earlier years (ODFW 2000). For those NP CHS that spawned in September, an average of 77% spawned upstream of Shady Cove during 1974-81, while an average of 48% (range = 35-57%) spawned upstream of Shady Cove in 2004-2006.

The most recent estimates of spawning distribution for all NP CHS date from 1986-87, when known CHS were individually tagged at Gold Ray Dam. These estimates indicated that more than 90% of the early-run and mid-run NP CHS spawned upstream of Dodge Bridge (Table 7).

Table 7. Spawning distribution of naturally produced spring chinook salmon tagged at Gold Ray Dam during various months in 1986-87.

		Month of tagging				
River miles	Survey area	May	June	July	August	May-June[a]
156-152	hatchery-Rogue Elk	48%	38%	14%	18%	42%
152-145	Rogue Elk-Shady Cove	26%	21%	16%	16%	23%
145-138	Shady Cove-Dodge	16%	23%	29%	24%	20%
138-131	Dodge-Touvelle	3%	6%	22%	21%	5%
131-127	Touvelle-Gold Ray pool	0%	4%	13%	18%	2%
0-1	Big Butte Creek	6%	9%	5%	3%	8%

[a] ***portion of population that exhibited greatest decline in status. As defined in this draft plan, early-run fish pass Gold Ray Dam in May, mid-run fish pass Gold Ray Dam in June, and late-run fish pass Gold Ray Dam in July-mid August.***

Spawner Composition

Naturally produced fish compose a smaller proportion of CHS spawners as compared to historical patterns of spawner composition. During 1974 through 1981, hatchery fish accounted for only 1-2% of the natural spawners (Cramer et al. 1985). During 2004-2006, hatchery fish composed an average of 11% (range = 9-12%) of the natural spawners. In the four mile reach downstream from Cole M. Rivers Hatchery, hatchery fish composed an average of 27% (range = 23-33%) of the natural spawners during 2004-2006.

DESIRED BIOLOGICAL STATUS

As outlined in the Native Fish Conservation Policy, a description of the desired biological status must be based on measurable criteria that are relative to biological attributes of population(s) within the relevant SMU. Prior to the development of specific numerical criteria, a series of generalized options were developed as related to potential fishery management scenarios were developed (Table 8). Options three and four were each preferred by three members of the public advisory committee. No members of the public advisory committee supported any of the other four options. A majority of the members of the technical advisory committee preferred option three.

Options three and four differ only in relation to the way that the hatchery program would be managed for CHS. The preferences expressed indicated that there was interest in maintaining historic life history characteristics among hatchery CHS and to maximize the contribution rates of hatchery CHS to the consumptive fisheries. In contrast, there was no, or minimal, support for options one, two, five, or six. Options one and two would have compromised, to some degree, the ability to manage effectively for other fishery resources in the Rogue River Basin. Options five and six would have resulted in the SMU being managed for the increased production of CHF in areas that historically were dominated by CHS.

Using the preferred generalized options as a guideline, attention subsequently focused on the development of measurable criteria that are relative to biological attributes of population(s) within the relevant SMU. With the considerable amount of data available for CHS in the Rogue SMU, there was a

Table 8. Six options designed to characterize some generalized attributes associated with potential management scenarios for chinook salmon in the Rogue Spring Chinook Salmon Species Management Unit.

Option 1

Restore, to the greatest degree possible, the historic abundance and life history characteristics of NP CHS. When possible, provide harvest opportunities for naturally produced fish. Manage hatchery fish so as to maximize contribution rates to recreational and commercial fisheries.

Option 2

Restore, to the greatest degree possible, the historic abundance and life history characteristics of NP CHS while providing harvest opportunities for naturally produced and hatchery fish. Manage hatchery fish so as to minimize potential impacts on naturally produced fish.

Option 3

Maintain, at sustainable levels of abundance, the historic life history characteristics of NP CHS while providing harvest opportunities for naturally produced and hatchery fish. Manage hatchery fish so as to mitigate for fishery losses associated with the blockage of spawning habitat and the change in the life history patterns of NP CHS.

Option 4

Maintain, at sustainable levels of abundance, the historic life history characteristics of NP CHS while providing harvest opportunities for naturally produced and hatchery fish. Manage hatchery fish so as to maximize contribution rates to recreational and commercial fisheries.

Option 5

Maximize the production of naturally produced chinook salmon in freshwater habitat that historically produced CHS while providing harvest opportunities for naturally produced and hatchery fish. Manage hatchery fish so as to maximize contribution rates to recreational and commercial fisheries.

Option 6

Maximize the production of naturally produced chinook salmon in freshwater habitat that historically produced CHS, while providing harvest opportunities for naturally produced and hatchery fish. Manage hatchery fish so as to minimize potential impacts on naturally produced fish.

myriad of possible elements that could compose a desired status statement. Generic elements that were initially considered included (1) abundance, migration timing, age composition, spawning time, and spawning distribution of NP CHS, (2) relative abundance of hatchery fish among migrating and spawning CHS, and (3) relative abundance of CHF among all naturally produced adult chinook salmon in the SMU. In addition, consideration was given to the length of time that provided an effective period by which to judge the status of attributes. A period of 10 years was chosen, which basically represents an interval that covers two complete generations.

Development of a specific statement of desired status followed a decision tree approach based on assessments of biological productivity and life history. Potential elements were set aside if (1) the critical parameter of a potential element was judged to be too difficult to estimate, (2) potential elements failed to complement each other, or (3) potential elements, in a practical sense, covered the same overall objective (**APPENDIX E**). There was a considerable amount of interest in development of a criterion related to juvenile abundance, but no means could be devised by which to differentiate juvenile CHS and CHF. The statement of desired status, outlined in Table 9, represents a final product that was preferred by four public advisory committee members, six technical advisory committee members, and by ODFW. Two of the public advisory committee members also expressed support for the statement, with the exception that they felt that hatchery fish should compose less than 10% of the natural spawners. In addition, two public advisory committee members chose not to express a preference on whether the persistence element should be added, but otherwise supported the desired status statement.

The final selection of the measurable criteria included in the desired status statements represents an iteration process in that multiple revisions were made to the criteria when as it became evident that more "liberal" goals could not be achieved because of certain limiting factors that are very unlikely to change. For example, it is very unlikely that Lost Creek Dam will be removed, so criteria for elements of fish abundance and life history characters were adjusted accordingly.

Table 9. Criteria indicative of desired status for the Rogue Spring Chinook Salmon Species Management Unit. All criteria apply as annual estimates averaged over a running period of 10 years. Progressive steps in the development of the statement are outlined in **APPENDIX E**.

1. At least 15,000 naturally produced spring chinook salmon should pass Gold Ray Dam.

2. At least 60% of the "adult" naturally produced spring chinook salmon should pass Gold Ray Dam by 15 June. Adults are defined as fish at least 24 inches in length, while smaller fish are defined as "jacks".

3. Jacks smaller than 24 inches should compose no more than 10% of the naturally produced spring chinook salmon that pass Gold Ray Dam.

4. Among naturally produced spring chinook salmon that spawn during September, at least 40% should spawn upstream of the Highway 62 bridge in Shady Cove.

5. Hatchery fish should compose no more than 15% of spring chinook salmon that spawn naturally.

6. There is at least a 99% chance that the population of naturally produced spring chinook salmon will persist over a period of 100 years.

DISPARITY BETWEEN DESIRED AND CURRENT STATUS

Some differences, or gaps, exist between singular elements of desired status and singular elements of current status. The magnitude of the gaps range widely, and in three cases are currently non-existent (Table 10).

PRIMARY FACTORS RESPONSIBLE FOR DISPARITY

There are a number of possible factors that contributed to the decline of, and the change in the life history of, NP CHS in the Rogue SMU. In addition, there were a number of factors that historically limited the population, and affected the life history strategies expressed within population attributes. Both types (current and historic) of possible limiting factors were considered as part of the following assessment. Possible limiting factors are organized under four categories (habitat volume, habitat quality, biological factors, and fisheries), and are classified as whether each factor can, or cannot be, managed through directed actions (Table 11). Factors that cannot be managed are excluded from the remaining discussion of potential limiting factors.

Table 10. Comparisons of singular elements of current and desired status for spring chinook salmon in the Rogue Spring Chinook Salmon Species Management Unit. Numbers listed under current status represent the average of all data available for the last 10 years.

Status Element	Desired Status	Current Status	"gap"
Abundance (at Gold Ray Dam)	≥15,000	8,200 (1996-2006)	6,800
Migration Timing[a] (% passage by 15 June)	≥60%	45% (2003-2006)	15%
Age Structure (% jacks)	≤10%	9% (2003-2006)	none
September Spawner Distribution (% above Shady Cove)	≥40%	48% (2004-2006)	none
Spawner Composition (% hatchery)	≤15%	11% (2004-2006)	none

[a] *For only those fish at least 24 inches in length ("adults").*

Table 11. Generalized parameters identified as potential factors that impact the abundance and life history of naturally produced spring chinook salmon in the Rogue Spring Chinook Salmon Species Management Unit. Factors with stars are judged to be unmanageable.

Habitat Volume
Amount of ocean rearing habitat
Amount of spawning habitat
Amount of freshwater rearing habitat
Migration barriers

Habitat Quality
Current patterns in the ocean
Water temperature in the ocean
Water temperature in freshwater
Water quality
Stream flow
Changes in stream flow
Spawning gravel
Morphology of stream channels
Riparian areas
Water diversions

Biological Factors
Predators in the ocean
Competitors in the ocean
Predation in freshwater
Freshwater competitors
Disease
Spawning escapement
Genetics

Fishing
Direct mortality
Indirect mortality

Habitat Volume

At the present time, there are about 30 miles of spawning habitat typically accessible to adult CHS in the Rogue River Basin. This estimate includes 29 miles in the mainstem of the Rogue River (head of the pool behind Gold Ray Dam, at river mile 127, upstream to the barrier dam at Cole M. Rivers Hatchery, at river mile 156) and also includes one mile in Big Butte Creek. A small natural waterfall in the lower portion of Big Butte Creek acts as a partial barrier to upstream migration. While spawning may occur in other areas, instances are sporadic and usually occur only during rare years when flows in tributaries increase significantly during the period of mid-September through mid-October (USFWS 1955c; ODFW unpublished data).

The construction of Lost Creek Dam and the barrier dam at Cole M. Rivers Hatchery blocked about 20 miles of spawning habitat previously used by CHS, although about nine miles appeared to be used only sporadically. Prior to construction of these structures, CHS typically spawned in the Rogue River upstream to river mile 167, which is near the site of Laurelhurst Bridge (USFWS 1955c). Other records indicate that CHS periodically spawned in the Rogue River upstream as far as river mile 168 at Cascade Gorge (Rivers 1946), spawned in the South Fork of the Rogue River upstream to at least river mile five (ODFW unpublished data), and spawned in the Middle Fork upstream to at least river mile three (ODFW unpublished data).

Under current operating strategies employed for Lost Creek Lake, the reservoir typically fills by 1 May, and is about 16 feet below full pool elevation in the middle of March. At full pool, Lost Creek Lake inundates the Rogue River upstream to river mile 168 and also inundates about one-half mile of the South Fork of the Rogue River. Prior to reservoir construction, fry of CHS would have likely emerged from the gravel in March and April. Assuming that eggs and sac-fry would survive only in locations of flowing water, there appears to be about nine miles of potential habitat for CHS in the area upstream of Lost Creek Lake. In order for CHS to use this habitat, adult fish would have to be collected and transported for release in upstream areas. The efficacy of this potential management action is unknown. Uncertainty related to the survival rates of transported adults, and the survival rates of juveniles that would have to pass through Lost Creek Dam, should be thoroughly investigated prior to the implementation of any management action. In addition, other areas may have the potential to more productive for NP CHS.

One index of the amount of spawning habitat available for CHS can be derived from visual surveys of spawning areas conducted in the 1940s. While contemporary survey procedures are more accurate, the historic surveys likely convey a general idea of the distribution of spawning habitat currently available to CHS. Historic surveys suggested that the construction of Lost Creek Dam blocked about 25% of the spawning habitat typically used by CHS. Although about 25% of the primary spawning habitat was blocked, about 33% of the spawners typically used this area because spawner densities tended to be greatest near the upstream terminus of primary spawning (USFWS 1955c). Of the historic habitat that was blocked, only the South and Middle forks of the Rogue River are located upstream of the area inundated by Lost Creek Lake (Table 12). These areas appear to have been used only sporadically by spawning CHS (ODFW unpublished data).

Estimates from historic surveys may reflect the volume of spawning habitat that might be available if habitat can be expanded for CHS. As previously discussed, CHS rarely spawn in tributary streams because of low flows before and during spawning (lower mile of Big Butte Creek excepted). Of the major tributaries that enter the Rogue River upstream of Gold Ray Dam, Little Butte Creek appears to have the greatest potential to produce a large number of NP CHS (Table 12). However, a large volume of water would be needed to sustain a

Table 12. Estimated volumes of potential spawning gravel in the Rogue River Basin upstream of Gold Ray Dam USFWS (1955c). Estimation criteria used for Rogue River surveys included only watered areas with a depth less than three feet and a water velocity of at least one foot/second. Estimation criteria used for surveys of Rogue River tributaries (South Fork excepted) included all gravel areas within the active channel of the streams in areas judged to be accessible to anadromous salmonids.

Stream, area	Square yards of gravel
Rogue River:	
Middle Fork	a,b
South Fork	9,700[b]
Lost Creek - Prospect	18,600[c]
McLeod - Lost Creek	31,200[c]
Elk Creek – McLeod	13,800[d]
Lewis Creek – Elk Creek	19,700[d]
Trail – Lewis Creek	26,900[d]
Shady Cove - Trail	26,100[d]
Dodge Bridge - Shady Cove	33,200[d]
Bybee Bridge - Dodge Bridge	48,900[d]
Gold Ray Dam - Bybee Bridge	5,700[d]
Big Butte Creek	58,100[d,e]
Elk Creek	64,900[e]
Trail Creek	8,900[e]
Little Butte Creek	119,700[e]
Bear Creek	a

[a] *No survey completed.*
[b] *Area is upstream of Lost Creek Lake.*
[c] *Area is mostly inundated by Lost Creek Lake.*
[d] *Currently used by spawning CHS.*
[e] *Low flows during migration usually preclude use of these areas by spawning CHS, except in the lowest mile of Big Butte Creek.*

natural population capable of using a large portion of the stream. Cursory observations of chinook salmon migration patterns in the Applegate River and in the lower end of Big Butte Creek suggest that flow in Little Butte Creek would need to be at least 100 cfs, during the middle of September through the middle of October, in order establish a widely spawning population of spring salmon. Recent estimates of average flow range between only 20 and 40 cfs during this period of time (Figure 4). Historic flow records and current rate of water diversions indicate that natural flows were never sufficient to allow for a self-sustaining run of CHS in the Little Butte Creek Basin. The need for appropriate water temperature during adult migration is factored into projected minimum flow of 100 cfs for the establishment of a natural run.

In contrast to Little Butte Creek, there may be an opportunity to expand spawning habitat for NP CHS in Big Butte Creek. Flows average about 60 cfs in the middle of September and increase to an average of more than 100 cfs during the first half of October (Figure 4). A small natural waterfall at mile one is currently a partial barrier to the upstream migration of CHS. Additional flow during the latter half of September, or improvements to an existing fish ladder, could possibly result in an appreciable increase in the number of NP CHS that spawn farther upstream in Big Butte Creek. If natural production increases to a level that is sustainable, the life history characteristics of returning adults should be comparable to the historic life history patterns of NP CHS because the operation of Lost Creek Dam does not affect water temperature in Big Butte Creek.

Construction of Lost Creek Dam blocked spawning habitat for NP CHS. The volume of spawning habitat in areas farther downstream is also likely to be impacted (or has been impacted) by dam construction. Recruitment of gravel from locations upstream of Lost Creek Dam has ceased. Consequently, there is a good chance that the amount of spawning habitat for NP CHS in the Rogue River will decrease over time, as has been observed in areas downstream of many other dams (Williams and Wolman 1984).

In contrast to spawning habitat, the volume of rearing habitat for juvenile NP CHS in the mainstem of the Rogue River probably has not changed appreciably since reservoir construction. ODFW (2000) documented wide variations (as great as 20-fold) in the abundance of naturally produced juveniles and also determined that fry abundance and smolt abundance were highly correlated. These findings indicate that spawning habitat, rather than rearing habitat, is a greater factor that limits the production of NP CHS.

Habitat Quality

Aspects of habitat quality that have the potential to affect the abundance and life history of CHS are diverse. Habitat features that affect adult CHS include channel morphology, water quality, and flow. Habitat features that affect juvenile CHS include channel morphology, water quality, flow, changes in flow, sedimentation, gravel composition, riparian areas, and water diversions.

Adult CHS hold in areas upstream of Gold Ray Dam prior to spawning. Habitat features associated with specific holding sites used in the Rogue River are unknown, but such sites likely include such features as deep pools, undercut stream banks, and large structures for cover (bedrock outcrops, large boulders, downed trees or logs). These types of morphological features of a channel can be impacted by bank erosion, removal of riparian vegetation, and placement of rock (rip-rap) along channel margins.

Water quality elements that can affect adult CHS include temperature, dissolved oxygen, nutrients, and pollutants. Based on water quality index ratings reported by Mrazik (2004), none of these factors, except water temperature, are likely to affect the survival of adult CHS in the Rogue River. In contrast, water temperature was identified as a primary factor that affected the survival rates of migrating adults. Prespawning mortality rates can exceed 50% (Table 13) during years of relatively high water temperatures (ODFW 2000).

Flow directly affects habitat quality through the dilution of pollutants and nutrients during the period adult CHS are present in freshwater. In addition, flow affects water temperature, especially from late spring through early autumn. During that period, higher flows result in lower water temperatures within downstream areas (USACE 1991).

Table 13. Estimated mortality rates (and number) of adult spring chinook salmon that died in the Rogue River downstream of Gold Ray Dam, 1975-2005. Years when mortality rates were estimated at less than 5% are not listed.

Year	Mortality rate	Number dead
1977	34%	8,539
1981	6%	1,071
1987	28%	31,579
1992	70%	13,684
1994	59%	20,134
2001	17%	8,286

Juvenile NP CHS are potentially affected by a broader array of features related to habitat quality. Similar to adults, juvenile NP CHS are probably not detrimentally impacted by water quality of the Rogue River, water temperature being a primary exception. Changes in water temperature, that resulted from reservoir operation, was identified as a primary factor that directly affected naturally produced juveniles through (1) increased developmental rates of eggs and sac-fry during gravel incubation, (2) earlier emergence of fry from the gravel, and (3) increased growth rate (ODFW 2000).

Resultant changes in these three factors led to various changes in life history characteristics of NP CHS including (1) an earlier time of ocean entry by juveniles, (2) earlier maturation at younger ages, (3) later migration in freshwater, (4) later spawning time and (5) a change in the race composition of naturally produced chinook salmon produced upstream of Gold Ray Dam (ODFW 2000). In addition, smolts migrating to the ocean are commonly exposed to water temperatures that exceed 75^{O}F, possibly resulting in decreased survival rates (Baker et al. 1995).

Flow, and changes in flow, have also been documented as factors that affect juvenile NP CHS. Peak flows were negatively related to fry production, almost certainly as the result of scouring when eggs and sac-fry are present in the gravel (ODFW 2000). Fast decreases in flow can strand and kill NP CHS fry (Table 14), and also can cause fry to be trapped in side channels (ODFW 2000). Low flows also can result in dewatered redds (ODFW 2000), and can cause mortality among eggs and sac-fry resident in the gravel.

Table 14. Documented instances when naturally produced juvenile spring chinook salmon were dewatered and killed as a result of reductions in outflow at Lost Creek Dam. None of the flow changes were carried out in response to potential flooding in downstream areas. In April, the largest decreases in natural flows generally do not exceed 800 cfs over 24 hours (ODFW 2000).

Year	Date of mortality	Decrease in outflow
1985	18 April	2,100 cfs in 7 hours
1986	2 April	500 cfs in 6 hours
1987	8 April	400 cfs in 4 hours
2002	19 April	900 cfs in 8 hours
2006	6 January	2,800 cfs in 24 hours

Flows, especially peak flow, also affect channel morphology, sedimentation rates, and gravel quality. Higher flows increase the width of unconstrained channels and the size of pools in low gradient streams; and these pools are the riverine habitat type preferred by juvenile chinook salmon. In addition, wide, unconstrained, channels in low gradient streams tend to be characterized by larger areas of more diverse spawning habitat (Montgomery et al. 1999). Peak flows are also associated with storm events that increase the amount of sediment introduced into streams.

Sediment can arise from numerous sources, and sediment deposition on redds has been associated with decreased survival rates of eggs and sac-fry. Sediment deposition can also affect gravel quality in spawning areas. Fines can fill spaces within gravel, reducing space for incubating sac-fry and reducing water exchange around eggs and sac-fry (Chapman 1988). However, of possible greater concern, is the lack of recruitment of gravel from areas upstream of Lost Creek Dam. With the lack of gravel recruitment, the average size of gravel within spawning areas downstream of Lost Creek Dam will likely increase because small gravel is more likely to be displaced during scour events as compared to larger gravel or rocks (Williams and Wolman 1984).

The amount of sediment that enters streams is dependent on a variety of factors including mass failures, landslides, surface erosion, and stream bank erosion. Rates of bank erosion along streams are influenced by the integrity of the riparian zone. The riparian zone also produces large wood pieces that provide cover for fish, helps to stabilize stream channels, produces terrestrial sources of food for fish, and also helps shade streams. Shade produced by riparian zones is likely a significant factor that affects water temperature of the Rogue River.

Water temperature may also be affected by water withdrawals and return flows from irrigated lands and municipal discharges. Water withdrawals can also affect the survival of juvenile salmonids if the diversions are unscreened, or are poorly maintained. The volume of water diverted from the Rogue River will increase in the future as additional storage from Lost Creek Lake is purchased for irrigation use or municipal and industrial use.

Within Jackson County, the need for municipal and industrial water supplies is predicted to increase from 36,000 acre-feet in 2000 to 71,000 acre-feet in 2050 (Ryan and Dittmer 2001). Increased demands can also be assumed for other counties in the Rogue River Basin. About 45,000 acre-feet of water in Lost Creek Lake is allocated for irrigation and municipal and industrial use, of which about 34,000 acre-feet has yet to be contracted. This 34,000 acre-feet is currently used for fish enhancement purposes (including protection of NP CHS), and will become less available for fishery purposes in future years as more storage is purchased for consumptive uses.

The impact of the reduction in the volume of storage available for fishery purposes was assessed by comparing predictions of prespawning mortality rates of naturally produced chinook salmon runs under two scenarios of (1) a year of low water yield and (2) a year of average water yield. Projections indicated that there is a good possibility that there will be sufficient reservoir storage to protect most CHS, provided that greater rates of prespawning mortality among CHF are acceptable (Table 15). These projections indicate that the protection and enhancement of chinook salmon populations will become more difficult with decreases in the volume of reservoir storage available for fishery purposes in downstream areas.

Table 15. Projected impacts of a 30,000 acre-feet reduction in the availability of reservoir storage from Lost Creek Lake. Projections were estimated for 2001 (a drought year) and 2002 (a year of average water yield). Projections assume zero return flows from the 30,000 acre-feet removal of water from the Rogue River and no reductions in reservoir releases for fishery purposes from Applegate Lake. Mortality rates of adult chinook salmon were predicted using relationships between water temperature and fish mortality (ODFW 1992; ODFW 2000).

	2001		2002	
Fish variety	Predicted[a]	Predicted[b]	Predicted[a]	Predicted[b]
Spring chinook salmon	21%	24%	3%	4%
Fall chinook salmon	40%	61%	8%	17%

[a] *Pre-season prediction that assumed average air temperatures, May-September.*
[b] *Pre-season prediction that assumed average air temperatures, May-September, with 30,000 acre-feet of reservoir storage removed from fish allocation.*

Biological Factors

Numerous biological factors have the potential to affect the abundance and life history of NP CHS in the Rogue SMU. The list of generalized factors includes competitors, predators, disease, spawning escapement, and hatchery fish. A discussion of specific aspects follows.

Competitors: The most likely competitors of juvenile NP CHS are juvenile NP CHF. As previously described, the abundance of the fall race has increased greatly in the area upstream of Gold Ray Dam (*see* **Comparisons to Other Populations**, page 32). However, as adult NP CHF tend to spawn later than adult NP CHS (ODFW 2000), progeny of the fall race should be generally smaller in size as compared to progeny of the spring race. Competition, if occurring, likely results in slower growth rates for juvenile NP CHS.

Redside shiners (*Richardsonius balteatus*) also compete with juvenile NP CHS, as both species are found in similar types of habitat. Redside shiners were first documented in the Rogue River Basin during 1957, and by 1962 had become widely spread between Agness and Gold Ray Dam (Rivers 1964). This species dominated the number of fish caught with beach seines at some sites downstream of Grants Pass in the 1970s and 1980s, but were much less abundant at sites sampled upstream of Gold Ray Dam. This species tends to prefer warmer water temperatures as compared with salmonids. Decreased water temperatures, resulting from reservoir releases during the summer months, have likely decreased the competitive ability of redside shiners in the primary rearing area of juvenile CHS (Reeves et al. 1987).

Juvenile Umpqua pikeminnow (*Ptychocheilus oregonensis*) may also compete with juvenile CHS, but to a lesser degree as compared to redside shiners. Umpqua pikeminnow were introduced in the Rogue River Basin during 1979. By the middle of the 1990s, the species was commonly found between Grants Pass and Gold Beach. Few have ever been found upstream of Gold Ray Dam, the primary rearing area for juvenile NP CHS. Similar to redside shiners, this species tends to prefer warmer water temperatures as compared with salmonids. Decreased water temperatures, resulting from reservoir releases during the summer months, have likely limited the upstream distribution of Umpqua pikeminnows in the Rogue River.

Competition with NP CHF is not restricted to the juvenile life history phase of life. A tagging project conducted in 1986-87 indicated that there was overlap in the spawning distribution of both races. While about 55% of tagged NP CHF were recovered as spawned carcasses in the nine miles immediately upstream of Gold Ray Dam, others were recovered as far upstream as Big Butte Creek (ODFW 2000). Given that there is also some overlap in spawning time, there may be some competition for redd sites among females of each race. Some NP CHF also spawned later than NP CHS (ODFW 2000). Thus, it is also possible that female NP CHF excavated redds previously constructed by female NP CHS. The degree of competition for redd sites, and the degree of redd superimposition by NP CHF, is difficult to judge as the relative abundance of NP CHF increased to even a greater degree during the 1990s (*see* **Comparisons to Other Populations**, page 32).

Predators: While competitors may be relatively few, there are a myriad of animals that prey upon NP CHS produced in the Rogue SMU. Known predators are listed in Table 16, along with the designation of each species as administered by the state of Oregon, and by the federal government. Among predators that inhabit freshwater, only three species are not protected under either state or federal law (Table 16).

The issue of predation on anadromous salmonids has received much attention in the Pacific Northwest, and numerous research projects have attempted to estimate salmonid losses as related to predation. However, predation is probably not a primary factor responsible for the differential decline of NP CHS in the Rogue SMU. CHF have increased in abundance, while the abundance of NP CHS has decreased (*see* **Comparisons to Other Populations**, page 32). Except for some juvenile hatchery fish that rear in the upper portion of the Rogue River after release from Cole M. Rivers Hatchery, individual types of predators are unlikely to have a greater effect on NP CHS as compared to NP CHF.

Table 16. A list of animals that prey, or likely prey, on juvenile or adult spring chinook salmon of Rogue River origin.

Species or animal type	Protected species? Federal	State
FISH		
Umpqua pikeminnow	no	no
Prickly sculpin	no	no
Reticulate sculpin	no	no
Largemouth bass	no	yes
Coho salmon (hatchery)	no	yes
Steelhead (hatchery)	no	yes
Coho salmon (wild)	yes	yes
Steelhead (wild)	no	yes
Cutthroat trout	no	yes
Marine species	some	some
BIRDS		
Cormorant (double-crested)	yes	yes
American merganser	yes	yes
Herons (multiple species)	yes	yes
Belted kingfisher	yes	yes
Gulls (multiple species)	yes	yes
Tern	yes	yes
Bald eagle	yes	yes
Osprey	yes	yes
Marine species	yes	yes
MAMMALS		
River otter	no	yes
Mink	no	yes
Harbor seal	yes	yes
California sea lion	yes	yes
Northern sea lion	yes	yes

Juvenile steelhead and coho salmon are released annually at Cole M. Rivers Hatchery. Release goals are presently 220,000 summer steelhead, 132,000 winter steelhead, and 200,000 coho salmon. Steelhead are generally released in late April and coho salmon are generally released in early May. These dates probably coincide with the period when peak numbers of CHS fry are present. Surveys conducted during 1979-81 indicated that both species preyed upon fry of NP CHS. Based on some major assumptions, the annual number of fry consumed by steelhead of hatchery origin ranged between 134,000 and 218,000, while the number of fry consumed by coho salmon of hatchery origin ranged between 29,000 and 57,000 (Evenson et al. 1981). These estimates, if accurate, represent 3-7% of the CHS fry produced during those years. The rate of predation loss is highly dependent on the duration of time that hatchery fish reside in the river, and on the proportion of the release groups that fail to migrate downstream. Not much is known about residence time after release, except a greater proportion of juvenile steelhead fail to migrate as compared to juvenile coho salmon.

There are three species of freshwater fish that likely prey on juvenile CHS and are not currently protected by state or federal law. Two of species are sculpins that reside on the substrate of waterbodies. Sculpin predation on juvenile salmonids generally occurs when sac-fry are resident in the gravel, or are moving in and out of the gravel. Predation losses to Umpqua pikeminnows are probably negligible until juvenile CHS begin to actively migrate to the ocean as smolts. Juvenile CHS primarily rear in the area upstream of Gold Ray Dam (ODFW 2000), while Umpqua pikeminnow rear primarily downstream of Grants Pass. Among Umpqua pikeminnows collected during summer between Grants Pass and Galice, 4% (1993) and 7% (1994) contained salmonids (Satterthwaite 1995). Comparable sampling in the spring of 1994 determined that 30% of the pikeminnows contained salmonids. Within all sampling periods, most of the consumed salmonids were juvenile chinook salmon. The best estimate of losses resulting from pikeminnow predation comes from the Columbia River, where it has been estimated that pikeminnows consume 8% of the juvenile salmonids that migrated as smolts (Beamesderfer et al. 1996; Zimmerman and Ward 1999).

Disease: In comparison to predation, disease is known to be a primary factor that affects the abundance of CHS. Downstream of Gold Ray Dam, extensive mortalities of adults were documented in 1977, 1987, 1992, and 1994. Estimates of mortality rates during those years ranged between 28% and 70% of the CHS that entered the Rogue River (ODFW 2000). In addition, extensive prespawning mortalities were documented in the area upstream of Gold Ray Dam during 1977 and 1981 (ODFW 2000).

A bacterial pathogen, *Flexibacter columnaris (Columnaris)*, was the disease organism most often isolated from dead and dying CHF sampled in the Rogue River during the late 1970s and early 1980s (Amandi et al. 1982). Virulence of this bacterium varies among strains and epizootics may occur intermittently in salmonid populations (Becker and Fujihara 1978). Mortality rates of juvenile chinook salmon infected with *Columnaris* increase as water temperature increases between 12^{O}C and 21^{O}C (Holt et al. 1975; Becker and Fujihara 1978). CHS in the Rogue River are annually exposed to water temperatures close to the upper end of this range.

Columnaris was detected in resident fish in Lost Creek Lake and in juvenile chinook salmon held in the reservoir, but was not detected in reservoir water or reservoir outflow (Amandi et al. 1982). Among the various water bodies sampled, pathogen concentrations were greatest in the outflow from Cole M. Rivers Hatchery. CHS in the hatchery were also found to be infected with the disease. It could not be determined whether adult salmon carried the disease into the hatchery or contracted the disease after entry. *Columnaris* was also found in several species of fish sampled throughout the Rogue River Basin, including the Applegate River (Amandi et al. 1982). Other disease organisms detected in CHS include Infectious Hematopoeitic Necrosis (IHN), Bacterial Kidney Disease (BKD), *Furunculosis*, and *Ceratomyxa shasta*. At the present time, *Columnaris* is believed to pose the greatest risk to NP CHS in the Rogue SMU.

To minimize losses of adult CHS to disease, ODFW identified targets for water temperature in the Rogue River canyon and has, since 1995, requested releases of reservoir storage in order to meet water temperature targets in downstream areas. River flow must be augmented to meet water temperature targets because the effect of outflow temperature at Lost Creek Lake diminishes rapidly with distance downstream (USACE 1991). This approach has proved to be effective in decreasing losses related to disease. For example, the mortality rate of adult CHS in 2001 was estimated to be 17%, even though the yield of water in the Rogue River Basin was one of the lowest on record (Satterthwaite 2002).

Similar methods of flow augmentation were tried in 1992 and in 1994, but only after disease outbreaks were already underway. Increased flows cooled water temperatures in downstream areas, but failed to appreciably decrease mortality among adult CHS. Consequently, the strategy employed since 1995 is directed towards using reservoir storage to prevent, or to delay as long as possible, disease outbreaks. This approach means that, during an average year of water yield, the available amount of reservoir storage is insufficient to prevent some disease-related loss among late-run adult CHS. Reservoir storage is limited because ODFW also requests the release of storage to minimize the chance of disease outbreaks among NP CHF and also to increase the survival rates of juvenile salmonids that rear and migrate in the Rogue River during the middle of summer (ODFW 2000). As more reservoir storage is purchased for irrigation, and municipal and industrial supply, the amount of storage available for fishery purposes will decrease.

Spawning Escapement: A critical factor that obviously affects salmon populations is the number of adults that survive to spawn. Knowledge of the relationship between spawning escapement and the production of progeny is of primary importance in order to effectively manage salmon populations. The numerical relationship between spawners and progeny is often obscured by numerous factors (Ricker 1975), or by a lack of appropriate data. In contrast to a lack of data for many salmon populations, there are three possible ways to develop a relationship between spawning escapement and recruitment for NP CHS in the Rogue River.

Estimation of the number of spawners is equivalent among methods, and is primarily based on the number of naturally produced fish that are estimated to have passed Gold Ray Dam. The number of naturally produced fish that survive to spawn are then estimated by subtracting estimates of angler harvest and prespawning mortality (ODFW 2000). The number of hatchery CHS that spawn naturally are estimated by a 5% stray rate from Cole M. Rivers Hatchery (Cramer et al. 1985). Common to all three methods, fish less than 24 inches in length ("jacks") are removed from the estimated number of spawners because all jacks are males (ODFW 2000). Methods to estimate parent and progeny relationships differ in the way that the abundance of progeny is indexed.

In method one, the number of naturally produced progeny (recruits) are estimated as the sum of ocean harvest and freshwater escapement. Numerous assumptions are required to generate recruitment estimates including (1) age composition of naturally produced fish that pass Gold Ray Dam (2) harvest and natural mortality in the river downstream of Gold Ray Dam, and (3) age-specific rates of harvest in the ocean fisheries. A comparison of the abundance of parents and recruits is often used in assessments of salmon populations. However, this approach fails to directly account for variations in survival rates during the initial period of ocean residence, which can vary almost 10-fold among years (ODFW 2000).

A comparison of the number of recruits and parents indicated that, during most years, the spawning CHS produced less than 60,000 recruits (Figure 5). In addition, this level of production has not been reached since the mid-1980s (Figure 5). A predictive line that appeared to "best fit" data from the 1985-2000 brood years suggested that 5,000 spawners would produce about 15,000 recruits, 10,000 spawners would produce about 21,000 recruits, and 15,000 spawners would produce about 26,000 recruits (Figure 5). These predictions are applicable for average environmental conditions, but not individual years. Annual estimates of the numbers of recruits and parents are listed in Appendix Table I-2.

Method two is very similar to method one, except that there is an attempt to directly account for variations in survival rates during the initial period of ocean residence. The number of naturally produced smolts (juveniles that entered the ocean) is indexed by assuming that the initial ocean survival rates of naturally produced and hatchery fish are highly correlated. Estimation of initial ocean survival rates of CHS of hatchery origin were described by ODFW (2000).

A comparison of the indexed number of smolts and the number of parents suggested that, during most years, the population of NP CHS produced less than two million smolts (Figure 6). A predictive line that appeared to "best fit" the data suggested that 5,000 spawners would produce about 700,000 smolts, 10,000 spawners would produce about 1.4 million smolts, and 15,000 spawners would produce about 2.1 million smolts. This prediction apply for average environmental conditions, but not individual years. Annual estimates of the numbers of smolts and parents are listed in Appendix Table I-2.

Method three is distinctly different from the other two methods. The annual abundance of progeny are indexed as the number of newly emergent fry of CHS caught annually by sampling with beach seines (nets) at two sites upstream of Gold Ray Dam during 1976-94 (ODFW 2000). Thus, highly variable survival rates during the initial period of ocean residence is not a factor that affects, in this case, the relationship of progeny and parents. In addition, with the data reported by ODFW (2000), it is possible to factor out the direct environmental effects of peak flow and water temperature during the period that eggs and sac-fry incubated in the gravel. The use of beach seines has been shown to be an effective method of indexing the abundance of juvenile chinook salmon (Parsley et al. 1989).

A comparison of net catches of CHS fry and the number of parents indicated that there was a positive relationship between the two variables (Figure 7). A predictive line that appeared to "best fit" the data suggested that 5,000 spawners would produce an average net catch of about 180 fry, 10,000 spawners would produce an average net catch of about 360 fry, and 15,000 spawners would produce an average net catch of about 540 fry (Figure 7). Annual estimates of the numbers of fry caught and parent numbers are listed in Appendix Table I-2.

Hatchery Fish: During the last 20 years, there has been increased concern that hatchery fish may be partially responsible for documented declines in the abundance of some naturally produced salmon populations (ISAB 2002). Potential impacts can be classified as either genetic in basis, or as ecological interactions. Genetic impacts can develop when populations of naturally produced and hatchery fish have different genetic complements. Differences in genotypes can result from domestication of a hatchery population, or use of a non-local brood stock to establish a hatchery population, or inbreeding caused by small numbers of hatchery fish in the brood stock (ISAB 2002). Ecological impacts can result from (1) competition of naturally produced and hatchery fish, (2) direct predation on naturally produced fish by hatchery fish, (3) increased losses if hatchery fish attract additional predators, (4) disease transmission from hatchery fish to naturally produced fish, and (5) changes in water quality directly attributable to hatchery operations (HSRG 2005).

The risk of potential negative impacts to NP CHS, that result from the release of CHS from Cole M. Rivers Hatchery, is difficult to thoroughly evaluate. However, the following information can be used, to some degree, to assess the potential for risk to NP CHS:

1. The amount of domestication of the hatchery population is unknown. Cole M. Rivers Hatchery has been operational since 1973, when the first adult CHS were collected for brood stock. Assuming that age 4 spawners dominated the brood stock, approximately five generations of families have been raised at the facility.
2. The brood stock was developed from CHS (almost all naturally produced fish) that volitionally entered the hatchery, and during the intervening years, only those fish that volitionally entered the hatchery were included in the brood stock.
3. A minimum of 500 adults (usually more than 1,000) composed the annual brood stocks since the hatchery began operation.

4. With the exception of four years during the 1980s, juvenile CHS were released from Cole M. Rivers Hatchery no earlier than the middle of August. This date of release ensures that the preponderance of the juvenile hatchery fish do not rear in the Rogue River for an appreciable period of time (ODFW 2000), nor prey upon juvenile NP CHS.
5. Time of hatchery entry by adult CHS closely reflects the entry time of naturally produced fish during the first few years of hatchery operation.
6. The spawning time of hatchery brood stocks has not changed since the hatchery began operation (ODFW 2000).
7. Hatchery fish tend to mature at younger ages as compared to naturally produced fish. This difference is likely due to brood stock selection practices and accelerated growth rates of juveniles during hatchery residence.
8. With the exception of age at maturity, hatchery fish exhibit life history characteristics similar to those of NP CHS produced before the operation of Lost Creek Dam.
9. Recent genetic assessments failed to detect differences between naturally produced and hatchery fish for the microsatellite DNA markers analyzed (*see* **SPECIES MANAGEMENT UNIT AND CONSTITUENT POPULATIONS**, page 10). Resolution of the testing does not preclude genetic differences.
10. Hatchery CHS have some life history characteristics that differ from NP CHS. Hatchery fish migrate in freshwater earlier, and spawn earlier, as compared to the current population of NP CHS. These life history characteristics are heritable traits and indicate that genetic differences are present. Differences between hatchery CHS and NP CHS are mostly related the changes in life history characteristics of NP CHS produced after the operation of Lost Creek Dam.
11. There have been periodic disease outbreaks at Cole M. Rivers Hatchery, making it probable that concentrations of fish pathogens increased in the Rogue River as a result of hatchery operations.
12. Adult CHS of hatchery origin appear to be more susceptible to disease outbreaks as compared to naturally produced counterparts (ODFW 2000). 13. The homing rate of adult CHS of hatchery origin was estimated to be about 95% and thus about 5% of the hatchery fish spawn naturally (Cramer et al. 1985).
14. Hatchery fish are projected to account for about 13% of the natural spawners during years when hatchery fish compose about 75% of the CHS that pass Gold Ray Dam (ODFW 2000).
15. Spawner surveys conducted during 2004 and 2005 suggested that hatchery fish composed an average of 11% of all natural spawners and 23% of the fish that spawned between the hatchery and Rogue Elk Park. More than 70% of the stray hatchery fish spawned within 5 miles of Cole M. Rivers Hatchery.
16. It is possible that the large run of hatchery fish support levels of angling intensity that result in freshwater harvest rates that exceed optimal levels for NP CHS under the current angling regulations.

The production program for CHS at Cole M. Rivers Hatchery is comparable an "integrated hatchery program" as defined by Hatchery Scientific Review Group (HSRG 2005). This term describes a management scenario where the hatchery brood stock is managed as a genetically integrated component of an existing population. Recommendations for brood stock composition for these types of programs are (1) naturally produced fish should compose at least 10% of the brood stock and (2) the proportion of naturally produced fish in the brood stock should be greater than the proportion of hatchery fish among natural spawners (HSRG 2005). These criteria were attained for the 2004 and 2005 brood stocks at Cole M. Rivers Hatchery (Table 17). Data from 2005 indicates that naturally produced fish may, in the future, need to be collected at a site other than Cole M. Rivers Hatchery. This issue should be addressed in a Hatchery Management Plan that will be developed by ODFW. Other recommendations related to principles of hatchery programs (HSRG 2005) are also mostly attained by the production program for CHS at Cole M. Rivers Hatchery.

Table 17. Estimated composition of adult spring chinook salmon that spawned naturally, and were spawned at Cole M. Rivers Hatchery, 2004-05.

Year	% naturally produced fish among hatchery brood stock	% hatchery fish among natural spawners
2004	26%	9%
2005	15%	12%

In conjunction with this conservation plan, ODFW will be developing a hatchery program management plan in order to comply with ODFW's Fish Hatchery Management Policy (ODFW 2003). This policy describes best management practices that are intended to help ensure the conservation of both naturally produced native fish and hatchery produced fish. Policy goals include:
1. Foster and sustain opportunities for sport, commercial and tribal fishers consistent with the conservation of naturally produced native fish.
2. Contribute toward the sustainability of naturally produced fish populations through the responsible use of hatcheries and hatchery-produced fish.
3. Maintain genetic resources of native fish populations spawned or reared in captivity.
4. Minimize adverse ecological impacts to watersheds caused by hatchery facilities and operations.

The Fish Hatchery Management Policy requires that ODFW hatchery programs be distinguished as harvest or conservation hatchery programs. Currently, ODFW manages the Rogue CHS program at Cole M. Rivers Hatchery as a mitigation type, harvest hatchery program. As described in the Fish Hatchery Management Policy, harvest hatchery programs operate to enhance or maintain fisheries without impairing naturally reproducing populations. The policy further states that a mitigation program is used pursuant to an agreement to provide fishing and harvest opportunities lost as a result of habitat deterioration, destruction or migration blockage.

However, there are some potential conservation benefits associated with the maintenance of the CHS hatchery program very similar to the present form. The brood stock was initially developed from NP CHS that volitionally entered Cole M. Rivers Hatchery, and efforts during the intervening years have focused on (1) the maintenance of genetic diversity and (2) the maintenance of some of the genetic based life history characteristics expressed by that portion of the NP CHS population that historically spawned upstream of Lost Creek Dam. While NP CHS and hatchery CHS currently differ in some life history characteristics, it may be important to maintain the current population of hatchery CHS in the event that further conservation efforts are needed for early-run and mid-run CHS.

Direct Impacts by Humans

A primary impact exerted on salmon populations is mortality that results from fishing activities. Wading and boating may have some impact on production (Roberts and White 1992; Horton 1994), but the greatest impact almost certainly originates from the directed fishing on salmon by recreational and commercial fisheries. Mortality rates associated with fishing can vary widely for salmon, especially for chinook salmon that mature at multiple ages.

Estimates of total harvest rates for NP CHS ranged between 30 and 76% for the 1972-2000 brood years (Appendix Table I-2). Harvest rates were greatest for fish produced in the 1970s, generally declined for fish produced during the mid 1980s through the mid 1990s, and slightly increased for fish produced in the late 1990s (Figure 8). The sharp decline in harvest rates for fish produced in 1980 and 1981 was probably linked to the extremely strong El Niño event of 1982-83 (ODFW 2000). Harvest rates were estimated by the equation:

(ocean harvest + river harvest)/(ocean harvest + escapement at river entry))

Changes in ocean harvest rates were more pronounced as compared to changes in freshwater harvest rates (Figure 9). Harvest rates in the ocean fisheries averaged 65% for broods that spawned in the 1970s, 40% for broods that spawned in the 1980s, and 11% for broods that spawned in the 1990s (Appendix Table I-2). In contrast, harvest rates in the river fisheries averaged 9% for broods that spawned in the 1970s, 16% for broods that spawned in the 1980s, and 28% for broods that spawned in the 1990s (Appendix Table I-2). The sharp decline in ocean harvest rates coincided with implementation of Amendment 9 of the Fishery Management Plan for CHF in the Klamath River Basin of northern California. Resultant harvest restrictions to the ocean fisheries caused NP CHS of Rogue River Basin origin to be harvested at lower rates because both groups of fish tend to be caught in the same general area of the ocean. For the purposes of this conservation plan, the harvest rates of NP CHS in the ocean fisheries can be assumed to average about 15% for the foreseeable future.

In contrast to ocean harvest rates, harvest rates in the river fishery increased during the last 30 years (Figure 9). Factors responsible for the increase include increased numbers of anglers, better equipment, and increased season length in the area upstream of Gold Ray Dam (Table 18). In addition, the entire length of the Rogue River, with the exception of some short areas near dams and falls, remains open to fishing and the harvest of CHS.

Table 18. Temporal changes in the fishing seasons for spring chinook salmon in the area upstream of Gold Ray Dam. Regulations listed below apply to only to chinook salmon at least 24 inches in length. Smaller chinook salmon (jacks) could be harvested for later periods of time during some years.

Years	Period of legal harvest
-1964	1 January - 30 June
1965-71	1 January - 04 July
1972-77	1 January - 15 July
1978-06	1 January - 31 July

NP CHS may have been harvested at rates that exceeded optimum in most years during the 1970s and 1980s. Projections of harvest rates at maximum sustainable yield were about 50% for “early-maturing” populations of chinook salmon and were about 40% for “mid-maturing” populations of chinook salmon (Hankin and Healey 1986). Maturation rates estimated by ODFW (2000) indicated that NP CHS in the Rogue SMU can be characterized as being intermediate to “early-maturing” and “mid-maturing” populations as defined by Hankin and Healey (1986). Estimates of total harvest rates averaged 74% for recruits produced in the 1970s, 55% for recruits produced in the 1980s, and 39% for recruits produced in the 1990s (Appendix Table I-2). These estimates indicate that mortality related to fishing was a primary factor that affected population productivity during the 1970s and 1980s, but not necessarily so during the 1990s.

However, there is a chance that fishing was a primary factor that contributed to the current low numbers of early-run CHS. Freshwater fisheries in the Rogue River are highly selective for NP CHS fish that return as age 4-6 adults (ODFW 2000). A selective harvest of chinook salmon in freshwater is not unique to the Rogue River. Anglers (primarily boaters) caught and released an estimated 73% of the early-run chinook salmon in the Kenai River, Alaska (Bendock and Alexandersdottir 1993). Early-run winter steelhead were captured at higher rates by anglers as compared to late-run counterparts in a British Columbia River (Nelson et al. 2005). For the purposes of the following discussion of NP CHS, early-run are defined as those that pass Gold Ray Dam before June, mid-run fish are defined as those that pass Gold Ray Dam during June, and late-run fish are those that pass Gold Ray Dam after June.

Direct estimation of the harvest rates of early-run NP CHS, as compared to later run NP CHS, was not possible with the available information. Some primary assumptions were needed in order to complete estimation of fishery metrics. These assumptions included (1) harvest estimates derived from salmon-steelhead cards ("punchcards") appropriately reflected total harvest within each area of the Rogue River and (2) the probability of harvest in each area was assumed to equal the harvest rate divided by the number of days that fish were exposed to fishing in each area. The residence time of fish in each area of the river was estimated from migration rate estimates reported by ODFW (2000). Results indicated that early-run NP CHS were likely harvested at greater rates as compared to later run counterparts (Table 19). In addition, there is an indication that early-run NP CHS, and possibly mid-run CHS, may be currently harvested at rates that exceed optimum and that mid-run and late-run NP CHS were likely harvested during the 1970s and 1980s at rates that exceeded optimum (Table 19).

Table 19. Total mortality rates of naturally produced spring chinook salmon estimated under three scenarios of harvest rates in the ocean fisheries. These estimates show projected rates of total fishing-related mortality (ocean and freshwater) for early-run, mid-run, and late-run female fish. A total mortality rate estimate of 50% means that half the fish were killed as a result of fishing activity. Estimates were developed based on freshwater fishing regulations in effect during 1978-2003. Significant assumptions were associated with estimation procedures (*see* text).

Harvest rate	Mortality rate for fish type		
in the ocean	early-run[a]	mid-run[b]	late-run[c]
15%	58%	40%	22%
30%	65%	51%	36%
50%	75%	65%	54%

[a] *Applicable to fish that pass Gold Ray Dam on 15 May.*
[b] *Applicable to fish that pass Gold Ray Dam on 15 June.*
[c] *Applicable to fish that pass Gold Ray Dam on 15 July.*

With the possibility that harvest rates on early-run NP CHS may have been excessive, projections of fishing mortality rates were developed under a variety of potential scenarios for the freshwater fisheries. In the absence of necessary information, some primary assumptions had to be made. Assumptions, in addition to those described in the previous paragraph, included: (1) the mortality rate of released CHS is 12% (Lindsay et al. 2004), (2) the probability that released fish are subsequently hooked again in fisheries downstream of Gold Ray Dam is equal to the probability of initial hooking, and (3) the probability that released fish are subsequently hooked again in fisheries upstream of Gold Ray Dam is equal to the probability of initial hooking during every subsequent period of twenty days. The propriety of the latter two assumptions is unknown, except that it seems certain that some released fish would be subsequently hooked again.

If the assumptions associated with the estimation procedures are reasonable, projections indicate that, if generalized regional rules for the freshwater fisheries are to be maintained, that significant changes should be made to one or more of the following components of angling regulations: (1) area open to harvest, (2) opening date of harvest, and (3) closing date of harvest (Table 20). This conclusion is based on the projection that optimal rates of fishing mortality are likely no more than 40%.

Table 20. Total mortality rates estimated for varied scenarios of angling regulations for NP CHS in freshwater. These estimates show projected rates of total fishing mortality (ocean and freshwater) for early-run, mid-run, and late-run female fish. The rate of fishing mortality in the ocean is assumed to be 15%. A total mortality rate estimate of 50% means that half the fish were killed as a result of fishing activity. Estimates were developed based on generalized statewide angling regulations for chinook salmon in freshwater and based on a 31 July closure for hatchery CHS in the area upstream of Gold Ray Dam. Significant assumptions were associated with estimation procedures (*see* text).

Harvest season below Gold Ray Dam	Harvest season above Gold Ray Dam	Mortality rate for fish type		
		early-run[a]	mid-run[b]	late-run[c]
opens 1 Jan.	Jan. - July	58%	40%	22%
opens 1 May	Jan. - July	53%	40%	22%
opens 1 June	Jan. - July	51%	37%	22%
opens 1 July	Jan. - July	50%	36%	22%
opens 1 Jan.	June - July	52%	40%	22%
opens 1 Jan.	Jan. - June	46%	27%	15%
opens 1 Jan.	closed	42%	26%	16%
opens 1 May	closed	34%	26%	16%
opens 1 May	July-Aug. (Dodge-GRD[d] only)	34%	33%	25%
opens 1 June	closed	32%	22%	16%
opens 1 June	July-Aug. (Dodge-GRD[d] only)	32%	30%	25%
opens 1 July	closed	31%	21%	16%

[a] *Applicable to fish that pass Gold Ray Dam on 15 May.*
[b] *Applicable to fish that pass Gold Ray Dam on 15 June.*
[c] *Applicable to fish that pass Gold Ray Dam on 15 July.*
[d] *Dodge Bridge to Gold Ray Dam.*

A number of other regulatory options have the potential to decrease mortality rates of NP CHS that result from freshwater fishing. Included in these options would be changes in harvest limits, allowable types of fishing gear, allowable types of angling methods, and allowable methods of handling those fish that must be released. A variety of possible regulatory changes were considered during development of this plan, and many of those possibilities are listed in **APPENDIX G.**

Implications associated with potential regulation changes related to allowable types of fishing gear, allowable types of angling methods, and allowable methods of handling those fish that must be released, were difficult to evaluate. Interest in these options primarily originated out of concern that, under the current gear and methods employed by anglers, NP CHS are commonly hooked in body locations other than the mouth. Non-mouth hooking most commonly occurs at sites where CHS hold for extended periods and at chokepoints below dams and waterfalls. Implementation of gear and method regulations designed to reduce the probability of non-mouth hooking in the freshwater fisheries could reduce the rates of total fishing mortality, but the degree of reduction could not be estimated.

Implications associated with potential regulation changes related to allowable daily and seasonal limits of NP CHS were also difficult to evaluate. Information on daily and annual harvest could be retrieved from individual salmon-steelhead cards, but it is not possible to separate naturally produced fish from hatchery fish within those records because only a portion of the CHS of hatchery origin exhibited fin clips prior to the 2004 return year. As a result, estimates of angler success rates in the river fisheries could only be developed for three years in the early 1990s.

The estimated number of anglers that fished for CHS in the Rogue River averaged 5,100 people annually during 1991-93 (Olsen et al. 1994). Harvest estimates from salmon-steelhead cards, adjusted for jacks and the differential harvest of naturally produced and hatchery fish, indicated that anglers harvested an average of 2,600 NP CHS annually in the Rogue River during 1991-93. These estimates suggest that success rates averaged 0.50 NP CHS per angler during those years. While some anglers must have harvested multiple fish, there was no way of directly estimating the proportion of anglers that harvested more than one NP CHS. Consequently, some scenarios were developed to assess a potential annual limit of one NP CHS for each angler.

Implications of an annual limit of one NP CHS were assessed by projecting changes in total freshwater harvest under three hypothetical scenarios of fish abundance and four hypothetical scenarios of the distribution of angler success. Additional assumptions included in the assessment were (1) naturally produced fish accounted for one-third (33%) of the CHS that passed Gold Ray Dam, (2) freshwater harvest rates were selective for older fish and for naturally produced fish as estimated by (ODFW 2000), (3) the number of anglers that participated in the freshwater fisheries was 5,000 (Olsen et al. 1994) for a scenario of about 15,000 fish passing Gold Ray Dam, and (4) the number of anglers increased by 25% for each additional 15,000 CHS passing Gold Ray Dam.

Projections that resulted from the assessment varied markedly. However, some general implications of a possible annual limit of one NP CHS seemed to be relevant. First, reductions in freshwater harvest rates were greatest under the scenarios were a small proportion of anglers captured most of the fish (Table 21). Second, the reductions in harvest rates were progressive, in that reductions in harvest rates were greatest when large numbers of CHS returned to freshwater and were lowest when small numbers of CHS returned to freshwater (Table 21). These findings suggest that, even for an annual harvest limit of one NP CHS, additional conservation measures are likely warranted for those years when relatively few naturally produced fish return to freshwater.

Comparisons to Other Populations

The abundance of NP CHS in the Rogue SMU has greatly decreased during the last 20 years. One possible cause might be a regional decrease in the survival rates of juvenile chinook salmon during the period of initial ocean residence. Cyclical patterns in survival rates of regional groups of Pacific salmon are related to changes in current patterns that typify various regions of the ocean (Beamish et al. 2004). Abundance trends among geographically proximal populations should roughly track each other, unless limiting factors differentially affect one or more of the populations (Pyper et al. 2005). Comparisons of abundance trends indicated that NP CHS in the Rogue SMU declined in abundance as compared to (1) the population of NP CHS in the North Umpqua River, (2) the population of NP CHF in the middle and lower portion of the Applegate River (Rogue River Basin), and (3) the population of NP CHF in the Rogue River upstream of Gold Ray Dam.

During the 1940s through the early 1980s, passage estimates of NP CHS at Gold Ray Dam consistently exceeded the passage estimates of counterparts at Winchester Dam on the North Umpqua River (Figure 10). In contrast, after 1990, there were four years when similar numbers of NP CHS passed the counting stations in both rivers (Figure 10). This change indicates that the abundance of NP CHS in the Rogue River decreased as compared to the abundance of NP CHS in the North Umpqua River. A similar differential trend was evident within a comparison of abundance trends NP CHS and NP CHF in the Rogue River Basin.

Table 21. Possible changes in freshwater harvest of naturally produced spring chinook salmon under some hypothetical scenarios of angler success rates and run sizes. Estimates of freshwater harvest under historic (1978-2003) angling regulations are compared to harvest estimates under an annual harvest limit of one NP CHS per angler. Significant assumptions were associated with estimation procedures (*see* text).

	Number harvested			
Distribution of harvest[a]	expected[b]	projected[c]	difference	% change
15,000 CHS (5,000 WILD) AT GOLD RAY DAM				
10% of anglers catch 50% of fish	2,295	1,658	637	28%
30% of anglers catch 50% of fish	2,295	2,295	0	0%
20% of anglers catch 80% of fish	2,295	1,481	814	35%
40% of anglers catch 80% of fish	2,295	2,295	0	0%
30,000 CHS (10,000 WILD) AT GOLD RAY DAM				
10% of anglers catch 50% of fish	4,590	2,934	1,656	36%
30% of anglers catch 50% of fish	4,590	4,211	379	8%
20% of anglers catch 80% of fish	4,590	2,195	2,395	52%
40% of anglers catch 80% of fish	4,590	3,473	1,118	24%
45,000 CHS (15,000 WILD) AT GOLD RAY DAM				
10% of anglers catch 50% of fish	6,885	4,241	2,644	38%
30% of anglers catch 50% of fish	6,885	5,837	1,048	15%
20% of anglers catch 80% of fish	6,885	2,974	3,911	57%
40% of anglers catch 80% of fish	6,885	4,570	2,315	34%

[a] *Assumed scenarios within the freshwater fisheries.*
[b] *Harvest of NP CHS estimated for historic (1978-2003) angling regulations.*
[c] *Harvest of NP CHS estimated for an annual limit of one per angler.*

Numbers of NP CHF, recovered as spawned carcasses in areas near Grants Pass and the city of Rogue River, were consistently lower than the passage estimates of NP CHS during the 1970s through the early 1980s (Figure 11). However, from the late 1990s onward, carcass counts of NP CHF were about equal to, or exceeded, numbers of NP CHS that passed Gold Ray Dam (Figure 11). This change indicates that the abundance of NP CHS in the Rogue River decreased as compared to the abundance of NP CHF that spawned in areas farther downstream. Differences in abundance trends were also evident among NP CHS and NP CHF that returned to areas upstream of Gold Ray Dam.

The number of NP CHS that passed Gold Ray Dam consistently exceeded the number of NP CHF during 1940s through the 1980s (Figure 12). However, during years after 1990, the annual returns for each race of naturally produced fish has been approximately equal (Figure 12). The relative abundance of CHF, among naturally produced chinook salmon that passed Gold Ray Dam, averaged 11% in the 1970s, 21% in the 1980s, 48% in the 1990s, and 62% during 2000-05. These changes indicate that the production of NP CHF increased, while the production of NP CHS decreased, in areas upstream of Gold Ray Dam; habitat that historically was dominated by the production of NP CHS.

The differential decline in the abundance of NP CHS in the Rogue SMU, as compared to other populations of naturally produced chinook salmon, indicates that one or more limiting factors differentially affect the abundance of NP CHS in the Rogue SMU. Decreased abundance of NP CHS, coupled with increases of nearby populations of NP CHS and NP CHF, should lead to serious consideration of those potential limiting factors that have differential affects on both races of naturally produced chinook salmon produced upstream of Gold Ray Dam. Limiting factors that clearly have differential affects on NP CHS, as compared to other populations of naturally produced chinook salmon, include (1) blockage of habitat that resulted from construction of Lost Creek Dam (ODFW 2000), (2) changes in river flow and water temperature that resulted from reservoir operation (ODFW 2000), and (3) harvest rates in the freshwater fisheries (ODFW 1992; ODFW 2000).

POPULATION PRODUCTIVITY

The productivity of salmon populations can be estimated in a variety of ways. For NP CHS in the Rogue SMU, population productivity can be assessed by two methods: (1) recruits per spawner and (2) smolts per spawner. Descriptions of methods to estimate numbers of smolts, recruits, and spawners were previously presented (*see* **Spawning Escapement:**, page 25).

Productivity estimates for NP CHS ranged between 0.1 and 20 recruits per spawner for the 1975-2000 brood years, and averaged 4.3 fish per spawner (Appendix Table I-3). The average rate of recruitment is much greater than the ODFW benchmark of 1.2 fish per spawner, indicating that the NP CHS population in the Rogue River exhibits strong intrinsic productivity (ODFW 2006). Recruitment rates peaked sharply twice during the period of record, once during the mid-1980s and once during the early 1990s (Figure 13). The peak in the mid-1980s followed the strong El Niño event of 1982-83 (ODFW 2000), and each of the sharp peaks in productivity was followed by a sharp decline in population productivity (Figure 13).

The wide range in annual recruitment rates, coupled with sporadic spikes in recruitment rates, makes it difficult to make conclusions in relation to short-term trends in productivity. In addition, productivity estimates for broods produced during recent years are not available. Six years must pass before all recruits can be accounted for, because some NP CHS mature during their sixth year of life. This time lag was also considered to be a primary drawback during an attempt to formulate a relevant element to include in the desired status statement.

Productivity estimates based on the number of naturally produced smolts tracked closely with productivity estimates based on the number of recruits (Figure 13). Estimates of the number of smolts produced per spawner ranged between about 20 and 700 smolts, with an average production rate of about 150 smolts per spawner for the period (Appendix Table I-3).

PERSISTENCE OF THE SPECIES MANAGEMENT UNIT

As outlined in the Native Fish Conservation Policy, this plan should forecast the likelihood of SMU persistence in the near and long terms. The relationship between recruits and spawners was used to assess persistence potential (viability) of NP CHS in the Rogue SMU. A modification of the Ricker stock-recruitment relationship was employed for this purpose. Modifications included removal of the descending limb of the curve at high spawner abundance and the addition of a model variable to better account for recruitment in successive years (Mark Chilcote, ODFW, personal communication). Extinction was assumed to be an average escapement of less than 300 fish over a successive period of four years. The recruitment model was run 2,500 times for a simulation period of 100 years. The model assumes that recruitment rates of hatchery fish were one-half those of NP CHS. However, the viability model assumes that no hatchery fish would spawn in the wild, and thus would not contribute to recruitment.

Results from the simulation models runs suggested that fishery harvest rates as great as 50% did not cause a detectable increase in the risk of SMU extinction risk (Figure 14). At a harvest rate of about 60%, the probability of extinction exceeded 5% (Figure 14). A 5% chance of extinction, over a 100 year period of time, is generally employed as a threshold value within conservation assessments. These projections from the simulations suggest that NP CHS in the Rogue SMU are a fairly robust population and that the population may be able to sustain fishery impact rates as high as 50%.

However, there is significant error around these estimates due to the poor fit of the stock recruitment relationships, which limited the ability to draw strong conclusions from these analyses. The extent of this uncertainty may be pronounced. Preliminary results from a more recent analysis, that used updated methodology to address this uncertainty problem, suggested that impact rates in excess of 20% are probably too high during periods of poor marine survival. Continued refinement of the methods to assess persistent, along with the underlying data will be an emphasis of future research, monitoring and evaluation. These results reflect the importance of implementing specific measures under adaptive management should SMU status reach conservation criteria identified in this plan (*see* **CRITERIA INDICATING DETERIORATION IN STATUS**, page 44).

ALTERNATIVE MANAGEMENT STRATEGIES

The Native Fish Conservation Policy requires that conservation plans shall illustrate a range of options for recovery strategies, fisheries and the responsible use of hatchery produced fish. Accordingly, a primary goal of the planning process was to develop alternatives that (1) if implemented, would have a reasonable chance for attainment of desired status for NP CHS in the Rogue SMU (*see* **DESIRED BIOLOGICAL STATUS**, page 13) and (2) would encompass a broad range of potential management strategies. A formidable number of potential management strategies were considered during the planning process. Each potential management strategy was categorically linked to those factors that limit, or could limit, attainment for each element of desired status (**APPENDIX F** and **APPENDIX G**). Potential limiting factors and potential management strategies were also assigned alphanumeric codes in order to aid in cross-referencing singular management strategies embedded within the various alternatives.

This approach resulted in the development of nine alternative suites of management strategies (Table 22). Probability of attainment of desired status varies considerably among the various alternatives, yet no objective means of ranking suite efficacy could be developed. As a result, strategy suites are presented in sequential order, without any implications in relation to a ranking of expected outcome.

All nine alternatives were considered by each of the advisory committees. The two alternatives which received some support from members of the public advisory committee are discussed below.

Alternative 8

This alternative was preferred by five advisory committee members who represented the public. The alternative incorporates various elements of input received from the entire advisory committee and from ODFW during the course of plan development. Primary features of the alternative include (1) design reservoir management strategies with an emphasis on the protection and enhancement of NP CHS, (2) expand natural spawning habitat for NP CHS, (3) increase the production of NP CHS by the transportation of adult CHS into areas currently not accessible to natural spawners, (4) establish predator

Table 22. Summary of the primary features that compose the nine alternative suites of management strategies developed during the planning process. Early-run spring chinook salmon pass Gold Ray Dam before June, mid-run spring chinook salmon pass Gold Ray Dam during June, and late-run spring chinook salmon pass Gold Ray Dam after June.

Alternative 1

a. Limit NP CHS to current habitat
b. Reservoir management recommendations designed solely for NP CHS
c. Terminate freshwater harvest of NP CHS

Alternative 2

a. Limit NP CHS to current habitat
b. Reservoir management strategies designed for emphasis on NP CHS
c. Terminate freshwater harvest of NP CHS

Alternative 3

a. Expand natural spawning habitat for NP CHS
b. Reservoir management strategies designed for emphasis on NP CHS
c. Freshwater harvest opportunity for late-run NP CHS

Alternative 4

a. Establish juvenile production in areas not accessible to adult CHS
b. Reservoir management strategies designed for emphasis on NP CHS
c. Freshwater harvest opportunity for mid-run and late-run NP CHS

Alternative 5

a. Expand natural spawning habitat for NP CHS
b. Establish juvenile production in areas not accessible to adult CHS
c. Reservoir management strategies designed for emphasis on NP CHS
d. Freshwater harvest opportunity for mid-run and late-run NP CHS

Alternative 6

a. Expand natural spawning habitat for NP CHS
b. Reservoir management strategies designed for emphasis on NP CHS
c. Establish freshwater sanctuary area (no fishing) for early-run NP CHS

Alternative 7

a. Expand natural spawning habitat for NP CHS
b. Reservoir management strategies designed for emphasis on NP CHS
c. Specialized regulations for freshwater CHS fisheries

Alternative 8

a. Expand natural spawning habitat for NP CHS
b. Establish juvenile production in areas not accessible to adult CHS
c. Reservoir management strategies designed for emphasis on NP CHS
d. Specialized regulations for freshwater CHS fisheries
e. Increased control of predators

Alternative 9

a. Expand natural spawning habitat for NP CHS
b. Reservoir management strategies designed for emphasis on NP CHS
c. Regional regulations for freshwater CHS fisheries
d. Adjust production goals at Cole M. Rivers Hatchery

control measures, (5) establish harvest regulations designed to limit the harvest to no more than three NP CHS for each angler, (6) establish a no-harvest zone for NP CHS, and (7) minimize the risk of genetic changes among naturally produced fish.

There is a reasonable chance that adoption of this alternative will result in the attainment of desired status, although efficacy is difficult to assess because expected harvest rates in the freshwater fisheries cannot be projected. Increased production of juvenile NP CHS in non-historic habitat is likely to increase returns of naturally produced adult fish, provided that transported adults survive at high rates. Assuming a sufficient number of transported adults survive through spawning, the increase in the production of NP CHS should compensate for continued selective harvest of early-run and mid-run NP CHS in the freshwater fisheries (*see* **Direct Impacts by Humans**, page 28).

Management Strategy 8.1. Implement actions designed to ensure that Lost Creek Lake is managed to maintain a viable population of naturally produced spring chinook salmon that exhibits, as much as possible, historic life history characteristics. Continue actions designed to protect habitat in the Rogue River downstream of Lost Creek Lake. The intent of this strategy is to maintain and enhance quantity and quality of habitat available to naturally produced spring chinook salmon that spawn in the Rogue River Basin.

Assumptions and Rationale

1. As outlined by the Congress of the United States of America, enhancement of fishery resources in downstream areas is a primary authorized purpose by which Lost Creek Lake should be managed.
2. As outlined by the Congress of the United States of America, fishery enhancement, irrigation supply, and municipal and industrial supply are primary authorized purposes of equal priority, and are of subservient priority only during those operations designed to prevent flooding in downstream areas.
3. Findings that resulted from a long-term fishery research project (ODFW 2000), funded by the USACE, provide reliable estimates of the impacts of reservoir operations on NP CHS produced in areas downstream of Lost Creek Lake.
4. Implementation of recommendations for reservoir management strategies at Lost Creek Lake, presented by ODFW (2000), are advisable methods to protect and enhance NP CHS produced in downstream areas.
5. Reservoir management strategies will continue to be refined as additional information becomes available.
6. The water control manual for Lost Creek Lake can be revised to incorporate measures designed to ensure that operational decisions recognize downstream needs of fishery resources as a primary authorized project purpose.
7. The USACE has the authority to manage Lost Creek Lake at elevations below the maximum elevations outlined by the United States Congress.
8. Quality of riparian zones along the Rogue River will continue to decline as human population numbers increase in the general area.
9. Gravel quality and quantity will decrease in areas downstream of Lost Creek Lake as a result of gravel being trapped at the upstream end of the reservoir.

Actions

Action 1.1. Request that Lost Creek Lake be managed to further reduce the intensity of peak flows during the period eggs and sac-fry incubate in the gravel.
Action 1.2. Request that Lost Creek Lake be managed to release the coldest water possible during egg and sac-fry incubation.
Action 1.3. Request development of simulation models for water temperature in order to determine release strategies that result in optimal strategies for reservoir management under a variety of water years.
Action 1.4. Request that the USACE investigate the means to bypass reservoir inflow around or through Lost Creek Lake.
Action 1.5. Request that Lost Creek Lake be managed to ensure minimal flow augmentation during the spawning period.
Action 1.6. Request implementation of procedures designed to minimize the potential dewatering of juveniles in areas downstream of Lost Creek Lake.

Action 1.7. Request that Lost Creek Lake be managed to minimize passage of CHF upstream of Gold Ray Dam.
Action 1.8. Request that Lost Creek Lake be managed to minimize potential for disease outbreaks in areas downstream of Lost Creek Lake.
Action 1.9. Monitor reservoir releases and if warranted, recommend adjustments to the USACE.
Action 1.10. Develop recommendations for reservoir release strategies on a seasonal and annual basis, and submit those recommendations to the USACE through the Oregon Department of Water Resources.
Action 1.11. Request an update of the water control manual for Lost Creek Lake, and support USACE efforts to incorporate those revisions designed to protect and enhance fishery resources in downstream areas.
Action 1.12. Continue to evaluate reservoir management strategies.
Action 1.13. Request that USACE employees, who work on reservoir management issues for Lost Creek Lake, be oriented on relevant fishery issues.
Action 1.14. Provide technical assistance, as requested by the USACE, on reservoir management issues for Lost Creek Lake.
Action 1.15. Continue to support improvements of fish passage facilities.
Action 1.16. Continue to comment on permit applications that have the potential to affect habitat quality and quantity.
Action 1.17. Develop a program designed to inform landowners about measures that help protect aquatic habitat.
Action 1.18. Request USACE restoration and maintenance of NP CHS spawning habitat in the area between Lost Creek Lake and Shady Cove.

Management Strategy 8.2. Establish the production of naturally produced spring chinook salmon in tributaries of the Rogue River. Obtain water rights to ensure the development of at least one self-sustaining run of naturally produced spring chinook salmon. Until water rights can be obtained, supplement the production of naturally produced fish by the release of adult spring chinook salmon in non-historic habitat that is not currently accessible to spawners. The intent of this strategy is to increase the amount of habitat available for the production of naturally produced spring chinook salmon.

Assumptions and Rationale

1. Advantages associated with the establishment of adult CHS in non-historic habitat outweigh the disadvantages of possible detrimental impacts on native species of fish.
2. Life history characteristics of fish produced within expanded habitat in tributary streams will be similar to those exhibited by fish produced in nearby areas of the Rogue River before construction of Lost Creek Dam.
3. Improved upstream passage in Big Butte Creek will significantly increase the production of NP CHS.
4. Dedicated water allocations can be obtained for either stored water or natural flows in the Big Butte Creek and Little Butte Creek basins as a result of a coordinated effort among the affected entities.
5. The production of juvenile NP CHS can be significantly increased by transporting adults to spawning areas currently not available to CHS.

Actions

Action 2.1. Obtain additional water allocations that would be dedicated to the increase of flow in Big Butte Creek during 15 September through 15 October.
Action 2.2. Support efforts to identify additional water allocations that would be dedicated to the increase of flow in Little Butte Creek during 15 September through 15 October.
Action 2.3. Support efforts to develop water projects that would provide for the storage of a volume of water sufficient to establish runs of NP CHS in Big Butte Creek and Little Butte Creek.
Action 2.4. Improve upstream passage for adult CHS at partial natural barriers and irrigation diversions to maximize spawning distribution in Big Butte Creek.
Action 2.5. Identify the potential to improve spawning habitat CHS in Big Butte Creek.

Action 2.6. If warranted, based on findings from Action 2.5, improve spawning habitat in Big Butte Creek.
Action 2.7. Identify optimal areas for the transportation and release of adult CHS in tributary streams of the Rogue River.
Action 2.8. Develop procedures for the transportation and release of adult CHS in tributary streams of the Rogue River.
Action 2.9. Transport and release adult CHS to spawn in areas of tributary streams not accessible to naturally migrating adults.

Management Strategy 8.3. Decrease rates of predation on naturally produced spring chinook salmon. The intent of this strategy is to increase the survival rate of naturally produced spring chinook salmon.

Assumptions and Rationale
1. Any reductions in introduced (non-native) predatory fishes are advantageous for native fishes.
2. The state of Oregon is able to obtain, from the federal government, the authority to limit cormorant numbers.

Actions
Action 3.1. Develop a program designed to encourage fishing related mortality for non-native Umpqua pikeminnows.
Action 3.2. Initiate a program designed to decrease numbers of comorants residing along the Rogue River.
Action 3.3. Request that NOAA Fisheries evaluate the effects of marine mammals on NP CHS in the Rogue River.
Action 3.4. Transport and release juvenile steelhead and coho salmon of hatchery origin downstream of Gold Ray Dam.

Management Strategy 8.4. Manage fisheries to sustain productivity for all segments of the population of naturally produced spring chinook salmon, with a secondary objective of affording anglers the opportunity to annually harvest three naturally produced spring chinook salmon. The intent of this strategy is to ensure sustainability of the historic life history characteristics of naturally produced spring chinook salmon, while maintaining harvest opportunities for all types of naturally produced spring chinook salmon.

Assumptions and Rationale
1. NP CHS mature at rates comparable to those estimated by ODFW (2000).
2. Ocean and river fisheries harvest CHS in an age-selective manner, and ODFW (2000) estimates of age-selective harvest rates are of reasonable accuracy.
3. River fisheries selectively intercept early-run CHS as compared to late-run counterparts (ODFW 2000), and that estimates of freshwater fishing mortality reported in this plan are of reasonable accuracy.
4. Spawning escapement goals and harvest rate goals established for CHF in the Klamath River Basin will remain unchanged over the lifetime of this plan.
5. Ocean distribution patterns of CHS and CHF of Klamath River Basin origin will not differentially change over the lifetime of this plan.
6. Future rates of ocean harvest will be about 15-20% for completed broods of NP CHS.
7. Harvest opportunities in the freshwater fisheries should be expanded when quantitative predictions indicate that more than 15,000 NP CHS can be expected to pass Gold Ray Dam.
9. In terms of pre-season expectations, expansion of harvest seasons is preferable as compared to reductions of harvest seasons.
10. Implementation of an annual harvest limit of three NP CHS, coupled with specific gear and method regulations, will keep freshwater harvest rates within appropriate levels for all segments of the population.
11. Survival rates of NP CHS released by anglers can be significantly increased through a combination of gear regulations, method regulations, increased enforcement, and increased angler knowledge of appropriate handling procedures.
12. Hatchery production will be consistent with the Fish Hatchery Management Policy of ODFW.

13. Reductions in the proportion of hatchery fish among natural spawners decrease the risk of genetic impacts on NP CHS.

Actions

Action 4.1. Establish regulations that allow individual anglers to annually harvest a maximum of three NP CHS in the area downstream of the Highway 62 bridge in Shady Cove (*see* **Alternative 8** in **APPENDIX H** for specific regulations). The area upstream of the Highway 62 bridge in Shady Cove would be closed to the harvest of NP CHS.
Action 4.2. Expand harvest opportunities for NP CHS in the Rogue River when returns to Gold Ray Dam are predicted to exceed 15,000 fish.
Action 4.3. Request increased enforcement of regulations established for freshwater fisheries that target CHS.
Action 4.4. Promote ethical angling and proper techniques for catch and release of NP CHS.
Action 4.5. Revise spawning practices at Cole M. Rivers Hatchery to increase harvest rates on CHS of hatchery origin.

Management Strategy 8.5. Manage spring chinook salmon of hatchery origin so as to minimize the risk of genetic changes among naturally produced fish and to maintain the genetic integrity, and life history characteristics, of that portion of the natural population that historically spawned in upstream areas prior to the construction of Lost Creek Dam. The intent of this strategy is to maintain the genetic integrity of naturally produced spring chinook salmon.

Assumptions and Rationale

1. Reductions in the proportion of hatchery fish among natural spawners decreases the risk of genetic impacts on NP CHS.
2. Methods developed to estimate the proportion of hatchery fish among CHS spawners are of reasonable accuracy.
3. Projections under revised regulations for freshwater fisheries indicate that the spawner composition will average about 10% hatchery fish annually.
4. Brood stock selection of CHS at Cole M. Rivers Hatchery should continue to reflect the life history characteristics of that portion of the NP CHS population that spawned in upstream areas prior to the construction of Lost Creek Dam.
5. Changes in brood stock composition at Cole M. Rivers Hatchery are warranted to compensate for the selective harvest of older CHS.

Actions

Action 5.1. Block adult CHS at the primary outflow from Cole M. Rivers Hatchery to increase the proportion of hatchery CHS that enter the collection facility at the hatchery.
Action 5.2. Revise spawning practices at Cole M. Rivers Hatchery so that maturity rates of hatchery CHS are similar to that portion of the natural population that historically spawned upstream of Lost Creek Dam.
Action 5.3. Develop a hatchery program management plan for Cole M. Rivers Hatchery.

Alternative 9

This alternative was preferred by three members of the public advisory committee, five members of the technical advisory committee, and by ODFW. The alternative incorporates various elements of input received from the entire advisory committee during the course of plan development. Primary features of the alternative include (1) design reservoir management strategies with an emphasis on the protection and enhancement of NP CHS, (2) expand natural spawning habitat for NP CHS, (3) limit harvest of early-run and mid-run NP CHS while providing freshwater harvest opportunities for NP late-run CHS, (4) establish a no-harvest zone for NP CHS, (5) minimize complexity of angling regulations, and (6) increase production goals at Cole M. Rivers

Hatchery to meet the intent of mitigation goals and to offset reduced harvest opportunities for early-run and mid-run NP CHS.

There is a reasonable chance that adoption of this alternative will result in the attainment of desired status. Reductions in freshwater harvest rates of early-run and mid-run NP CHS are likely to lead to total (ocean + freshwater) harvest rates that should rarely exceed 40% for completed broods (*see* **Direct Impacts by Humans**, page 28). In addition, strategies designed for the freshwater fisheries are likely to decrease the selective harvest of early-run fish as compared to late-run fish (*see* **Direct Impacts by Humans**, page 28).

Management Strategy 9.1. Implement actions designed to ensure that Lost Creek Lake is managed to maintain a viable population of naturally produced spring chinook salmon that exhibits, as much as possible, historic life history characteristics. Continue actions designed to protect habitat in the Rogue River downstream of Lost Creek Lake. The intent of this strategy is to maintain and enhance quantity and quality of habitat available to naturally produced spring chinook salmon that spawn in the Rogue River Basin.

Assumptions and Rationale

1. As outlined by the Congress of the United States of America, enhancement of fishery resources in downstream areas is a primary authorized purpose by which Lost Creek Lake should be managed.
2. As outlined by the Congress of the United States of America, fishery enhancement, irrigation supply, and municipal and industrial supply are primary authorized purposes of equal priority, and are of subservient priority only during those operations designed to prevent flooding in downstream areas.
3. Findings that resulted from a long-term fishery research project (ODFW 2000), funded by the USACE, provide reliable estimates of the impacts of reservoir operations on NP CHS produced in areas downstream of Lost Creek Lake.
4. Implementation of recommendations for reservoir management strategies at Lost Creek Lake, presented by ODFW (2000), are advisable methods to protect and enhance NP CHS produced in downstream areas.
5. Reservoir management strategies will continue to be refined as additional information becomes available.
6. The water control manual for Lost Creek Lake can be revised to incorporate measures designed to ensure that operational decisions recognize downstream needs of fishery resources as a primary authorized project purpose.
7. The USACE has the authority to manage Lost Creek Lake at elevations below the maximum elevations outlined by the United States Congress.
8. Quality of riparian zones along the Rogue River will continue to decline as human population numbers increase in the general area.
9. Gravel quality and quantity will decrease in areas downstream of Lost Creek Lake as a result of gravel being trapped at the upstream end of the reservoir.

Actions

Action 1.1. Request that Lost Creek Lake be managed to further reduce the intensity of peak flows during the period eggs and sac-fry incubate in the gravel.
Action 1.2. Request that Lost Creek Lake be managed to release the coldest water possible during egg and sac-fry incubation.
Action 1.3. Request development of simulation models for water temperature in order to determine release strategies that result in optimal strategies for reservoir management under a variety of water years.
Action 1.4. Request that Lost Creek Lake be managed to ensure minimal flow augmentation during the spawning period.
Action 1.5. Request implementation of procedures designed to minimize the potential dewatering of juveniles in areas downstream of Lost Creek Lake.
Action 1.6. Request that Lost Creek Lake be managed to minimize passage of CHF upstream of Gold Ray Dam.

Action 1.7. Request that Lost Creek Lake be managed to minimize potential for disease outbreaks in areas downstream of Lost Creek Lake.
Action 1.8. Monitor reservoir releases and if warranted, recommend adjustments to the USACE.
Action 1.9. Develop recommendations for reservoir release strategies on a seasonal and annual basis, and submit those recommendations to the USACE through the Oregon Department of Water Resources.
Action 1.10. Request an update of the water control manual for Lost Creek Lake, and support USACE efforts to incorporate those revisions designed to protect and enhance fishery resources in downstream areas.
Action 1.11. Continue to evaluate reservoir management strategies.
Action 1.12. Request that USACE employees, who work on reservoir management issues for Lost Creek Lake, be oriented on relevant fishery issues.
Action 1.13. Provide technical assistance, as requested by the USACE, on reservoir management issues for Lost Creek Lake.
Action 1.14. Continue to support improvements of fish passage facilities.
Action 1.15. Continue to comment on permit applications that have the potential to affect habitat quality and quantity.
Action 1.16. Develop a program designed to inform landowners about measures that help protect aquatic habitat.
Action 1.17. Request USACE restoration and maintenance of NP CHS spawning habitat in the area between Lost Creek Lake and Shady Cove.

Management Strategy 9.2. Enhance the production of naturally produced spring chinook salmon in Big Butte Creek. The intent of this strategy is to increase the amount of habitat available for the production of naturally produced spring chinook salmon.

Assumptions and Rationale
1. Improved upstream passage in Big Butte Creek will significantly increase the production of NP CHS.
2. Life history characteristics of fish produced within expanded habitat in Big Butte Creek will be similar to those exhibited by fish produced in nearby areas of the Rogue River before construction of Lost Creek Dam.

Actions
Action 2.1. Improve upstream passage for adult CHS at a partial natural barrier in lower Big Butte Creek.
Action 2.2. Obtain additional water allocations that would be dedicated to the increase of flow in Big Butte Creek during 15 September through 15 October.
Action 2.3. Identify the potential to improve spawning habitat for CHS in Big Butte Creek.
Action 2.4. If warranted, based on findings from Action 2.3, improve spawning habitat in Big Butte Creek.

Management Strategy 9.3. Decrease rates of predation on naturally produced spring chinook salmon. The intent of this strategy is to increase the survival rate of naturally produced spring chinook salmon.

Assumptions and Rationale
1. Any reductions in introduced (non-native) predatory fishes are advantageous for native fishes.

Actions
Action 3.1. Develop a program designed to encourage fishing related mortality for non-native Umpqua pikeminnows.

Management Strategy 9.4. Manage fisheries to sustain productivity for all segments of the population of naturally produced spring chinook salmon, with a secondary objective of increasing harvest opportunities for hatchery fish produced to mitigate for blocked habitat. The intent of this strategy is to

ensure sustainability of the historic life history characteristics of naturally produced spring chinook salmon while maximizing freshwater harvest opportunities for spring chinook salmon of hatchery origin.

Assumptions and Rationale

1. NP CHS mature at rates comparable to those estimated by ODFW (2000).
2. Ocean and river fisheries harvest CHS in an age-selective manner, and ODFW (2000) estimates of age-selective harvest rates are of reasonable accuracy.
3. River fisheries selectively intercept early-run CHS as compared to late-run counterparts (ODFW 2000), and that estimates of freshwater fishing mortality reported in this plan are of reasonable accuracy.
4. Spawning escapement goals and harvest rate goals established for CHF in the Klamath River Basin will remain unchanged over the lifetime of this plan.
5. Ocean distribution patterns of CHS and CHF of Klamath River Basin origin will not differentially change over the lifetime of this plan.
6. Future rates of ocean harvest will be about 15-20% for completed broods of NP CHS.
7. Methods developed to estimate the proportion of hatchery fish among spawners are of reasonable accuracy.
8. Harvest opportunities in the freshwater fisheries should be expanded when quantitative predictions indicate that more than 15,000 NP CHS can be expected to pass Gold Ray Dam.
9. In terms of pre-season expectations, expansion of harvest seasons is preferable as compared to reductions of harvest seasons.
10. It is in the public interest to minimize the complexity of regulations for freshwater fisheries.
11. Survival rates of NP CHS released by anglers can be significantly increased through a combination of increased enforcement and increased angler knowledge of appropriate handling procedures.
12. CHS of hatchery origin originated from naturally produced fish that volitionally swam into Cole M. Rivers Hatchery during the 1970s and exhibit, to some degree, life history characteristics that reflect that portion of the run that was blocked by construction of Lost Creek Dam (ODFW 2000).
13. The loss of harvest opportunities for NP CHS, that resulted from construction of Lost Creek Dam, was to be mitigated by comparable harvest opportunities for hatchery fish.
14. Mitigation goals, as assessed by commercial and recreational harvest, have not been attained because of constraints to ocean fisheries and the tendency of hatchery fish to leave the Rogue River and enter Cole M. Rivers Hatchery rather than remain in the river during ongoing fisheries (ODFW 2000).
15. Among hatchery fish, CHS are harvested at greater rates than coho salmon (ODFW 1991; ODFW 2000).
16. Hatchery production will be consistent with the Fish Hatchery Management Policy of ODFW.
17. Reductions in the proportion of hatchery fish among natural spawners decrease the risk of genetic impacts on NP CHS.
18. About 90% of the early-run and mid-run NP CHS spawn upstream of Dodge Bridge.

Actions

Action 4.1. Employ regional (zone) regulations that allow for the harvest of naturally produced chinook salmon to begin on 1 June downstream of Gold Ray Dam, and that allow for the harvest of naturally produced chinook salmon during July and August in the area between Gold Ray Dam and Dodge Bridge. The area upstream of Dodge Bridge would be closed to the harvest of NP CHS.

Action 4.2. Expand harvest opportunities for NP CHS in freshwater when returns to Gold Ray Dam are predicted to exceed 15,000 fish.

Action 4.3. Support only those special regulations for freshwater fisheries that are critical to conservation needs for CHS.

Action 4.4. Request increased enforcement of regulations established for freshwater fisheries that target CHS.

Action 4.5. Promote ethical angling and proper techniques for catch and release of NP CHS.
Action 4.6. Revise spawning practices at Cole M. Rivers Hatchery to increase harvest rates on CHS of hatchery origin.
Action 4.7. Replace the production of coho salmon at Cole M. Rivers Hatchery, not needed for monitoring and evaluation purposes, with the production of CHS. Production change will begin with the 2009 brood year and will be initiated only if hatchery fish compose less than 20% of the CHS that spawn naturally between Cole M. Rivers Hatchery and Rogue Elk Park.

Management Strategy 9.5. Manage spring chinook salmon of hatchery origin so as to minimize the risk of genetic changes among naturally produced fish and to maintain the genetic integrity, and life history characteristics, of that portion of the natural population that historically spawned in upstream areas prior to the construction of Lost Creek Dam. The intent of this strategy is to maintain the genetic integrity of naturally produced spring chinook salmon.

Assumptions and Rationale
1. Reductions in the proportion of hatchery fish among natural spawners decreases the risk of genetic impacts on NP CHS.
2. Methods developed to estimate the proportion of hatchery fish among CHS spawners are of reasonable accuracy.
3. Projections under revised regulations for freshwater fisheries indicate that the spawner composition will average about 10% hatchery fish annually.
4. Brood stock selection of CHS at Cole M. Rivers Hatchery should continue to reflect the life history characteristics of that portion of the NP CHS population that spawned in upstream areas prior to the construction of Lost Creek Dam.
5. Changes in brood stock composition at Cole M. Rivers Hatchery are warranted to compensate for the selective harvest of older CHS.

Actions
Action 5.1. Block adult CHS at the primary outflow from Cole M. Rivers Hatchery to increase the proportion of hatchery CHS that enter the collection facility at the hatchery.
Action 5.2. Revise spawning practices at Cole M. Rivers Hatchery so that maturity rates of hatchery CHS are similar to that portion of the natural population that historically spawned upstream of Lost Creek Dam.
Action 5.3. In the event that hatchery fish compose more than 25% of the CHS that spawn between Cole M. Rivers Hatchery and Rogue Elk Park, employ additional measures to reduce the proportion of hatchery fish among natural spawners.
Action 5.4. Develop a hatchery program management plan for Cole M. Rivers Hatchery.

CRITERIA INDICATING DETERIORATION IN STATUS

As outlined in the Native Fish Conservation Policy, measurable criteria are needed as indicators of a significant deterioration in SMU status. Reaching conservation criteria would trigger a modification to management strategies that are adopted in this conservation plan (*see* **ALTERNATIVE MANAGEMENT STRATEGIES**, page 35). Revised strategies would be crafted to begin or to expand recovery actions, and could take a variety of forms depending upon (1) which criteria were reached and (2) the degree of deterioration in status.

A number of potential criteria were considered as potential indicators of status deterioration of NP CHS in the Rogue SMU. Of primary importance was the identification of conservation criteria that would ensure maintenance of genetic diversity, population productivity, and historic life history characteristics. Development of criteria related to elements included in the desired status statement (*see* **DESIRED BIOLOGICAL STATUS**, page 13) was advantageous because these attributes were already identified as primary indicators of SMU status. In addition, consideration was given to the length of time that provided an effective period by which to judge whether significant deterioration may have occurred. The statement of conservation status, outlined in Table 23, represents a final product that was preferred by all members (four) of the public advisory committee who expressed their preference on the matter, four of the five members of the technical advisory committee, and by ODFW.

Table 23. Conservation criteria indicative of a significant deterioration in the status of naturally produced spring chinook salmon in the Rogue SMU.

1. Passage of naturally produced spring chinook salmon at Gold Ray Dam is less than 3,500 fish during any single year or averages less than 5,000 fish during any three year period.

2. Less than 30% of the "adult" naturally produced spring chinook salmon pass Gold Ray Dam by 15 June. This goal represents a running average over a period of three years. Adults are defined as fish greater than 24 inches in length as compared to smaller fish (jacks).

3. Jacks smaller than 24 inches compose more than 25% of the naturally produced spring chinook salmon that pass Gold Ray Dam. This goal represents a running average over a period of three years.

4. Among naturally produced spring chinook salmon that spawn during September, less than 30% spawn upstream of the Highway 62 bridge in Shady Cove. This goal represents a running average over a period of three years.

5. Hatchery fish compose more than 25% of naturally spawning spring chinook salmon. This goal represents a running average over a period of two years.

Identification of the conservation criterion for fish abundance is considered to be of primary importance. The criterion outlined in Table 23 was chosen after review of the relationships between the abundance of parents and the abundance of progeny, for those years of relatively low spawning escapements. As previously described, three methods were developed to assess the relationship between parents and progeny (*see* **Spawning Escapement:**, page 25). These relationships, for those years when less than 16,000 "adult" CHS spawned naturally, are shown in Figure 15.

As described in the Native Fish Conservation Policy, realization of any criteria outlined in Table 23 could trigger a modification of management strategies implemented as part of this conservation plan for CHS in the Rogue SMU. Modification of strategies should be dependent on which conservation criteria were realized, the current status of the SMU, and the projected status of the SMU during subsequent years. Adaptive management will be employed by ODFW as a means to identify and implement revisions to management strategies (*see* **Status Review**, page 48). Revised strategies may be refined to improve performance, or some strategies may be terminated and be replaced by management strategies that are determined to be more effective. Some strategies that were previously identified, but not adopted as part of this plan, may be employed under a scenario of significant deterioration of SMU status. Examples include, but are not limited to, increased emphasis on CHS during ODFW planning of reservoir release strategies (as was done in 2001), use of hatchery fish to temporarily supplement the production of NP CHS, and additional harvest reductions in freshwater (as was done in 2006) and in the area of the ocean that falls under the jurisdiction of the state of Oregon.

MONITORING, EVALUATION, AND RESEARCH NEEDS

Efficacy of resource management plans can only be determined if objective measures are developed by which to track and evaluate progress towards attainment of plan goals. Tracking of progress can be accomplished through the development of methods to monitor those SMU attributes relevant to critical components of the plan. As new information becomes available, updated evaluations can better identify (or quantify) the relationships between limiting factors and management strategies employed by the plan. For those management strategies that are critical to plan execution, and that have substantial uncertainty, research projects will be needed to test the assumptions associated with adoption and implementation of specific management strategies. To complete the efforts outlined in the remainder of this section, ODFW will need additional staff, or will need to restructure the priorities of current staff, or will need to arrange for help from other entities.

Monitoring Needs

Specific monitoring of CHS must be conducted annually in order to determine SMU status in relation to the desired status statement and the conservation status statement embedded in this plan. Estimates relevant to these annual monitoring needs include:

1. Number of NP CHS that pass Gold Ray Dam.
2. Migration timing of NP CHS that pass Gold Ray Dam.
3. Percent jacks among NP CHS that pass Gold Ray Dam.
4. Percentage of NP CHS that spawn upstream of Shady Cove during September.
5. Percent hatchery fish among CHS that spawn naturally.
6. Percent hatchery fish among CHS that spawn naturally between Cole M. Rivers Hatchery and Rogue Elk Park.

Evaluation Needs

In contrast to monitoring needs, evaluation needs vary greatly in relation to immediacy of need, frequency of need, and duration of need. However, as with the proposed monitoring, the following evaluations must be conducted in order to assess the efficacy of the management strategies adopted as part of this conservation plan. Evaluation needs are outlined below, and are ranked in an approximate order of priority:

1. Evaluate the efficacy of ODFW recommendations for the release of reservoir storage from Lost Creek Lake during years of low water yield. Surveys need to be conducted during years of low flow to identify optimal use of the limited volume of reservoir storage allocated for fishery purposes. Availability of reservoir storage utilized for fishery purposes in downstream areas will decrease through time, as additional reservoir storage is purchased for consumptive uses.
2. Evaluate efficacy of management strategies adopted within this conservation plan. Recruitment estimates provide one measure by which to index population status. As recruitment estimates from any singular brood year are difficult to interpret, and as estimates of harvest in the ocean and freshwater fisheries takes significant effort, this type of evaluation should be conducted only every 3-5 years.
3. Evaluate the efficacy of ODFW recommendations for ramping rates (rates of flow decreases) at Lost Creek Lake. Surveys, during periods when river flow decreases quickly, need to be conducted in order to identify optimal recommendations that will minimize stranding rates of juvenile NP CHS.
4. Evaluate the handling mortality of any NP CHS collected for brood stock at any site other than Cole M. Rivers Hatchery, or are transported in order to increase the number of NP CHS that spawn naturally.

5. Evaluate the feasibility of adjusting catch area designations on salmon-steelhead cards. Depending on the strategies employed for the management of freshwater fisheries, some adjustments appear warranted in order to improve estimates of the spatial and temporal harvest of NP CHS and CHS of hatchery origin.

Research Needs

Research needs were identified as discrete projects designed to directly assess the efficacy of the key management strategies adopted as part of this conservation plan. As the most important management strategies will be investigated, it is imperative that estimates of uncertainty (or certainty) be developed as part of each proposed project. Estimation of uncertainty will significantly increase the amount of effort needed to complete each of the proposed research projects. As a result, research projects will only be conducted if the appropriate amount of funding can be obtained. A unified project has been designed to address three of the research needs described below as bullet numbers 3, 4, 5. Proposed needs are not listed in order of priority, as each need is of critical importance:

1. Develop methods to quantitatively predict the number of NP CHS expected to return to freshwater. Pre-season predictions of run size will afford fishery managers the means to (1) expand harvest opportunities when more than 15,000 NP CHS are predicted to pass Gold Ray Dam (*see* **DESIRED BIOLOGICAL STATUS**, page 13) or (2) constrain harvest opportunities when predictions indicate that conservation criteria are likely to be reached (*see* **CRITERIA INDICATING DETERIORATION IN STATUS**, page 44).
2. Determine the distribution and relative abundance of juvenile NP CHS upstream and downstream of the partial barrier proposed for modification in the lower portion of Big Butte Creek. This project should be conducted to ensure that modification of the partial barrier results in an increased production of NP CHS.
3. Develop a method to monitor (index) spawning escapement and spawner composition. No method is currently employed because of the spawning overlap of spring and fall chinook salmon. A method to index spawning escapement is also needed because there is a good chance that Gold Ray Dam will eventually be removed, resulting in the loss of the fish counting station.
4. Determine the relationships between (1) time of freshwater entry, (2) passage timing at Gold Ray Dam, (3) spawning time, and (4) spawning distribution for early-run, mid-run, and late-run NP CHS. This information is needed in order to effectively manage distinct components of the naturally produced population and to determine efficacy of management strategies for freshwater fisheries.
5. Determine freshwater fishing mortality rates in order to effectively manage distinct components of the population and to determine efficacy of management strategies for freshwater fisheries.
6. Develop methods to monitor spawning habitat for NP CHS in the Rogue River. The volume and quality of spawning areas will (and probably has) likely decrease through time as a result of gravel being trapped in Lost Creek Lake.
7. Determine the efficacy of attempting to restore the production of NP CHS in the area upstream of Lost Creek Lake.

PROCESS TO MODIFY CORRECTIVE STRATEGIES

Findings that result from monitoring, evaluation, and research efforts described in the previous section will provide insight as to the efficacy of management strategies and actions outlined in this conservation plan for NP CHS in the Rogue SMU. Management strategies adopted as components of this plan are mostly general in nature, while management actions are fairly specific. Specificity can be advantageous, yet can also be disadvantageous unless there is flexibility to revise management actions as new information becomes available. In addition, changes in local, state, or federal laws may require modifications to management strategies or actions outlined in this plan.

Adaptive Management

Given the inherent uncertainty associated with quantitative estimates of cause-and-effect relationships, adaptive management will be employed as a means to identify and implement revisions to management actions adopted as plan components. For example, harvest opportunities on NP CHS could be increased if a pre-season forecast indicates that spawning escapement would significantly exceed 15,000 age 4-6 fish. ODFW fishery managers will consider current SMU status, and predicted run size, prior to deciding whether or not to increase harvest opportunities for naturally produced fish in freshwater.

Other actions may be revised to improve performance, or actions may be terminated and be replaced by other actions that are determined to be more effective. Rationale associated with any changes in management actions will be detailed in annual status reports developed by ODFW (*see* **Reporting**, page 48), and where applicable, will be linked to findings from monitoring, evaluation, and research efforts.

Findings from research projects not directly applicable to NP CHS in the Rogue SMU should be evaluated thoroughly prior to revision of any management actions outlined in this plan. Should research projects not be completed, it is probable that at least two generations (10 years) of NP CHS will need to return to freshwater before the efficacy of employed strategies and actions can be evaluated.

Status Review

Reviews of SMU status will be conducted on an annual basis, and these status reviews will form the basis for the assessment of the efficacy of management strategies and actions employed under this conservation plan. Attainment of desired status, or progress towards attainment of desired status, or lack of progress towards attainment of desired status will be used to judge the success of the management strategies and actions. Findings will be detailed in annual status reports developed by ODFW (*see* **Reporting**, page 48), and where applicable, will be linked to findings from monitoring, evaluation, and research efforts.

Status reviews should describe the rationale associated for any changes in the management actions described in this plan. In the event that a status review indicates that conservation criteria will likely be realized (*see* **CRITERIA INDICATING DETERIORATION IN STATUS**, page 44), ODFW will craft management options to address the need to temporarily modify the plan. These options will be presented in the annual report, and ODFW will solicit public input. ODFW will evaluate input received from the public prior to making the decision on how to adjust management actions to address any deterioration in SMU status.

In addition to annual status reviews, a more comprehensive assessment will be undertaken every 15 years, which is approximately three generations of spring chinook salmon, in order to determine whether the adopted management strategies are making progress towards the attainment of desired status. Under this scenario, ODFW will craft management options designed to address the need to permanently modify the plan. These options will be presented in a summary report, and two public meetings will be held in order to obtain input. These meetings will be held at locations near the district offices of ODFW. ODFW will evaluate input received during the public meetings prior to making revisions to the conservation plan. The revised plan, including public comments, will then be submitted to the ODFW commission for approval.

Reporting

Status reports will be produced on an annual basis for CHS in the Rogue SMU. At a minimum, annual reports will present the SMU status in relation to desired status and conservation status statements embedded in this plan, and should also present summaries of annual efforts to monitor SMU attributes.

Other primary components of annual reports will include (1) presentation of the implications of research or evaluation projects completed during the reporting year, (2) presentation of any updated assessments of population attributes completed during the reporting year, and (3) presentation of the rationale associated with any changes in management strategies. Annual status reports should be completed within the succeeding year of the reporting period to be covered. These reports will be available from the district offices in the Rogue Watershed District, and should address all SMUs within the Rogue Watershed District that have completed conservation plans.

In addition, a summary report will be completed every five years, beginning in 2010. This summary report will be designed to brief the public and the ODFW commission on the progress made towards attainment of desired status for all SMUs within the Rogue Watershed District.

POTENTIAL IMPACTS TO OTHER NATIVE SPECIES

Some impacts to other species of native fish will likely result from implementation of management strategies outlined in this conservation plan. Degree of impact is dependent upon which suite of management strategies is adopted, but some of most probable impacts are discussed below.

Changes in ODFW recommendations for reservoir management strategies are likely to have minimal effect on native fishes, with the possible exception of coho salmon and fall chinook salmon. Under the management strategy of attempting to reduce passage of CHF at Gold Ray Dam by less flow augmentation in September, coho salmon and fall chinook salmon may become more vulnerable to disease outbreaks (ODFW 1991; ODFW 1992). Impacts to other species of native fish are likely to be benign, or possibly advantageous. Findings from water temperature modeling will most likely lead to water temperatures in the area upstream of Gold Ray Dam that more closely resemble conditions prior to the operation of Lost Creek Dam.

Modification of the partial barrier in the lower portion of Big Butte Creek will likely lead to increased upstream passage of adult NP CHS, and an associated increase in the production of juvenile NP CHS. That portion of Big Butte Creek, located above the barrier is a primary producer of coho salmon and steelhead. Some cutthroat trout also reside in the area. Increased numbers of CHS are not expected to have significant impacts because (1) CHS spawn earlier than the other species, (2) juvenile NP CHS mostly spend less than one year in freshwater (ODFW 2000), and (3) juvenile coho salmon appear to dominate (out-compete) juvenile chinook salmon (Taylor 1991). Similar conclusions can be drawn for potential impacts associated with the transportation strategy for adult CHS, except that transported adults could be placed in areas of streams not accessible to anadromous salmonids. These areas would most likely contain resident rainbow trout or cutthroat trout.

ECONOMIC IMPACTS

Economic impacts of plan implementation will vary to some degree based on which suite of management strategies is adopted as part of this conservation plan for NP CHS in the Rogue SMU. The first portion of this section will outline projected impacts associated with those management actions that are common to each of the primary alternatives proposed for consideration. The second portion of the section will outline projected impacts based on those management actions that are unique to the primary alternatives under consideration. Regardless of the adopted alternative, no reporting requirements are proposed for any business or the public in general. Consequently, there are no compliance costs associated with the implementation of this plan, except for some minor reporting costs accrued by ODFW.

Implementation of any of the primary alternatives presented in this plan are expected to have the following economic impacts:
1. Tourboat operations on the Rogue River will be impacted during a ten day period in September. With minimal flow augmentation from Lost Creek Lake during 10-20 September, the company based in Grants Pass will be likely either (1) need to dredge channels in order to continue operations or (2) operations will cease. Companies based in Gold Beach may also be impacted, but to a lesser degree as compared to the company based in Grants Pass.
2. Fishing guides, tackle shops, lodging providers, restaurants, and other support services will negatively impacted if angler effort decreases in response to decreased opportunities to harvest NP CHS.
3. Fishing guides, tackle shops, lodging providers, restaurants, and other support services will be positively impacted if angler effort increases in response to increased opportunities to harvest NP CHS that result from the attainment of desired status.
4. The state of Oregon (ODFW) will accrue additional expense as a result of the proposed monitoring, evaluation, and research that is needed to ensure the efficacy of management actions implemented as part of this plan. In addition, ODFW will accrue additional expenses in order to improve fish passage at the partial barrier in Big Butte Creek.
5. The federal government (USACE) will be requested to revise reservoir management policies and practices, and will also be requested to complete some additional assessments of reservoir management strategies. These requests will result in additional expenses for the USACE.

Economic impacts of the primary alternatives differ in relation to the immediate effects on businesses that benefit from harvest opportunities for NP CHS. In a broad sense, adoption of Alternative 8 would likely have the least immediate impact as there would be minimal change in the opportunity to harvest NP CHS (*see* **Alternative 8**, page 35). Adoption of Alternative 9 may have the greatest immediate impact, but would be offset to some degree, by a possible increase in the production of hatchery fish and an added month (August) of angling opportunity for chinook salmon in the area upstream of Gold Ray Dam (*see* **Alternative 9**, page 40). The long-term economic impacts of the primary alternatives presented in this plan is dependent on how quickly, and to what degree, the population of NP CHS responds to the differing management actions.

Adoption of Alternative 8 (*see* **Alternative 8**, page 35) is expected to have the following additional significant economic impacts:
1. The state of Oregon (ODFW) will accrue additional expense as a result of the need to (1) transport and release adult CHS at sites other than Cole M. Rivers Hatchery, (2) transport and release juvenile steelhead and coho salmon at a site other than Cole M. Rivers Hatchery.

ATTAINMENT OF DESIRED STATUS

The purpose of this Conservation Plan is to ensure the continued viability of the Rogue Spring Chinook Salmon Species Management Unit (SMU), and to achieve a desired status that will provide significant ecological, economic and cultural benefits for all Oregonians.

Upon attainment of desired status, fishery management actions will be modified to allow for increased harvest opportunities for naturally produced spring chinook salmon. After full implementation of management strategies and management actions, ODFW projects that there is a reasonable chance that desired status can be attained within two or three generations (12 or 18 years) of spring chinook salmon. It should be noted that this conservation plan remains in effect regardless of SMU status, because ocean survival rates of spring chinook salmon are cyclical. Thus, the SMU could exceed desired status for a period of time, and subsequently once again drop below desired status for a period of time.

Until attainment of desired status, harvest opportunities for naturally produced spring chinook salmon could increase if pre-season forecasts predict large returns to freshwater. ODFW fishery managers will consider current SMU status, and predicted run size, prior to deciding whether or not to increase harvest opportunities for naturally produced fish in freshwater.

ADVISORY COMMITTEE MEMBERS

Public Representatives

Steve Beyerlin, Gold Beach, Oregon Guides and Packers
Keith Coddington, Medford, Middle Rogue Chapter of Trout Unlimited
Jim Dunlevy, Medford, guide
Vernon Grieve, Shady Cove, guide
Redge Heth, Southern Oregon Flyfishers
Mark Lottis, Curry Sportfishing Association
Allen Rettman, Central Point, Rogue River Guides Association
Peter Tronquet, Medford, Native Fish Society

Agency Representatives

Jim Buck, Trail, United States Army Corps of Engineers
Randy Frick, Medford, United States Forest Service
Dale Johnson, Medford, Bureau of Land Management
Lance Kruzic, Roseburg, NOAA Fisheries
Janelle McFarland, Central Point, Oregon State Police
Kirk Meyer, Central Point, Oregon State Police

REFERENCES

Amandi, A., S.F. Hui, C.K. Arakawa, and J.S. Rohovec. 1982. Assessment of disease related mortality of adult salmonids in the Rogue River basin. Progress Report. Oregon State University, Department of Microbiology, Corvallis.

Baker, P.F., T.P. Speed, and F.K. Ligon. 1995. Estimating the influence of temperature on the survival of chinook salmon smolts (Oncorhynchus tshawytscha) migrating through the Sacramento - San Joaquin River Delta of California. Canadian Journal of Fisheries and Aquatic Sciences 52:855-863.

Banks, M.A., V.K. Rashbrook, M.J. Calavetta, C.A. Dean, and D. Hedgecock. 2000. Analysis of microsatellite DNA resolves genetic structure and diversity of chinook salmon (*Oncorhynchus tshawytscha*) in California's central valley. Canadian Journal of Fisheries and Aquatic Sciences 57:915-927.

Beamesderfer, R.C., D.L. Ward, and A.A. Nigro. 1996. Evaluation of the biological basis for a predator control program on northern squawfish, *Ptychocheilus oregonsis*, in the Columbia and Snake rivers. Canadian Journal of Fisheries and Aquatic Sciences 53:2898-2908.

Beamish, R.J., J.T. Schnute, A.J. Cass, C.M. Neville, and R.M. Sweeting. 2004. The influence of climate on the stock and recruitment of pink and sockeye salmon from the Fraser River, British Columbia, Canada. Transactions of the American Fisheries Society 133:1396-1412.

Becker, C.D., and M.P. Fujihara. 1978. The bacterial pathogen *Flexibacter columnaris* and its epizootiology among Columbia River fish. A review and synthesis. American Fisheries Society, Monograph 2.

Bendock, T., and M. Alexandersdottir. 1993. Hooking mortality of chinook salmon released in the Kenai River, Alaska. North American Journal of Fisheries Management 13:540-549.

Bureau of Fisheries. 1911. The salmon fisheries of the Pacific Coast. Bureau of Fisheries Document Number 751. Department of Commerce and Labor, Washington, D.C.

Chapman, D.W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. Transactions of the American Fisheries Society 117:1-21.

Cobb, J.N. 1930. Pacific salmon fisheries. United States Department of Commerce, Bureau of Fisheries. Document 1092, Washington, D.C.

Collins, J.W. 1892. Report on the fisheries of the Pacific coast of the United States. *In:* Part XVI. Report of the commissioner for 1888. United States Commission of Fish and Fisheries, Washington D.C.

Cramer, S.P., T.D. Satterthwaite, R.R. Boyce, and B.P. McPherson. 1985. Lost Creek Dam fisheries evaluation phase I completion report. Volume I. Impacts of Lost Creek Dam on the biology of anadromous salmonids in the Rogue River. Oregon Department of Fish and Wildlife, Fish Research Project DACW57-77-C-0027, Portland.

Evenson, M.D., and R.D. Ewing. 1988. Cole Rivers Hatchery evaluation. Oregon Department of Fish and Wildlife, Fish Research Project AFS-78-1, Annual Progress Report, Portland.

Hankin, D.G., and M.C. Healey. 1986. Dependence of exploitation rates for maximum yield and stock collapse on age and sex structure of chinook salmon (*Oncorhynchus tshawytscha*) stocks. Canadian Journal of Fisheries and Aquatic Sciences 43:1746-1759.

Hankin, D.G., J.W. Nicholas, and T.W. Downey. 1993. Evidence for inheritance of age of maturity in chinook salmon *Oncorhynchus tshawytscha*. Canadian Journal of Fisheries and Aquatic Sciences 50:347-358.

HSRG (Hatchery Scientific Review Group). 2005. Hatchery reform in Washington State: principles and emerging issues. Fisheries 30(6):10-23.

Holt, R.A., J.E. Saunders, J.L. Zinn, J.L. Fryer, and K.S. Pilcher. 1975. Relation of water temperature to *Flexibacter columnaris* infection in steelhead trout (*Salmo gairdneri*), coho (*Oncorhynchus kisutch*) and chinook (*O. tshawytscha*) salmon. Journal of the Fisheries Research Board of Canada 32:1553-1559.

Horton, G.E. 1994. Effects of jet boats on salmonid reproduction in Alaskan streams. Master’s Thesis. University of Alaska. Fairbanks.

ISAB (Independent Scientific Advisory Board). 2002. Hatchery surpluses in the Pacific Northwest. Fisheries 27(12):16-28.

Lewis, M.A. 2005. Stock assessment of anadromous salmonids, 2004. Monitoring Program Report Number OPSW-ODFW-2005-04. Oregon Department of Fish and Wildlife, Salem, Oregon.

Montgomery, D.R., E.M. Beamer, G. Pess, and T.P. Quinn. 1999. Channel type and salmonid spawning distribution and abundance. Canadian Journal of Fisheries and Aquatic Sciences 56:377-387.

Mrazik, S. Oregon water quality index summary report, water years 1994-2003. Oregon Department of Environmental Quality, Portland.

NOAA Fisheries. 1999. Status review update for deferred ESUs of west coast chinook salmon (Oncorhynchus tshawytscha) from Washington, Oregon, California, and Idaho. NOAA Fisheries Northwest Fisheries Science Center, Seattle, Washington.

ODFW (Oregon Department of Fish and Wildlife). 1991. Effects of Lost Creek Dam on coho salmon in the Rogue River. Phase II Completion Report. Oregon Department of Fish and Wildlife, Fish Research Project DACW 57-77-C-0033, Completion Report, Portland.

ODFW (Oregon Department of Fish and Wildlife). 1992. Effects of Lost Creek Dam on CHF in the Rogue River. Phase II Completion Report. Oregon Department of Fish and Wildlife, Fish Research Project DACW 57-77-C-0033, Completion Report, Portland.

ODFW (Oregon Department of Fish and Wildlife). 2000. Effects of Lost Creek Dam on CHS in the Rogue River. Phase II Completion Report. Oregon Department of Fish and Wildlife, Fish Research Project DACW 57-77-C-0033, Completion Report, Portland.

ODFW (Oregon Department of Fish and Wildlife). 2003. Fish Hatchery Management Policy. Oregon Department of Fish and Wildlife, Salem.

ODFW (Oregon Department of Fish and Wildlife). 2006. Native Fish Status Report. Oregon Department of Fish and Wildlife, Salem.

Olsen, D., J. Richards, C. Carter, R. Jones, and R. Baxter. 1994. Rogue River Sport Fisheries Economic Study. Rogue Valley Council of Governments. Medord, Oregon.

Parsley, M.J., D.E. Palmer, and R.W. Burkhardt. 1989. Variation in capture efficiency of a beach seine for small fishes. North American Journal of Fisheries Management 9:239-244.

Pyper. B.J., F.J. Mueter, and R.M. Peterman. 2005. Across-species comparisons of spatial scales of environmental effects on survival rates of northeast Pacific salmon at multiple lags. Transactions of the American Fisheries Society 134:86-104.

Reeves, G.H., F.H. Everest, and J.D. Hall. 1987. Interactions between the redside shiner (***Richardsonius balteatus***) and the steelhead trout (***Salmo gairdneri***) in western Oregon: the influence of water temperature. Canadian Journal of Fisheries and Aquatic Sciences 44:1603-1613.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fisheries Research Board of Canada Bulletin 191.

Rivers, C.M. 1946. Third progress report of fishery investigation of the Rogue River and its tributaries. Oregon State Game Commission, unpublished manuscript, Portland.

Rivers, C.M. 1964. Rogue River fisheries. Oregon State Game Commission, unpublished manuscript, Portland.

Roberts, B.C., and R.G. White. 1992. Effects of angler wading on survival of trout eggs and pre-emergent fry. North American Journal of Fisheries Management 12:450-459.

Ryan, B., and E. Dittmer. 2001. Jackson County Water Resources Study. Economic Development Administration Project 07-79-04777. Jackson County Planning Department, Medford, Oregon.

Satterthwaite, T.D. 1995. Effects of boat traffic on juvenile salmonids in the Rogue River. Oregon Department of Fish and Wildlife, Fish Research Project (unnumbered), Completion Report, Portland.

Satterthwaite, T.D. 2002. Effects of reservoir releases on adult salmon during a drought year. Supplemental Report Number 1. Lost Creek Dam Evaluation Project. Oregon Department of Fish and Wildlife, Portland.

Taylor, E.B. 1991. Behavioural interaction and habitat use in juvenile chinook, ***Oncorhynchus tshawytscha***, and coho, ***O. kisutch***, salmon. Animal Behaviour 42:701-712.

United States Congress. 1962. Rogue River basin, Oregon and California. Public Law 87-874, 87th Congress, 2nd Session, House Document 566.

USACE (United States Army Corps of Engineers). 1967. Design Memorandum Number 8: Fish Facilities. Lost Creek Reservoir, Rogue River, Oregon. Portland District, Portland, Oregon.

USACE (United States Army Corps of Engineers). 1972. Final environmental statement. Lost Creek Lake Project, Rogue River, Oregon. Portland District, Portland, Oregon.

USACE (United States Army Corps of Engineers). 1983. Water quality investigations - 1981, Lost Creek Lake Project, Rogue River, Oregon. Portland District, Portland, Oregon.

USACE (United States Army Corps of Engineers). 1990. Cooperative agreement between the United States of American and the State of Oregon for the operation and maintenance of certain Portland District COE hatcheries. Portland District, Portland, Oregon.

USACE (United States Army Corps of Engineers). 1991. Final environmental statement. Elk Creek Lake Project, Rogue River, Oregon. Portland District, Portland, Oregon.

USFWS (United States Fish and Wildlife Service). 1955a. Volume I. Progress reports 1-8 on creel census of the lower Rogue River sport salmon fishery in 1952-53. United States Fish and Wildlife Service, Portland.

USFWS (United States Fish and Wildlife Service). 1955b. Volume II. Progress reports 1-7, 10-18, 20 on creel census of the upper Rogue River sport fishery from 1952-54. United States Fish and Wildlife Service, Portland.

USFWS (United States Fish and Wildlife Service). 1955c. Volume III. Progress reports 8-9, 19, 21-23 on spawning grounds and populations in the upper Rogue River, 1949-54. United States Fish and Wildlife Service, Portland.

USFWS (United States Fish and Wildlife Service). 1955d. Volume IV. Summary reports dealing with sport fishery, spawning, and population studies for the entire Rogue River system in 1949-54. United States Fish and Wildlife Service, Portland.

Williams, G.P., and M.G. Wolman. 1984. Downstream effects of dams on alluvial rivers. Geological Survey Professional Paper Number 1286. United States Geological Survey, Washington D.C.

Zimmerman, M.P, and D.L. Ward. 1999. Index of predation on juvenile salmonids by northern pikeminnow in the lower Columbia River basin, 1994-1996. Transactions of the American Fisheries Society 128:995-1007.

APPENDIX A

Definitions

"Anadromous" means fish which migrate from saltwater to freshwater for spawning.

"Aquatic habitat" means the waters which support fish or other organisms which live in water and which includes the adjacent land area and vegetation (riparian habitat) that provides shade, food, and/or protection for those organisms.

"Brood" means a group of fish that are produced by parents during a single year of spawning.

"Brood stock" means a group of fish that are held and eventually artificially spawned to provide a source of fertilized eggs for hatchery programs.

"Brood year" means the year in which the adults spawn.

"CH" means chinook salmon (spring and fall races).

"CHF" means fall chinook salmon.

"CHS" means spring chinook salmon.

"Conservation" means managing for sustainability of native fish so that present and future generations may enjoy their ecological, economic, recreational, and aesthetic benefits.

"Disease" means problems caused by infectious agents, such as parasites or pests, and by other conditions that impair the performance of the body or one of its parts.

"Early-run" means spring chinook salmon that pass Gold Ray Dam before 1 June.

"Enhancement" means management activities including rehabilitation and supplementation that increase fish production beyond the existing levels.

"Fish Hatchery" means a facility at which adult broodstock are held, or where eggs are collected and incubated, or where eggs are hatched, or where fish are reared.

"Fry" means fish which have recently hatched.

"Genotype" means the kinds of and the combination of genes possessed by an individual.

"Hatchery fish" means a fish incubated or reared under artificial conditions for at least a portion of its life.

"Hatchery Program" means a program in which a specified hatchery population is planted in a specified geographical location.

"Late-run" means spring chinook salmon that pass Gold Ray Dam after 30 June.

"Lost Creek Dam" means the same as William Jess Dam.

"Marine species" means those fish found in the ocean or the saline or brackish water of estuaries or bays along the coast, but not generally found in freshwater streams.

"Mid-run" means spring chinook salmon that pass Gold Ray Dam during June.

"Mitigation" means to lessen the impact of activities or events that cause fish or habitat loss.

"Native fish" means indigenous to Oregon, not introduced. This includes both naturally produced and hatchery produced fish.

"Naturally produced" means fish that reproduce and complete their full life cycle in natural habitats.

"Natural spawners" means fish, regardless of parental origin, that spawn in the natural environment.

"NP" means naturally produced.

"NP CHS" means naturally produced spring chinook salmon.

"NP CHF" means naturally produced fall chinook salmon.

APPENDIX A (continued)

"ODFW" means the Oregon Department of Fish and Wildlife.

"Optimum" means the level of fish abundance that results in the greatest ecological, economic, recreational, and aesthetic benefits.

"Policy" means mandatory direction or constraints that provide the framework for programs of governmental agencies.

"Population" means a group of fish originating and reproducing in a particular area at a particular time which do not interbreed to any substantial degree with any other group reproducing in a different area or in the same area at a different time.

"Production" means the number or pounds of fish raised in a hatchery or resulting from natural spawning and rearing in freshwater, estuarine, or ocean habitats.

"Recruits" means fish produced by a single generation of parents.

"Recruitment" means the addition of recruits to a population of fish.

"Risk" means the extent to which, a management practice may reduce population productivity or cause an undesirable change in genetic characteristics of a population.

"Selective mortality" means fish mortality that generally affects the genotypic and phenotypic traits of fish populations.

"Serious depletion" means a significant likelihood that the species management unit will become threatened or endangered under either the state or federal Endangered Species Act.

"Smolt" means a juvenile salmon or trout that is capable of initiating a seaward migration and is capable of living in the sea.

"Species" means any group or population that interbreeds and is substantially reproductively isolated.

"Species management unit″ or "SMU" means a collection of populations from a common geographic region that share similar genetic and ecological characteristics.

"Stray" means a hatchery fish that spawns naturally in a location different from the location intended when the fish was stocked.

"Sustainable" means persistence over time, that is to say the ability of a population or a species management unit to maintain temporal, spatial, genetic, and ecological coherence while withstanding demographic, environmental, and genetic variation and catastrophic events from natural and human induced causes.

"USACE" means the United States Army Corps of Engineers.

"Wild" means fish that reproduce and complete their full life cycle in natural habitats (same definition as "naturally produced").

APPENDIX B

Regulatory Responsibilities of Governmental Agencies

Local Government

Cities and counties are responsible for the administration of land-use planning. Under Oregon’s statewide land-use planning program, administered by the Department of Land Conservation and Development (DLCD), all cities and counties are required to adopt comprehensive plans that meet mandatory state land-use standards. The standards are 19 statewide planning goals that deal with land use, development, housing, transportation, and the conservation of natural resources. Comprehensive plans approved by the Land Conservation and Development Commission (LCDC) become the controlling document for land use in the area covered by that plan.

Several statewide planning goals require the protection of natural resources by cities and counties through adoption of land-use planning ordinances. Most notable is Goal #5, which covers open spaces, scenic and historic areas, and natural resources. Other applicable statewide planning goals include Goal #6, which covers air, water and land resources quality, Goal #8, which covers recreational needs, Goal #16, which covers estuarine resources, and Goal #19, which covers ocean resources.

Natural resource related land-use activities that may be regulated by cities and counties, through land-use planning, include riparian and wetland protection, stormwater management, floodway/floodplain development, and removal-fill activities in waters of the State.

State Government

ODFW goals and policies for commercial and sport fishing regulations, fish management, and the Native Fish Conservation Policy and Fish Hatchery Management Policy are adopted as Oregon Administrative Rules (OAR). These policies along with the Oregon Plan for Salmon and Watersheds provide guidance on the development of fisheries management options for water bodies throughout the state.

Fish management authority and associated activities conducted by ODFW are provided and directed by statute, rule, and policy. ODFW is authorized by Oregon Revised Statute (ORS) to manage the fish and wildlife resources of the state (ORS chapter 496). Within the Oregon Administrative Rules (OAR's), Division 007 rules provide directives associated with fish management and hatchery operations. Specific Division 007 policies include the Native Fish Conservation Policy (OAR 635-007-0502), General Fish Management Goals (OAR 635-007-0510), Hatchery Program Management Plans (OAR 635-007-0545), and Control of Fish Disease (OAR 635-007-0550). Additional guiding policies are found within OAR Division 415 and 412 rules for Fish and Wildlife Habitat Mitigation and Fish Passage and within Division 500 rules for fish management plans.

Regulatory responsibilities for the preponderance of activities that may affect aquatic ecosystems are executed by a variety of state agencies under the umbrella of the Oregon Plan for Salmon and Watersheds.

The Oregon Department of Environmental Quality (DEQ) is responsible for protecting and enhancing Oregon's water and air quality, for cleaning up spills and releases of hazardous materials, and for managing the proper disposal of hazardous and solid wastes. In addition to local programs, the Environmental Protection Agency (EPA) delegates authority to DEQ to operate federal environmental programs within the state such as the Federal Clean Air, Clean Water, and Resource Conservation and Recovery Acts.

The Oregon Water Resources Department (OWRD) is charged with administration of the laws governing surface and ground water resources. The Department's core functions are to protect existing water rights, facilitate voluntary flow restoration in streams, increase the understanding of the demands on the

APPENDIX B (continued)

state's water resources, provide accurate and accessible water resource data, and facilitate water supply solutions.

The Department of State Lands (DSL) is responsible for administering the removal-fill law, which protects Oregon´s waterways and wetlands from uncontrolled alteration. DSL is the lead state agency for the protection and maintenance of wetlands resources; and management of coastal resources seaward of the mean high tide line.

The Oregon Department of Forestry (ODF) responsibilities include implementation of the Oregon Forest Practices Act, which provides for timber harvest using techniques that are consistent with conservation and environmental protection. ODF also manages state-owned forest land in Oregon.

The Oregon Department of Geology and Mineral Industries (DOGAMI) is lead regulator for geologic resources (oil; gas; geothermal energy; metallic and industrial minerals; and sand, gravel, and crushed stone). The Mineral Land Regulation and Reclamation Program is the lead coordinating agency for state mining regulation.

The Oregon Parks and Recreation Department (OPRD) administers the Oregon Scenic Waterways Program. Approval must be obtained from OPRD for activities such as cutting of trees, mining, construction of roads, railroads, utilities, buildings, or other structures within a one-quarter mile of the bank of a designated scenic waterway. Portions of both the Rogue and Illinois Rivers are designated as scenic waterways. The OPRD, through its ocean shore rules, administers a permit program for ocean shore alterations.

The Oregon Department of Agriculture (ODA) Natural Resources Division works to conserve, protect, and develop natural resources on public and private lands so agriculture will continue to be productive and economically viable in Oregon. Primary program areas include: water quality, confined animal feeding operations, smoke management, land use, soil & water conservation districts, and plant conservation biology. The ODA Plant Division oversees statewide noxious weed control efforts.

The Oregon State Marine Board (OSMB) is Oregon's recreational boating agency. The OSMB registers outfitters and guides and licenses ocean charter boats. The OSMB establishes statewide boating regulations and contracts with county sheriffs and the Oregon State Police to enforce marine laws. The OSMB also provides grants and engineering services to local governments (cities, counties, park districts, port districts) to develop and maintain accessible boating facilities and protect water quality.

Oregon State Police (OSP) Fish and Wildlife Enforcement Services Division ensures compliance with the laws and regulations that protect and enhance the long term health and equitable utilization of Oregon's fish and wildlife resources and the habitats upon which they depend.

The Oregon Watershed Enhancement Board (OWEB) promotes and funds voluntary actions that strive to enhance Oregon's watersheds. OWEB programs support efforts to restore salmon runs, improve water quality, and strengthen ecosystems that are critical to healthy watersheds and sustainable communities. OWEB administers a grant program funded from the Oregon Lottery. The grant program supports voluntary efforts by Oregonians seeking to create and maintain healthy watersheds.

Regulatory Responsibilities – Federal Government

The Bureau of Land Management (BLM) administers public lands within a framework of numerous laws. The most comprehensive of these is the Federal Land Policy and Management Act of 1976. Other applicable laws include the National Environmental Policy Act of 1969, Multiple-Use Sustained-Yield Act of 1960, Mining Law of 1872, Taylor Grazing Act of 1934, and the Oregon and California Act of 1937.

APPENDIX B (continued)

The United States Forest Service (USFS) manages national forest lands for a number of multiple uses within the framework of the National Forest Management Act of 1976. Other applicable laws include the Multiple-Use Sustained-Yield Act of 1960, National Environmental Policy Act of 1969, and Mining Law of 1872.

Substantial portions of the Rogue River Basin are managed by the BLM and the USFS. Land management activities such as logging and road construction are designed to meet forest practices rules and water quality standards outlined by the Oregon Forest Practices Act. A portion of the Rogue River was designated a national Wild and Scenic River in 1968. The BLM and USFS regulate commercial and recreational boat traffic within the Wild and Scenic section of the Rogue River.

The Environmental Protection Agency (EPA) administers the Clean Water Act. The Clean Water Act gives EPA the authority to implement pollution control programs such as setting wastewater standards for industry. The Clean Water Act also continued requirements to set water quality standards for all contaminants in surface waters. The Act makes it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under provisions of the Act.

National Marine Fisheries Service (NOAA Fisheries) is responsible for the management, conservation and protection of living marine resources within the Exclusive Economic Zone (waters three to 200 miles offshore) as provided by the Magnuson-Stevens Act. Under the Marine Mammal Protection Act and the Endangered Species Act, NOAA Fisheries is responsible for the recovery of protected marine species, which includes species of anadromous fish species.

The Pacific Fishery Management Council (PMFC) is one of eight regional fishery management councils established by the Magnuson Fishery Conservation and Management Act of 1976. Fishery Management Councils advise NOAA Fisheries on issues that relate to the management of ocean fisheries within the Exclusive Economic Zone. PFMC is responsible for fisheries off the coasts of California, Oregon, and Washington.

The United States Fish and Wildlife Service (USFWS) administers protection programs for native endangered and threatened species under the Endangered Species Act. The USFWS also administers permits for activities such as depredation control under the Migratory Bird Act.

The Natural Resources Conservation Service (NRCS) provides technical and financial assistance to help agricultural producers, and other entities, conserve land and water resources. NRCS works through conservation districts, and other entities, to help landowners, as well as Federal, State, tribal, and local governments and community groups, conserve natural resources on private lands.

The U.S. Army Corps of Engineers (USACE) regulatory authority extends to structures in navigable waterways under the Rivers and Harbors Act of 1899 and the discharge of dredge and fill material under Section 404 of the Federal Water Pollution Control Act Amendments of 1972. In addition, the USACE regulates stream flows under the Flood Control Acts of 1936 and 1958. Included in these legislative acts were directives to survey for flood control potential in the Rogue River Basin. Subsequent legislation authorized the construction of three dams in the basin (United States Congress 1962), two of which have been built and are operational.

APPENDIX C

Synopsis of the Lost Creek Dam Fisheries Evaluation Project

PROJECT GOALS AND OBJECTIVES

1974-1977 Goals

1. Determine baseline conditions for major salmonid populations.
2. Develop data to assess impact of USACE dams on native salmonid populations.

1974-77 Objectives

1. Determine the life history of juvenile chinook salmon; including growth, distribution, migration behavior, and time of ocean entry.
2. Determine the variation in juvenile life history and the relative contribution of each variant life history to the adult population.
3. Determine the spawning time and spawning distribution of adult chinook salmon.

1978-1985 Goals

1. Determine the effects of Lost Creek Dam on anadromous salmonids.
2. Develop operating strategies that optimize the production and harvest of fishery resources in downstream areas.

1978-85 Objectives

1. Determine changes in water temperature, flow, and turbidity which result from reservoir operation.
2. Determine the effects of Lost Creek Dam and develop criteria for its operation as related to the river sport fishery for adult salmonids.
3. Determine the effects of Lost Creek Dam and develop criteria for its operation as related to the abundance, migration, spawning, and size and age composition of adult salmonids.
4. Determine the effects of Lost Creek Dam and develop criteria for its operation as related to the rearing and migration of juvenile salmonids.

1986-1996 Goal

Determine release strategies at Lost Creek that result in optimum production and harvest of wild spring chinook salmon.

1986-96 Objectives

1. Determine the effect of the modified release strategy on water temperature.
2. Determine the effect of water temperature on the production of wild juvenile spring chinook salmon.
3. Determine the effect of water temperature on the maturity rate, race composition, and spawning time of adult chinook salmon.
4. Develop recommendations for reservoir release strategies during years of varied water yield in the Rogue River Basin.

APPENDIX C (continued)

PROJECT FINDINGS
(reproduced from ODFW 2000)

Physical Factors

1. Reservoir operation increased flow in summer, decreased flow in winter and spring, and decreased the intensity of peak flows during winter in all downstream areas.

2. Reservoir operation decreased water temperature in summer and increased water temperature during autumn and winter in all downstream areas.

3. Water temperature three kilometers downstream of the dam decreased by an average of $2^{o}C$ in early summer, and again in early summer, after a change in release strategies during the mid-1980s.

4. Simulation modeling is the best available method to estimate the effects of reservoir operation on water temperature.

Adult Spring Chinook Salmon

1. Passage estimates of wild and hatchery fish at Gold Ray Dam during 1942-94 averaged 31,000 spring chinook salmon and 3,300 fall chinook salmon. Annual estimates of spring chinook salmon varied between 6,000 and 90,000. Annual estimates of fall chinook salmon varied between 700 and 14,000.

2. Comparisons made with returns of wild spring chinook salmon to the North Umpqua River indicated that the operation of Lost Creek Dam was associated with (1) an increase in the production of wild fall chinook salmon, (2) a decrease in the production of wild spring chinook salmon, and (3) a decrease in production of all wild chinook salmon.

3. In terms of numbers of adult fish that passed Gold Ray Dam, returns of hatchery fish mitigated for spawning habitat blocked by Lost Creek Dam.

4. The percentage of hatchery fish among spring chinook salmon averaged 7% in the 1970's, 43% in the 1980's, and 70% in the early 1990's.

5. Fall chinook salmon accounted for 13% of the wild fish produced before reservoir operation and 24% of the wild fish produced after reservoir operation.

8. The number of wild age 2 spring chinook salmon resident in the ocean averaged about 240,000 fish for broods produced before reservoir operation and about 96,000 fish for broods produced after reservoir operation.

11. Ocean fisheries annually harvested an average of 44,000 chinook salmon in 1974-93. Annual landings of spring chinook salmon averaged about 29,000 wild fish and about 14,000 hatchery fish. Annual landings of wild fall chinook salmon averaged about 1,600 fish.

12. Annual estimates of ocean harvest rates in 1977-93 ranged between 0.03 and 0.54 for age 3 fish and ranged between 0.04 and 0.80 for age 4 fish.

13. Production estimates averaged about 11 recruits per spawner and ranged between 1 and 37 recruits per spawner for wild spring chinook salmon from the 1974-89 brood years.

APPENDIX C (continued)

14. Adults matured at ages 2-6. Spring chinook salmon of hatchery origin, and wild fall chinook salmon, matured at younger ages as compared to wild spring chinook salmon.

15. Maturation rates of wild and hatchery fish affected contribution rates to recreational and commercial fisheries in the ocean. Older fish contributed to the ocean and freshwater fisheries at greater rates than younger fish.

16. Wild spring chinook salmon produced after reservoir operation matured at younger ages than counterparts produced before reservoir operation. Maturity rates of fish produced in the initial years of reservoir operation (1978-85) did not differ from those for fish produced in the later years of reservoir operation (1986-90).

17. Maturity rates of wild fish were primarily related to growth rates in the ocean and to growth rates of juveniles in freshwater.

18. Maturation rates of hatchery fish were primarily related to growth rates in the ocean, date of release from the hatchery, and to fish size when released from the hatchery.

19. Among fish of the same age, hatchery fish migrated upstream earlier than wild fish. Older fish migrated upstream earlier than younger fish among wild and hatchery fish.

20. Wild fish produced after reservoir operation migrated upstream later than wild fish produced before reservoir operation. Migration timing of wild fish was more highly related to water temperature when the fish were embryos than to water temperature or flow when the fish were adults.

21. Large numbers of adults died prior to spawning before and after operation of Lost Creek Dam. Annual mortality rates downstream of Gold Ray Dam ranged between 0% and 70%. Annual mortality rates upstream of Gold Ray Dam ranged between 1% and 63%.

23. Fish that migrated earliest spawned farthest upstream and also spawned earliest.

24. Wild fish produced after reservoir operation spawned farther downstream and spawned later than counterparts produced before reservoir operation. In contrast, time of spawning did not change among hatchery fish.

25. A decrease in the relative abundance of early migrating adults was responsible for the downstream shift in the spawning distribution of spring chinook salmon.

26. The change to later spawning was most pronounced for early migrating spring chinook salmon. Late migrating adults were less affected.

27. Later spawning probably resulted from a decrease in the survival rate for progeny of early spawning adults.

29. Fall chinook salmon excavated few redds of spring chinook salmon, but probably interbred with the spring race. In the area where spawning of fall and spring races overlapped, spawning time differed little between races.

30. About 5% of the spring chinook salmon of hatchery origin spawned naturally rather than entering Cole M. Rivers Hatchery.

APPENDIX C (continued)

Juvenile Spring Chinook Salmon

1. Reservoir operation caused eggs and alevins to develop at accelerated rates, resulting in an early emergence of fry from gravel nests. Accelerated emergence timing is most evident for the progeny of females that spawned early.

6. Eggs and alevins that incubate in gravel redds can become dewatered during the period of reservoir filling when reservoir releases increase river flow while parents spawn.

7. Large changes in river flow caused fry to be dewatered and killed.

8. Juvenile growth rates increased during the initial years of reservoir operation (1978-85) and then decreased during the later years of reservoir operation (1986-90).

9. Annual growth rates were primarily related to the abundance of juvenile chinook salmon and water temperature.

10. Fish that matured at younger ages grew faster when juveniles in the Rogue River as compared to cohorts that matured at older ages.

11. Most juveniles entered the ocean in their first year of life and the relative abundance of older migrants decreased after reservoir operation.

12. Subyearling migrants entered the ocean earlier during the initial years of reservoir operation (1978-81) as compared to counterparts produced before reservoir operation. Data were insufficient to estimate the date of ocean entry for later years of reservoir operation.

13. Juveniles destined to mature at age 2 entered the ocean earlier as compared to cohorts that matured at older ages.

14. Date of ocean entry was primarily related to growth rate and water temperature. Broods that grew at faster rates entered the ocean earlier.

15. Juveniles were larger at ocean entry during the initial years of reservoir operation (1978-85) as compared to later years of reservoir operation (1986-90) and as compared to years before reservoir operation.

Freshwater Fisheries

1. Estimates of freshwater harvest averaged 6,900 spring chinook salmon in 1956-94. These estimates only included those fish large enough to require entry on salmon-steelhead cards.

2. Annual harvest rates averaged 23% of spring chinook salmon that returned in 1961-94. Annual harvest rates averaged 13% in the lower river and 16% in the upper river (1971-94). These estimates only included those fish large enough to require entry on salmon-steelhead cards._ _

3. Fisheries for spring chinook salmon were age-selective. Older fish were harvested at greater rates than younger fish in the lower river and in the upper river.

4. Among fish of the same age, wild fish and hatchery fish were harvested at similar rates in the lower river fishery. In the upper river fishery, hatchery fish were harvested at only one-half of the rate for wild fish of the

APPENDIX C (continued)

same age, probably because they entered Cole M. Rivers Hatchery while wild fish stayed in the river.

5. Harvest in the lower river fishery was primarily related to age at return, fish abundance, and flow during the fishery. Harvest in the upper river fishery was primarily related to age at return and the abundance of wild and hatchery fish.

6. Angler catch rates in the lower river and in the upper river were primarily related to fish abundance, flow, and water temperature.

7. Angler effort in the lower river was primarily related to fish abundance, flow, and water temperature. In contrast, angler effort in the upper river was primarily related to fish abundance.

Simulation Model

1. We developed a simulation model that reflected major life history events in fresh water and in the ocean. However, we were not able to simulate changes in rates of natural mortality in the ocean or the rate of natural mortality between the time of downstream migration and the initial six months of ocean residence.

2. Simulations indicated that the production, harvest, and mortality of wild chinook salmon was more greatly affected by changes in water temperature as compared to changes in river flow.

3. Simulations indicated that hatchery fish account for about 13% of the spring chinook salmon that spawn naturally when hatchery fish account for 75% of the run at Gold Ray Dam.

RECOMMENDATIONS

Reservoir Management and Operation of Lost Creek Dam

The following recommendations are directed primarily to the United States Army Corps of Engineers, the agency responsible for managing the reservoir and releases from Lost Creek Dam. Cooperation of other state and federal agencies are needed to implement these recommendations.

1. Plans for reservoir releases should be developed seasonally and should incorporate estimates of the projected water yield from the Rogue River Basin and objectives identified by state and federal agencies responsible for management of fishery resources.

2. The simulation model described in this report can be used to help evaluate the responses of wild chinook salmon to alternative strategies of reservoir management.

3. The USACE should develop additional simulations for water temperature of the Rogue River under varied strategies of reservoir management. These simulations are needed to better allocate reservoir storage for the maintenance and possible enhancement of salmonids in areas downstream of Lost Creek Dam. At a minimum, water temperature should be simulated for years of low, average, and high water yield; and should also be simulated under alternative management strategies of (1) use of hypolimnetic storage in summer, (2) use of hypolimnetic storage in autumn, and (3) equal use of hypolimnetic storage in summer and autumn.

APPENDIX C (continued)

4. The reservoir should be managed so that daily maximum water temperature does not exceed 18^{O}C (65^{O}F) at Agness in May-June. This recommendation is designed to minimize prespawning mortality among adult spring chinook salmon.

Additional simulations of water temperature are needed to determine the flow that is required to attain the recommended water temperature. In the interim, the USACE should continue to coordinate annual efforts to identify the minimum flow at Agness needed to protect spring chinook salmon. Current information indicates that a flow of 4,000 cfs is sufficient. This interim target flow may change as more information becomes available.

5. The reservoir should be managed to minimize intensity of peak flows in downstream areas during November-March. This recommendation is designed to increase the survival rates of eggs and alevins that incubate in the gravel. Present strategies for reservoir operation decrease peak flows during operational seasons of flood control and conservation storage. We believe that the intensity of peak flows can be further decreased in years of high water yield.

Authorizing documents for the Rogue River Basin project designate flood control as the first priority for reservoir management. Storage in excess of the rule curve decreases reservoir capability for flood control. However, maintenance of the reservoir level below the rule curve can provide for additional reductions in peak flows.

The USACE should develop criteria for reservoir level in operational seasons for flood control and conservation storage. We believe reservoir level can be scaled to estimates of water yield in the area upstream of the reservoir. Reservoir level should be reduced when water content of the snowpack is great. Implementation of this recommendation would increase reservoir capacity for flood control and decrease intensity of peak flows in downstream areas.

6. Release of water stored in the reservoir during freshets should be managed so flow in downstream areas does not exceed the peak flow that previously occurred during the season. This recommendation is designed to increase survival rates of eggs and alevins that incubate in the gravel.

We recognize that this recommendation may conflict, at times, with flood control operations. For example, managers may seek to return the reservoir level to the authorized rule curve for short periods between large storms. However, when potential for further flooding is minimal, reservoir level should be returned to minimum pool for flood control (or lower) so as not to produce a new peak flow in downstream areas.

7. Release of water stored in the reservoir during flood control operations should be managed so that the rate of decrease in reservoir outflow does not exceed the rate of decrease in reservoir inflow following the freshet. This recommendation is designed to reduce the number of juvenile salmonids, including spring chinook salmon, that are stranded and killed as a result of flood control operations.

8. Release of water stored in the reservoir during operations other than flood control should be managed so that the rate of decrease in reservoir outflow do not exceed maximum incremental rates of 150 cfs every three hours and 750 cfs daily. This recommendation is designed to reduce the stranding mortality of juvenile fish. Transect surveys to determine the relationship between discharge and gravel coverage may produce more effective recommendations for the reduction of stranding mortality.

APPENDIX C (continued)

9. The reservoir should be managed so that there is minimal flow augmentation between 21 September and 15 November. This recommendation is designed to (1) minimize the probability that eggs and alevins of spring chinook salmon will be dewatered and killed during the subsequent filling of the reservoir, (2) reduce the proportion of fall chinook salmon that migrate to spawning areas upstream of Gold Ray Dam (ODFW 1992), and (3) conserve cold hypolimnetic storage to reduce early emergence of spring chinook salmon fry.

10. Reservoir storage that is not released to minimize prespawning mortality among fall chinook salmon (ODFW 1992) and spring chinook salmon should be released so as to decrease the water temperature to the greatest degree possible in the area downstream of Grants Pass during July-August. This recommendation is designed to provide more optimal water temperatures for juvenile salmonids resident in the area (ODFW 1992; ODFW 1994) and to decrease the number of juvenile salmonids, including spring chinook salmon, that are consumed by Umpqua squawfish.

11. Recommendations for water temperatures to be released from Lost Creek Dam in March-October should be considered as interim recommendations that need to be evaluated upon the completion of additional simulations of water temperature by the USACE. These recommendations are designed to (1) minimize prespawning mortality among spring chinook salmon in the area upstream of Gold Ray Dam, (2) minimize the risk of disease outbreaks among fish rearing at Cole M. Rivers Hatchery, and (3) conserve cold hypolimnetic storage for release in autumn, as described in the succeeding recommendation.

12. The temperature of water released from Lost Creek Dam should be as cold as possible during November-February. This recommendation is designed to minimize early emergence by fry of spring chinook salmon and should be evaluated upon the completion of additional simulations of water temperature by the USACE.

13. The USACE should monitor the quality and quantity of salmon and steelhead spawning habitat downstream of Lost Creek Dam. Reservoir construction terminated the recruitment of gravel from areas upstream of the dam and the recruitment of gravel, from an unknown distance downstream of the dam, may not be sufficient to prevent the additional loss of spawning habitat.

Management and Evaluation of Fishery Resources

The following recommendations are directed primarily to the Oregon Department of Fish and Wildlife, the lead agency for management of fishery resources in the Rogue River Basin. Cooperation of other state and federal agencies are needed to implement these recommendations.

1. Management objectives, in order of priority, should be developed annually by agencies responsible for the management of anadromous salmonids in the Rogue River Basin.

2. The simulation model described in this report can be used to help evaluate the responses of wild and hatchery chinook salmon to differing strategies of fisheries management.

3. Management plans and activities should recognize that wild and hatchery spring chinook salmon differ in life history and also differ in contribution rates to recreational and commercial fisheries.

4. Management plans and activities should recognize that modification of the current hatchery program to reflect life history parameters of the present population of wild spring chinook salmon will decrease the contribution rates of hatchery fish to recreational and commercial fisheries.

APPENDIX C (continued)

5. Management plans and activities should recognize that it is unlikely that the life history parameters of wild spring chinook salmon will be completely restored to preimpoundment conditions, unless Lost Creek Dam is removed.

6. Management plans and activities should recognize three populations of chinook salmon in the Rogue River upstream of Gold Ray Dam: (1) wild spring chinook salmon that pass Gold Ray Dam before 16 August, (2) early-run fall chinook salmon that pass Gold Ray Dam after 15 August, and (3) spring chinook salmon of hatchery origin.

7. All spring chinook salmon of hatchery origin should be marked with fin clips so that adult fish can be identified at Gold Ray Dam and so that known wild fish can be collected for hatchery broodstock.

8. Representative samples of each group exposed to differing hatchery practices should be marked with adipose fin clips and coded-wire tags in order to monitor and evaluate survival rates, maturation rates, and contribution rates to the ocean fisheries.

9. Maturation rates of the production group raised at Cole M. Rivers Hatchery should not exceed: 0.01 for age 2 fish, 0.10 for age 3 fish, 0.70 for age 4 fish, and 0.95 for age 5 fish in order to optimize contribution rates to the fisheries. Changes in broodstock selection practices may be needed to meet these targets.

10. Fall chinook salmon of hatchery origin should not be released in the area upstream of Gold Ray Dam.

11. Management of spring chinook salmon should be brought into compliance, or exempted from, the Wild Fish Management Policy that was adopted by the Oregon Fish and Wildlife Commission in 1992. Current management strategies are not in compliance with the policy because (1) hatchery fish now appear to compose more than 10% of the natural spawners, (2) wild fish compose less than 30% of the hatchery broodstock, and (3) wild-type phenotypes of the present population of wild fish are not maintained in hatchery fish.

Fishery managers have five options by which to bring management strategies for spring chinook salmon into compliance with the Wild Fish Policy: (1) release no hatchery fish, (2) limit the number of hatchery fish to less than 50% of the naturally spawning population and establish hatchery practices to include at least 30% wild fish in the broodstock and establish wild-type phenotypes among hatchery fish, (3) limit the number of hatchery fish to less than 10% of the naturally spawning population, (4) classify the production of hatchery fish as a special rehabilitation program, and (5) exemption from the policy. Implications associated with each of these options are discussed in the report.

12. We recommend no adjustments to the management of the ocean fisheries for chinook salmon, except as outlined in the succeeding recommendation. Current programs designed to manage fall chinook salmon produced in the Klamath River Basin of northern California should provide sufficient protection to spring chinook salmon of Rogue River origin because both populations exhibit similar patterns of distribution in the ocean and contribute to the ocean fisheries at similar rates.

13. Management plans should identify a minimum spawning escapement for age 4-6 spring chinook salmon and should regulate harvest as needed to meet the goal. The management option selected under the Wild Fish Policy will probably affect any goal chosen for minimum spawning escapement. Our findings are insufficient for identification of specific spawning goals because we found a linear, rather than a curvilinear, relationship between spawning escapement and resultant juvenile production.

APPENDIX C (continued)

14. Habitat projects designed to maintain or increase the production of spring chinook salmon should be directed at gravel quality and quantity in the Rogue River and in Big Butte Creek.

15. Management plans for public and private lands in the Rogue River Basin should identify and minimize activities that may increase the intensity of peak flows in autumn-winter and may increase water temperature in summer.

16. Continual removal of Umpqua squawfish from the Rogue River should be supported to the greatest possible extent to reduce predation losses of juvenile chinook salmon.

17. Information related to the impact of Umpqua squawfish on anadromous salmonids in the Rogue River should be publicized in order to decrease the chance that the species is unintentionally introduced into other coastal basins in southwest Oregon and northern California.

APPENDIX D

Brief History of Hatchery Programs for Spring Chinook Salmon in the Rogue River

1877 - R.D. Hume begins raising spring chinook salmon near Gold Beach.
1899 - Brood stock collection site moved to upper river.
1918 - Brood stock collection site moved to Big Butte Creek. United States Bureau of fisheries takes over program.
1921 - Rearing of fry to the fingerling stage begins. Fish are raised at Butte Falls Hatchery.
1938 - Oregon State Game Commission takes over program.
1949 - Evaluation of hatchery program begins.
1962 - Evaluation of hatchery program ends. Findings included (1) releases in the middle river and in the upper river survived at greater rates as compared to releases in the lower river and in the canyon, (2) releases in December survived at greater rates as compared to releases during other months (July through March). Hatchery fish composed an average of 2% of the spring chinook salmon run.
1973 - Cole M. Rivers Hatchery begins operation. Brood stock is developed from fish that volitionally entered the hatchery. Brood stock practices attempt to randomly mate fish in order to mimic wild fish genetics and life history.
1976 - Size and time of release experiments (Phase I) begin.
1977 - Experimental release in estuary. Returns indicate almost no survival.
1978 - First outbreak of bacterial kidney disease.
1980 - Erythromycin feeding and incubation experiments begin.
1981 - Experimental release of spring chinook salmon in the Applegate River. Returns indicate a low survival rate.
1981 - Effect of release time on age-at-maturity first noted.
1981 - Recycling of excess hatchery adults begins in the upper river.
1982 - Off-station and on-station release experiments begin. Results indicated there were no differences between groups in adult homing rates to the hatchery, or time of hatchery entry.
1984 - Recycling of excess adults found to be cost-effective.
1985 - Time of release experiments (Phase II) begin.
1987 - Time of release experiments (Phase I) completed. Results indicated that fish released in October survived at greater rates as compared to fish released in December or March.
1988 - Broodstock collection guidelines modified to include older fish.
1990 - Incubation of eggs and sac-fry changed to single pass water system.
1993 - Experimental release of acclimated fish held in net pens for about one month at a site 27 miles downstream of the hatchery. Results indicated there were no differences between groups in homing rates to the hatchery, or in the time of hatchery entry.
1999 – First release of 100% marked smolts (mostly adipose fin clips).
2000 - Loss of 1.4 million fry results in shortfall of about 1.2 million smolts. ODFW decides to increase releases in 2001-2004 by 0.3 million smolts annually, and to increase number of recycled adults.

APPENDIX E

Chronological Development of Desired Status Statement

FINAL COORDINATED (ODFW + ADVISORS) STATEMENT OF DESIRED STATUS (changes of 20 November 2006 in bold text)

1. On average, at least 15,000 wild spring chinook salmon should annually pass Gold Ray Dam. This goal represents a running average over a period of 10 years.

2. On average, at least 60% of the wild "adult" spring chinook salmon should annually pass Gold Ray Dam by 15 June. Adults are defined as fish greater than 24 inches in length as compared to smaller fish (jacks). This goal represents a running average over a period of 10 years.

3. On average, jacks smaller than 24 inches should compose no more than 10% of the wild spring chinook salmon that annually pass Gold Ray Dam. This goal represents a running average over a period of 10 years.

4. On average, among wild spring chinook salmon that spawn during September, at least 40% should spawn upstream of the Highway 62 bridge in Shady Cove. This goal represents a running average over a period of 10 years.

5. On average, hatchery fish should compose no more than 15% of naturally spawning spring chinook salmon. This goal represents a running average over a period of 10 years.

6. There is at least a 99% chance that the population of naturally produced spring chinook salmon will persist over a period of 100 years.

COORDINATED (ODFW + ADVISORS) WORKING STATEMENT OF DESIRED STATUS (19 April 2006)

1. On average, at least 15,000 wild spring chinook salmon should annually pass Gold Ray Dam. This goal represents a running average over a period of 10 years.

2. On average, at least 60% of the wild "adult" spring chinook salmon should annually pass Gold Ray Dam by 15 June. Adults are defined as fish greater than 24 inches in length as compared to smaller fish (jacks). This goal represents a running average over a period of 10 years.

3. On average, jacks smaller than 24 inches should compose no more than 10% of the wild spring chinook salmon that annually pass Gold Ray Dam. This goal represents a running average over a period of 10 years.

4. On average, among wild spring chinook salmon that spawn during September, at least 40% should spawn upstream of the Highway 62 bridge in Shady Cove. This goal represents a running average over a period of 10 years.

5. On average, hatchery fish should compose no more than 15% of naturally spawning spring chinook salmon. This goal represents a running average over a period of 10 years.

APPENDIX E (continued)

ODFW WORKING STATEMENT OF DESIRED STATUS[a] (17 April 2006)

1. On average, at least 15,000 wild spring chinook salmon should annually pass Gold Ray Dam. This goal represents a running average over a period of 10 years.

2. On average, at least 60% of the wild "adult" spring chinook salmon should annually pass Gold Ray Dam by 15 June. Adults are defined as fish greater than 24 inches in length as compared to smaller fish (jacks). This goal represents a running average over a period of 10 years.

3. On average, jacks smaller than 24 inches should compose no more than 10% of the wild spring chinook salmon that annually pass Gold Ray Dam. This goal represents a running average over a period of 10 years.

4. On average, among wild spring chinook salmon that spawn during September, at least 40% should spawn upstream of the Highway 62 bridge in Shady Cove. This goal represents a running average over a period of 10 years.

5. On average, hatchery fish should compose no more than 20% of naturally spawning spring chinook salmon. This goal represents a running average over a period of 10 years.

[a] *Goals were developed based on input received from the advisory committee and on fishery management objectives established by the agency.*

ADVISORY COMMITTEE WORKING STATEMENT OF DESIRED STATUS (committee changes of 18 February 2006 in bold text)

1. On average, at least 15,000 wild spring chinook salmon should annually pass Gold Ray Dam. This goal represents a running average over a period of 10 years.

2. On average, at least 50% of the wild "adult" spring chinook salmon should annually pass Gold Ray Dam by 15 June. Adults are defined as fish greater than 24 inches in length as compared to smaller fish (jacks). This goal represents a running average over a period of 10 years.

3. On average, jacks smaller than 24 inches should compose no more than 10% of the wild spring chinook salmon that annually pass Gold Ray Dam. This goal represents a running average over a period of 10 years.

4. On average, among wild spring chinook salmon that spawn during September, at least 60% should spawn upstream of the Highway 62 bridge in Shady Cove. This goal represents a running average over a period of 10 years.

5. On average, hatchery fish should compose no more than 10% **of naturally spawning spring chinook salmon**[a]. This goal represents a running average over a period of 10 years.

[a] *Goal was modified by the advisory committee in order to establish a goal that covered the entire population, rather than a segment of the population.*

APPENDIX E (continued)

ADVISORY COMMITTEE WORKING STATEMENT OF DESIRED STATUS (committee changes of 7 January 2006 in bold text)

1. On average, at least **15,000**[a] wild spring chinook salmon should annually pass Gold Ray Dam. This goal represents a running average over a period of 10 years.

2. On average, at least 50% of the wild "adult" spring chinook salmon should annually pass Gold Ray Dam by 15 June. Adults are defined as fish greater than 24 inches in length as compared to smaller fish (jacks). This goal represents a running average over a period of 10 years.

3. On average, jacks smaller than 24 inches should compose no more than 10% of the wild spring chinook salmon that annually pass Gold Ray Dam. This goal represents a running average over a period of 10 years.

4. On average, among wild spring chinook salmon that spawn during September, at least 60% should spawn upstream of the Highway 62 bridge in Shady Cove. This goal represents a running average over a period of 10 years.

5. On average, hatchery fish should compose no more than 10% of the spring chinook salmon that spawn naturally during September. This goal represents a running average over a period of 10 years.

[a] ***Goal was modified by the advisory committee because assessments indicated that this level of production was unlikely without major changes in water level during the winter at Lost Creek Lake.***

ADVISORY COMMITTEE WORKING STATEMENT OF DESIRED STATUS (as of 22 June 2005)

1. On average, at least 23,000 wild spring chinook salmon should annually pass Gold Ray Dam. This goal represents a running average over a period of 10 years.

2. On average, at least 50% of the wild "adult" spring chinook salmon should annually pass Gold Ray Dam by 15 June. Adults are defined as fish greater than 24 inches in length as compared to smaller fish (jacks). This goal represents a running average over a period of 10 years.

3. On average, jacks smaller than 24 inches should compose no more than 10% of the wild spring chinook salmon that annually pass Gold Ray Dam. This goal represents a running average over a period of 10 years.

4. On average, among wild spring chinook salmon that spawn during September, at least 60% should spawn upstream of the Highway 62 bridge in Shady Cove. This goal represents a running average over a period of 10 years.

5. On average, at least 50% of the spring chinook salmon that pass Gold Ray Dam should spawn during September. This goal represents a running average over a period of 10 years.

6. On average, hatchery fish should compose no more than 10% of the spring chinook salmon that spawn naturally during September. This goal represents a running average over a period of 10 years.

APPENDIX E (continued)

POSSIBLE ELEMENTS FOR DESIRED STATUS (set aside by advisory committee in January 2006)

On average, at least 50% of the spring chinook salmon that pass Gold Ray Dam should spawn during September. This goal represents a running average over a period of 10 years. Goal set aside by committee because measurement of attribute would require tagging wild fish at Gold Ray Dam.

POSSIBLE ELEMENTS FOR DESIRED STATUS (set aside by advisory committee in May and July 2005)

Measurable goals related to (1) the percentage of fall chinook salmon among all wild chinook salmon that pass Gold Ray Dam, (2) the percentage of hatchery fish among all chinook salmon that spawn upstream of Gold Ray Dam, and (3) the percentage of hatchery fish among spring chinook salmon that pass Gold Ray Dam.

POSSIBLE ELEMENTS FOR DESIRED STATUS (measurable goal was never proposed)

A measurable goal related to the specific age composition of wild spring chinook salmon that pass Gold Ray Dam (relative abundance of age 2, age 3, age 4, age 5, and age 6 fish).

APPENDIX F

Potential Management Actions Considered during Plan Development

List includes only those factors that limit, or have the potential to limit, attainment of desired biological status

DESIRED STATUS ELEMENT: FISH ABUNDANCE (≥15,000 NP CHS)

Limiting Factor A1 - peak flow during egg and sac-fry incubation

Potential management options:

A1(a). ODFW requests that the USACE reduce peak flows during the period of November through March as much as possible under current reservoir management strategies adopted for Lost Creek Lake. **Primary Implications:** This action has been taken (ODFW 2000), but has yet to be incorporated in an ODFW fisheries management plan.

A1(b). ODFW requests that the USACE increase the reduction of peak flows during the period of November through March. **Primary Implications:** This action would usually require that the USACE manage Lost Creek Lake at levels significantly below the rule curve and also would require the release of more than 180,000 acre-feet of reservoir storage annually, which exceeds the amount authorized for a "normal" year (United States Congress 1962).

A1(c). ODFW recommends a specific maximum target for flow in the upper portion of the Rogue River. One plausible target might be 7,000 cfs at Dodge Bridge. **Primary Implications:** This action would decrease flexibility of USACE reservoir regulators if the reservoir level reaches the rule curve and cause the reservoir to be evacuated at greater rates, leading to a potential increase in fry dewatering. In addition, this action may lead to the perception that no regulatory actions should be taken when flows are not expected to reach 7,000 cfs.

A1(d). Take no action. Reductions of peak flows may negatively affect long term productivity of aquatic ecosystems.

Limiting Factor A2 - water temperature during egg and sac-fry incubation

Potential management options:

A2(a). ODFW requests that the USACE release the coldest water possible during November through February. **Primary Implications:** This action has been taken by ODFW (ODFW 2000), but has yet to be incorporated in an ODFW fisheries management plan.

A2(b). Same as option A2(a) except ODFW also requests that the USACE determine if the reservoir operations can be modified to further decrease the temperature of water released during the period of November through February. Development of water temperature models will be needed to accomplish this assessment. **Primary Implications:** This action has been taken by ODFW (ODFW 2000), but has yet to be incorporated in an ODFW fisheries management plan.

A2(c). ODFW requests that the USACE investigate the possibility of bypassing reservoir inflow around, or through, Lost Creek Lake during the period of November through February. **Primary Implications:** This action may require that the USACE obtain funds to conduct such an assessment.

A2(d). Take no action.

APPENDIX F (continued)

Limiting Factor A3 - flow during egg and sac-fry incubation

Potential management options:

A3(a). ODFW requests that the USACE manage reservoir releases for minimal flow augmentation during the spawning period for CHS in order to minimize the number of redds that would be dewatered during the season of reservoir filling. **Primary Implications:** This action has been taken (ODFW 2000), but has yet to be incorporated in an ODFW fisheries management plan.

A3(b). Take no action.

Limiting Factor A4 - flow decreases during juvenile rearing

Potential management options:

A4(a). ODFW requests that the USACE manage reservoir releases to meet current criteria designed to minimize the potential for dewatering of juvenile NP CHS. **Primary Implications:** This action has been taken (ODFW 2000), but has yet to be incorporated in an ODFW fisheries management plan.

A4(b). ODFW requests that the USACE undertake measures to improve criteria designed to minimize the potential for dewatering of juvenile NP CHS. **Primary Implications:** This action has been taken (ODFW 2000), but has yet to be incorporated in an ODFW fisheries management plan.

A4(c). Take no action.

Limiting Factor A5 - predation by juvenile hatchery fish

Potential management options:

A5(a). ODFW reduces the number of steelhead and/or coho salmon of hatchery origin. **Primary Implications:** Reductions in fishery contributions.

A5(b). ODFW reduces the number of steelhead and/or coho salmon of hatchery origin and, to compensate for the fishery losses, increases the number of juvenile CHS released. **Primary Implications:** This action would increase the relative abundance of hatchery fish among spawning CHS (conflicts with desired status element of no more than 15% hatchery fish among spawners).

A5(c). ODFW reduces residualism among juvenile steelhead and coho salmon by moving to some strict volitional migration criteria at Cole M. Rivers Hatchery. **Primary Implications:** This action would likely result in non-migrants being moved to fisheries for resident salmonids (i.e. lakes) and would result in some level of harvest reduction in the coho salmon and steelhead fisheries. Also, the hatchery would need to be modified so that cleaning effluent can be pumped directly into the abatement pond without using the release channel.

A5(d). Angling regulations would be modified so as to allow for the harvest of juvenile steelhead and coho salmon of hatchery origin during the entire year. **Primary Implications:** This action would increase the non-harvest related mortality on wild juvenile steelhead (juvenile coho salmon not likely to be impacted).

A5(e). Transport, and release, juvenile steelhead and coho salmon downstream of Gold Ray Dam. **Primary Implications:** This action would probably slightly increase the proportions of hatchery fish among naturally spawning steelhead and/or coho salmon.

A5(f). Take no action.

APPENDIX F (continued)

Limiting Factor A6 - water temperature during smolt migration

Potential management options:

A6(a). ODFW requests that the USACE manage reservoir releases to increase survival of migrating smolts by releasing storage that is not needed to decrease disease-related losses of adult CHS and adult CHF. **Primary Implications:** This action has been taken (ODFW 2000), but has yet to be incorporated in an ODFW fisheries management plan.

A6(b). Analogous to option A6(a), except ODFW requests that the USACE manage reservoir releases to maximize smolt survival rates. **Primary Implications:** This alternative will result in increased mortality among adult CHS and adult CHF (ODFW 2000), or more reservoir storage, in excess of the current fisheries allocation, will be needed to protect both races of chinook salmon.

A6(c). Analogous to A6(a), except ODFW requests that the USACE manage reservoir releases to meet specific water temperature goals at Agness during the smolt migration period in summer. **Primary Implications:** This action would sometimes result in increased mortality among adult NP CHF, unless more reservoir storage (in excess of the current fisheries allocation) is authorized by the United States Congress.

A6(d). Take no action.

Limiting Factor A7 - predation on smolts (and adults)

Potential management options:

A7(a). The same as described in option A6(a). Umpqua pikeminnow consumption of chinook salmon smolts would decrease because decreased water temperatures in downstream areas would decrease pikeminnow metabolic rates and growth rates. **Primary Implications:** The same as described in option A6(a).

A7(b). ODFW encourages fishing-related mortality for Umpqua pikeminnows. **Primary Implications:** This action has been taken (ODFW 2000), but has yet to be incorporated in an ODFW fisheries management plan.

A7(c). ODFW delays the release of juvenile CHS from Cole M. Rivers Hatchery until October to ensure that juvenile NP CHS have completely migrated from the river. This action is based on the hypothesis that hatchery fish attract near-shore and off-shore predators that likely feed on wild fish as well as hatchery fish. **Primary Implications:** Efficacy of action is unknown. Fishery yields of hatchery fish would decrease, because fish released in August or September contribute to fisheries at greater rates.

A7(d). ODFW initiates a program to decrease cormorant predation on smolts passing through the estuary. **Primary Implications:** These animals are currently protected under the Federal Migratory Bird Treaty Act. However, the United States Fish and Wildlife Service has authorized some states to take steps designed to limit cormorant populations.

A7(e). ODFW requests that NOAA Fisheries evaluate the effects of marine mammals on salmon and steelhead of Rogue River origin. **Primary Implications:** This action would provide background information in the event that NOAA Fisheries authorizes states to take steps designed to limit populations of marine mammals. Marine mammals are currently protected under federal law.

A7(f). Take no action.

APPENDIX F (continued)

Limiting Factor A8 - juvenile mortality at water diversions

Potential management options:

A8(a). ODFW continues to support improvements at diversion sites in order to increase the survival rates of juvenile salmonids. **Primary Implications:** This action has been taken by ODFW, and would include support for the reconstruction or removal of structures that inadequately protect downstream migrants.

A8(b). Take no action.

Limiting Factor A9 - water temperature during adult migration

Potential management options:

A9(a). ODFW requests that the USACE manage reservoir releases to increase survival by decreasing disease-related losses of adult CHS. **Primary Implications:** This action has been taken (ODFW 2000), but has yet to be incorporated in an ODFW fisheries management plan.

A9(b). The same as described in option A9(a), except ODFW requests that the USACE manage reservoir releases to maximize survival by decreasing disease-related losses of adult CHS. **Primary Implications:** This action would often result in increased mortality among adult CHF (ODFW 1992), unless more reservoir storage (in excess of the current fisheries allocation) is authorized by the United States Congress.

A9(c). The same as described in option 9A(a), except ODFW requests that the USACE manage reservoir releases to cap expected disease-related losses of adult CHS at a maximum of 5%. **Primary Implications:** This action would often result in increased mortality among adult NP CHF (ODFW 1992), unless more reservoir storage (in excess of the current fisheries allocation) is authorized by the United States Congress.

A9(d). Take no action.

Limiting Factor A10 - redd competition and excavation by fall chinook salmon

Potential management options:

A10(a). ODFW requests that the USACE manage reservoir releases to minimize flow augmentation after September 20, in part to discourage adult CHF from migrating upstream of Gold Ray Dam. **Primary Implications:** This action has been taken by (ODFW 2000), but has yet to be incorporated in an ODFW fisheries management plan.

A10(b). The same as described in option 10A(a), except change the date to September 10. **Primary Implications:** same as alternative A10(a), except there is an increased risk of disease related losses increases among adult CHF and adult coho salmon (ESA protected fish).

A10(c). ODFW requests that the USACE manage reservoir releases to minimize flow augmentation during the period of July 20 through August 20. The intent of this action would be to increase disease related losses among NP CHF destined to migrate upstream of Gold Ray Dam (ODFW 1992). **Primary Implications:** This action would decrease flows during the period when NP CHS smolts migrate to the ocean (conflicts with potential management actions A6 and A7).

A10(d). ODFW requests that the USACE determine if the reservoir operations can be modified to further decrease the temperature of water released during the period of November through February (same as option A2(b). Colder water during the period of egg and sac-fry incubation is more suitable for the production of NP CHS and less suitable for the production of NP CHF. **Primary Implications:** This action has been taken (ODFW 2000), but has yet to be incorporated in an ODFW fisheries management plan.

APPENDIX F (continued)

A10(e). ODFW attempts to selectively exclude adult CHF from passing upstream of Gold Ray Dam. **Primary Implications:** Summer steelhead and coho salmon (ESA protected fish) passage must continue at site.

A10(f). Angling regulations would be modified so as to allow for an increase in the harvest of CHF destined to pass Gold Ray Dam. **Primary Implications:** Depending on the area, this action may impact other populations of NP CHF, and would require a deviation from regional angling regulations currently in effect for the fisheries for CHF.

A10(g). Take no action.

Limiting Factor A11 - amount of spawning habitat

Potential management options:

A11(a). ODFW pursues the means to improve the passage of adults at a small falls in the lower mile of Big Butte Creek. **Primary Implications:** This action would require installation of a fish ladder or modification of a natural barrier.

A11(b). ODFW collects and transfers adult CHS into potential spawning habitat that is not accessible to naturally migrating adults. **Primary Implications:** Hatchery fish excess to broodstock needs would compose most of the transported fish. However, adult NP CHS may have to trapped, transported to, and held at, Cole M. Rivers Hatchery before release in streams to ensure that hatchery fish would account for less than 15% of the natural spawners. Survival rates of trapped and transported adult NP CHS may be low as a result of handling and stress.

A11(c). ODFW pursues the means to obtain high quality water that would be used to allow for adult migration and spawning in Little Butte Creek during the period of September 15 through October 15. **Primary Implications:** This action would likely require at least 10,000 acre-feet of water that is currently not available. It is likely that such a volume can only become available if it originates from storage in a reservoir that has yet to be planned.

A11(d). ODFW pursues the means to obtain high quality water that would be used to allow for adult migration and spawning in Bear Creek during the period of September 15 through October 15. **Primary Implications:** This action would likely require at least 10,000 acre-feet of water that is currently not available. It is likely that such a volume can only become available if it originates from storage in a reservoir that has yet to be planned.

A11(e). ODFW pursues the means to obtain high quality water that would be used to allow for adult migration and spawning in Big Butte Creek during the period of September 15 through October 15. **Primary Implications:** This action might require about 5,000 acre-feet of water that is currently not available. It is possible that such a volume can only become available if it originates from storage in a reservoir that has yet to be planned.

A11(f). Take no action.

Limiting Factor A12 - amount of rearing habitat

Potential management options:

A12(a). ODFW annually transfers juvenile CHS of hatchery origin upstream of Lost Creek Lake to supplement production in the lower 5 miles of the Middle Fork and the lower 10 miles of the South Fork. These areas were accessible to anadromous salmoids prior to the construction of Lost Creek Dam. **Primary Implications:** Survival rates of smolts passing through the water intake tower in Lost Creek Lake are unknown. Juveniles would need to be marked as hatchery fish so that any survivors could be identified upon return to Cole M. Rivers

APPENDIX F (continued)

Hatchery or upon recovery as spawned carcasses. If returning adults spawn naturally, rather than entering Cole M. Rivers Hatchery, this action is in conflict with the desired status element that calls for no more than 15% hatchery fish among natural spawners.

A12(b). ODFW annually transfers juvenile CHS of hatchery origin to rear in areas of tributary streams that are not accessible to natural spawners. **Primary Implications:** Returning adults would not be able to return and spawn in natal areas, but would spawn in areas currently used by NP CHS. This action is in conflict with the desired status element that calls for no more than 15% hatchery fish among natural spawners.

A12(c). Take no action.

Limiting Factor A13 - quality of spawning habitat

Potential management options:

A13(a). ODFW requests that the USACE monitor spawning habitat in areas downstream from Lost Creek Lake. **Primary Implications:** This action has been taken by (ODFW 2000), but has yet to be incorporated in an ODFW fisheries management plan.

A13(b). ODFW uses spawning survey data to determine when it would be desirable to begin efforts to improve spawning habitat. **Primary Implications:** Decisions would be resource dependent as determined from some objective criteria (i.e. when carcass densities upstream of Elk Creek drop below 75% of the average calculated from areas farther downstream).

A13(c). ODFW requests that the USACE act to restore and maintain, at historic levels, gravel quality and quantity in spawning areas between Lost Creek Lake and Shady Cove. **Primary Implications:** None.

A13(d). ODFW investigates the potential to improve spawning habitat in Big Butte Creek, and if warranted, takes steps to improve spawning habitat. **Primary Implications:** This action would be taken if the upstream passage of adults is improved at a partial barrier near the mouth of the stream.

A13(e). Take no action.

Limiting Factor A14 - quality of rearing habitat

Potential management options:

A14(a). ODFW develops an education program designed to encourage landowners to maintain riparian habitat. **Primary Implications:** The primary benefits of this action are maintenance of channel shading and streambank stability.

A14(b). Take no action.

Limiting Factor A15 – fishing mortality in the ocean

Potential management options:

A15(a). ODFW recommends additional harvest restrictions for fisheries operating in the Klamath Zone Management Area. Fisheries operating (3-200 miles offshore) in this area are managed by NOAA Fisheries, with input from the Pacific Fisheries Management Council. **Primary Implications:** Allowable harvest in this area is currently primarily based on projected impacts to CHF produced in the Klamath River Basin.

A15(b). ODFW adopts additional harvest restrictions inside the three mile coastal zone, where the state of Oregon establishes fishery regulations. **Primary Implications:** Commercial and recreation fishery regulations inside the three mile limit usually match those fishery regulations set for those areas outside the three mile limit.

APPENDIX F (continued)

A15(c). Combine fishing-related mortality in the ocean and in freshwater. Identify an allowable harvest rate, and then allocate a portion of the harvest to each fishery.

A15(d). Take no action.

Limiting Factor A16 – fishing mortality in freshwater

Potential management options (specific options are in APPENDIX G):

A16(*). Establish daily or annual limits for harvest.

A16(*). Establish specific seasons for harvest.

A16(*). Establish specific areas for harvest.

A16(*). Establish gear restrictions to maximize survival of released fish.

A16(*). Establish area(s) closed to angling.

A16(f). Combine fishing related mortality in the ocean and in freshwater. Identify an allowable harvest rate, and then allocate a portion of the harvest to each fishery.

A16(g). Promote ethical angling and proper techniques for catch and release.

A16(h). Increase effectiveness of enforcement of fishery regulations.

A16(i). Take no action.

Limiting Factor A17 - spawning escapement

Potential management options are the same as those described under **Limiting Factors A1-A16.**

DESIRED STATUS ELEMENT: MIGRATION TIMING (≥60% PASSAGE BY 15 JUNE)

Limiting Factors include peak flow during egg and sac-fry incubation (**Limiting Factor A1**), water temperature during egg and sac-fry incubation (**Limiting Factor A2**), flow during egg and sac-fry incubation (**Limiting Factor A3**), flow decreases during juvenile rearing (**Limiting Factor A4**), predation by juvenile hatchery fish (**Limiting Factor A5**), water temperature during adult migration (**Limiting Factor A9**), redd competition and excavation by CHF (**Limiting Factor A10**), amount of spawning habitat (**Limiting Factor A11**), amount of rearing habitat (**Limiting Factor A12**), quality of spawning habitat (**Limiting Factor A13**), and spawning escapement (**Limiting Factor A17**). All of these factors differentially affect the abundance of early-run CHS as compared to late-run CHS. Other limiting factors include:

Limiting Factor B1 - water temperature during adult migration

Potential management options:

B1(a). ODFW requests that the USACE manage reservoir releases so as to increase water temperatures during the late spring and early summer, with the objective of earlier passage of adult NP CHS at Gold Ray Dam. This direct environmental effect has a non-genetic basis, and thus differs from option

B1(b). **Primary Implications:** This action would increase risk of disease related losses of adult CHS in low flow years (ODFW 2000). In addition, this action would slightly increase growth rates of juvenile NP CHS (ODFW 2000). Faster growth leads to a younger age at maturity (ODFW 2000), which conflicts directly with the desired status element that calls for no more than 10% jacks among NP CHS that pass Gold Ray Dam.

APPENDIX F (continued)

B1(b). ODFW follows management actions, as described under **Limiting Factors A1-A5** and **Limiting Factors A9-A13**, that are designed to increase the production of NP CHS genetically programmed to migrate as early-run or mid-run adults.

B1(c). Take no action.

Limiting Factor B2 - age-selective fishing mortality in the ocean

Potential management options:

Spring chinook salmon destined to mature at older ages are selectively harvested by the ocean fisheries (ODFW 2000), and older CHS pass Gold Ray Dam earlier as compared to younger cohorts (ODFW 2000). Management actions directed at the ocean fisheries thus affect passage timing at Gold Ray Dam. Options for potential management actions associated with ocean fisheries were previously described (*see* **Limiting Factor A15**).

Limiting Factor B3 - time-selective fishing mortality in freshwater

Potential management options:

Early-run CHS are selectively harvested by recreational fisheries in the Rogue River (ODFW 2000). Management actions directed at the freshwater fisheries thus affect passage timing at Gold Ray Dam. Options for relevant potential management actions were previously described (*see* **Limiting Factor A16**).

DESIRED STATUS ELEMENT: AGE COMPOSITION (≤10% JACKS)

Limiting Factor C1 - water temperature during juvenile rearing

Potential management options:

C1(a). ODFW requests that the USACE manage reservoir releases to decrease water temperatures during spring and early summer when juveniles rear in freshwater. Decreased growth rates cause juveniles to migrate later to the ocean, which in turn causes NP CHS to mature at older ages (ODFW 2000). **Primary Implications**: This action would more quickly deplete cold water stored in Lost Creek Lake, and would result in warmer water temperatures during the period eggs incubate in the gravel (*see* **Limiting Factor A2**). Water temperature modeling is needed to assess magnitude of the impact.

C2(b). Take no action.

Limiting Factor C2 - juvenile abundance

Potential management options:

Juvenile NP CHS that grow at slower rates in freshwater mature at older ages (ODFW 2000), and growth rates are dependent on water temperature and juvenile density (ODFW 2000). Actions taken to increase fry production and fry survival rates will thus also act to increase the age of maturity for NP CHS. ODFW follows management actions, as described under **Limiting Factors A1-17**, that are designed to increase the production of juvenile NP CHS.

Limiting Factor C3 - age-selective fishing mortality in the ocean

Potential management options:

Spring chinook salmon destined to mature at older ages are selectively harvested by the ocean fisheries (ODFW 2000). Management actions directed at the ocean fisheries thus affect the age composition of adults that pass Gold Ray Dam. Options for potential management actions associated with ocean fisheries were previously described (*see* **Limiting Factor A15**).

APPENDIX F (continued)

Limiting Factor C4 - age-selective fishing mortality in freshwater

Potential management options:

Spring chinook salmon destined to mature at older ages are selectively harvested by recreational fisheries in the Rogue River (ODFW 2000). Management actions directed at the freshwater fisheries thus affect the age composition of adults that pass Gold Ray Dam. Options for relevant potential management actions were previously described (*see* **Limiting Factor A16**).

DESIRED STATUS ELEMENT: DISTRIBUTION OF SEPTEMBER SPAWNERS (≥40% ABOVE SHADY COVE)

Limiting Factors include peak flow during egg and sac-fry incubation (**Limiting Factor A1**), water temperature during egg and sac-fry incubation (**Limiting Factor A2**), flow during egg and sac-fry incubation (**Limiting Factor A3**), flow decreases during juvenile rearing (**Limiting Factor A4**), predation by juvenile hatchery fish (**Limiting Factor A5**), water temperature during adult migration (**Limiting Factor A9**), and quality of spawning habitat (**Limiting Factor A13**). All of these factors differentially affect the abundance of NP CHS that spawn close to Lost Creek Dam as compared to cohorts that spawn farther downstream. Other limiting factors include:

Limiting Factor D1 – selective fishing mortality in freshwater

Potential management options:

Adult NP CHS that are destined to spawn farthest upstream are selectively harvested in the fisheries that operate in the Rogue River (ODFW 2000). Fishery management actions thus affect the proportion of NP CHS that spawn upstream of Shady Cove. Options for relevant potential management actions were previously described (*see* **Limiting Factor A16**).

DESIRED STATUS ELEMENT: SPAWNER COMPOSITION (≤15% HATCHERY)

Limiting Factors include peak flow during egg and sac-fry incubation (**Limiting Factor A1**), water temperature during egg and sac-fry incubation (**Limiting Factor A2**), flow during egg and sac-fry incubation (**Limiting Factor A3**), flow decreases during juvenile rearing (**Limiting Factor A4**), predation by juvenile hatchery fish (**Limiting Factor A5**), water temperature during adult migration (**Limiting Factor A9**), redd competition and excavation by adult CHF (**Limiting Factor A10**), amount of spawning habitat (**Limiting Factor A11**), amount of rearing habitat (**Limiting Factor A12**), quality of spawning habitat (**Limiting Factor A13**), and spawning escapement (**Limiting Factor A17**). All of these factors differentially affect the abundance of NP CHS as compared to CHS of hatchery origin. Other limiting factors include:

Limiting Factor E1 – abundance of naturally spawning hatchery fish

Potential management options:

E1(a). ODFW attempts to increase homing rates to Cole M. Rivers Hatchery. **Primary Implications:** This action would require the engineering, installation, and operation of an adult fish trap at the primary outflow for the hatchery; or would require blocking adult fish that attempt to enter the primary outflow from the hatchery.

E1(b). ODFW decreases the number of juvenile CHS released from Cole M. Rivers Hatchery. Current releases average 1.6 million smolts annually. **Primary Implications:** This action would result in decreased fishery yields.

APPENDIX F (continued)

E1(c). ODFW develops a sliding scale of smolt release goals dependent on the percentage of naturally produced fish within the parental broodstock. **Primary Implications:** Smolt releases from Cole M. Rivers Hatchery would vary among years.

E1(d). ODFW revises broodstock collection practices at Cole M. Rivers Hatchery to increase age at maturity of progeny by developing length-specific goals for adult fish to be included in the broodstock. Older adults would be selectively bred at the hatchery to compensate for age-selective harvest in the ocean and freshwater fisheries. **Primary Implications:** This action would likely (1) increase harvest in the ocean fisheries, (2) to a lesser degree, decrease harvest in the freshwater fishery, and (3) decrease the number of hatchery fish that spawn naturally. This action also runs counter to the prevailing concept of random mating of hatchery brood stocks. Currently, jacks excepted, size (age) is not considered when collecting fish for broodstock at the hatchery.

E1(e). ODFW terminates the recycling of excess hatchery fish through the recreational fishery upstream of Gold Ray Dam. **Primary Implications:** This action will result in decreased fishery yields and it's likely that few recycled fish spawn naturally.

E1(f). Take no action.

Limiting Factor E2 - age-selective fishing mortality in the ocean

Potential management options:

Naturally produced CHS are selectively harvested by the ocean fisheries as compared to CHS of hatchery origin, because hatchery fish tend to mature at younger ages than wild fish (ODFW 2000). Thus, management actions directed at the ocean fisheries affect the relative abundance of hatchery fish among adult CHS that return to freshwater. Options for potential management actions associated with ocean fisheries were previously described (*see* **Limiting Factor A15**).

Limiting Factor E3 - selective fishing mortality in freshwater

Potential management options:

Naturally produced CHS are selectively harvested in the recreational fishery upstream of Gold Ray Dam because most hatchery CHS tend to enter Cole M. Rivers Hatchery while NP CHS remain in the river (ODFW 2000). Fishery management actions can differentially affect the number of wild and hatchery fish that survive to spawn. Options for relevant potential management actions were previously described (*see* **Limiting Factor A16**).

Limiting Factor E4 – water temperature during juvenile rearing

Potential management options:

E4(a). ODFW requests that the USACE manage reservoir releases to increase water temperatures during spring and early summer when juveniles rear in freshwater. Increased growth rates cause juveniles migrate earlier to the ocean, which in turn causes chinook salmon to mature at younger ages (ODFW 2000). A younger age at maturity increases spawning escapement of NP CHS because the ocean and freshwater fisheries operate in an age-selective manner (ODFW 2000). **Primary Implications:** This action would likely conserve cold water stored in Lost Creek Lake, and would result in warmer water temperatures during the period eggs incubate in the gravel (*see* **Limiting Factor A2**). However, this action would also increase the relative abundance of younger fish in the run (conflicts with desired status element of no more than 10% jacks among NP CHS that pass Gold Ray Dam). Water temperature modeling is needed to assess magnitude of these impacts.

E4(b). Take no action.

APPENDIX G

Potential Strategies for Management of Freshwater Fisheries Considered during Plan Development

Limiting Factor A16 – fishing mortality in freshwater

The following options for specific regulations apply only to wild chinook salmon (CH), unless otherwise stated. For all options, the harvest of wild chinook salmon is closed during August through December in the area upstream of Gold Ray Dam, unless otherwise stated. Also, for all options, gear and method restrictions apply only to the period of January through July, unless otherwise stated.

Alternative A16(a)

Management options are organized under the scenario that wild spring chinook salmon would be managed without differential protection to various segments of the run. Regional (zone) harvest limits would be employed during fisheries for spring chinook salmon.

Option A16(a1). Harvest of wild CH and hatchery CH opens 1 July below Gold Ray Dam and is closed above Gold Ray Dam.
Option A16(a2). Harvest of wild CH opens 1 July below Gold Ray Dam and is closed above Gold Ray Dam.
Option A16(a3). Harvest of wild CH opens 1 January below Gold Ray Dam and is closed above Gold Ray Dam.
Option A16(a4). Harvest of wild CH opens 1 July below Gold Ray Dam and is open January-July above Gold Ray Dam.
Option A16(a5). Harvest of wild CH opens 1 July below Gold Ray Dam and is open January-June above Gold Ray Dam.
Option A16(a6). Harvest of wild CH opens 1 June below Gold Ray Dam and is open January-June above Gold Ray Dam.
Option A16(a7). Harvest of wild CH opens 1 May below Gold Ray Dam and is open January-June above Gold Ray Dam.
Option A16(a8). Extend angling deadlines at migration bottlenecks (Rainie Falls, Savage Rapids Dam, Hayes Falls, and Gold Ray Dam).

Alternative A16(b)

Management options are organized under the scenario that wild spring chinook salmon would be managed without differential protection to various segments of the run. Specialized (non-zone) harvest limits would be employed during fisheries for spring chinook salmon.

Option A16(b1). Daily and seasonal limit of one wild CH, January-July.
Option A16(b2). Daily and seasonal limit of one wild CH, January-July below Gold Ray Dam. Harvest of wild CH closed above Gold Ray Dam.
Option A16(b3). Daily and seasonal limit of one wild CH, January-July above Gold Ray Dam. Harvest of wild CH closed below Gold Ray Dam.
Option A16(b4). Daily limit of one wild CH, season limit of three wild CH, January-July
Option A16(b5). Daily limit of one wild CH, season limit of three wild CH, January-July. Harvest of wild CH closed above Gold Ray Dam.
Option A16(b6). Daily limit of one wild CH, season limit of three wild CH, January-July. Harvest of wild CH closed below Gold Ray Dam.
Option A16(b7). Daily limit of one wild CH, January-July.
Option A16(b8). Daily limit of one wild CH, harvest of wild CH closed above Gold Ray Dam.
Option A16(b9). Daily limit of one wild CH, harvest of wild CH closed below Gold Ray Dam.
Option A16(b10). Daily limit of one CH (wild or hatchery) and harvest of wild CH closes June 30 above Gold Ray Dam.
Option A16(b11). Daily limit of one CH (wild or hatchery) and harvest of wild CH closes July 31 above Gold Ray Dam).
Option A16(b12). Extend angling deadlines at migration bottlenecks (Rainie Falls, Savage Rapids Dam, Hayes Falls, and Gold Ray Dam).

APPENDIX G (continued)

Alternative A16(c)

Management options are organized under the scenario that wild spring chinook salmon would be managed without differential protection to various segments of the run. Specialized (non-zone) harvest limits would be employed during fisheries for spring chinook salmon.

Option A16(c1). Daily and seasonal limit of one wild CH, January-July.
Option A16(c2). Daily limit of one wild CH, season limit of three wild CH, January-July.
Option A16(c3). Daily limit of one wild CH, January-July.
Option A16(c4). Daily limit of one CH (wild or hatchery), January-July.

Package 1 - Gear and Method Options

Gear restrictions include: (1) two hooks maximum per line, (2) barbless hooks only, maximum hook size of #1 on non-floating lures, (4) maximum hook size of 2/0 for single hooks, (5) maximum leader length of five feet between attached weight and farthest hook.

Method restrictions include: (1) CH to be released must be kept in water, (2) soft nets must be used when handling CH in areas downstream of Hog Creek, (3) no fishing from moored device, Touvelle Park – Cole M. Rivers Hatchery, May – October, (4) ODFW recommends, to Oregon State Marine Board, no motor use between Touvelle Park and Cole M. Rivers Hatchery, May – October.

Package 2 - Gear and Method Options

Gear restrictions include: (1) maximum leader length of five feet between attached weight and farthest hook, (2) no treble hooks allowed, except on floating lures.

Method restrictions include: (1) CH to be released must be kept in water, (2) soft nets must be used when handling CH in areas downstream of Hog Creek.

Alternative A16(d)

Management options are organized under the scenario that wild spring chinook salmon would be managed with differential protection to various segments of the run. Regional (zone) harvest limits would be employed during fisheries for spring chinook salmon.

Option A16(d1). Harvest of wild CH is closed upstream of Dodge Bridge.
Option A16(d2). Harvest of wild CH is closed upstream of Shady Cove.
Option A16(d3). No fishing allowed, May – October, Elk Creek – Shady Cove.
Option A16(d4). No fishing allowed, May – October, Shady Cove – Dodge Bridge.
Option A16(d5). Harvest of wild CH opens 1 May below Gold Ray Dam and is closed above Gold Ray Dam.
Option A16(d6). Harvest of wild CH opens 1 June below Gold Ray Dam and is closed above Gold Ray Dam.
Option A16(d7). Harvest of wild CH opens 1 July below Gold Ray Dam and is closed above Gold Ray Dam.
Option A16(d8). Harvest of wild CH opens May 1 below Gold Ray Dam and is open July + August, Dodge Bridge to Gold Ray Dam.
Option A16(d9). Harvest of wild CH opens June 1 below Gold Ray Dam and is open July + August, Dodge Bridge to Gold Ray Dam.
Option A16(d10). Harvest of wild CH opens 1 June below Dodge Bridge and closes 31 August above Gold Ray Dam.
Option A16(d11). Harvest of wild CH opens 1 July below Dodge Bridge and closes 31 August above Gold Ray Dam.
Option A16(d12). Harvest of wild CH opens June 1 below Gold Ray Dam and is open July + August, Shady Cove to Gold Ray Dam.
Option A16(d13). Harvest of wild CH opens June 1 below Gold Ray Dam, closes June 30 above Dodge Bridge, and closes August 31 above Gold Ray Dam.
Option A16(d14). Harvest of wild CH opens June 1 below Gold Ray, closes June 30 above Shady Cove, and closes August 31 above Gold Ray Dam.
Option A16(d15). Extend deadlines at migration bottlenecks (Rainie Falls, Savage Rapids Dam, Hayes Falls, and Gold Ray Dam).

APPENDIX G (continued)

Alternative A16(e)

Management options are organized under the scenario that wild spring chinook salmon should be managed with differential protection to various segments of the run. Specialized (non-zone) harvest limits would be employed during fisheries for spring chinook salmon.

Option A16(e1). Harvest of wild CH is closed upstream of Dodge Bridge.
Option A16(e2). Harvest of wild CH is closed upstream of Shady Cove.
Option A16(e3). Harvest of wild CH is closed in the area between Rogue Elk Park and the Highway 62 bridge at McGregor Park. Area is open only to flyfishing or fishing with floating lures.
Option A16(e4). Daily and seasonal limit of one wild CH for (inclusive):
Mouth to Hog Creek, January - May (zone limits after May),
Hog Creek to Gold Ray Dam, January - June (zone limits after June),
Gold Ray Dam to McGregor Park, January - July,
McGregor Park to Cole M. Rivers Hatchery, January - 15 September.
Option A16(e5). Daily limit of one wild CH, season limit of three wild CH, for (inclusive):
Mouth to Hog Creek, January - June (zone limits after June),
Hog Creek to Cole M. Rivers Hatchery, January - July.
Option A16(e6). Daily limit of one wild CH, season limit of three wild CH, for (inclusive):
Mouth to Hog Creek, January - June (zone limits after June)
Hog Creek to Shady Cove, January - July.

Package 1 - Gear and Method Options

Gear restrictions include: (1) two hooks maximum per line, (2) barbless hooks only, maximum hook size of #1 on non-floating lures, (4) maximum hook size of 2/0 for single hooks, (5) maximum leader length of five feet between attached weight and closest hook.

Method restrictions include: (1) CH to be released must be kept in water, (2) soft nets must be used when handling CH in areas downstream of Hog Creek, (3) no fishing from moored device, Touvelle Park – Cole M. Rivers Hatchery, May – October, (4) ODFW recommends, to Oregon State Marine Board, no motor use between Touvelle Park and Cole M. Rivers Hatchery, May – October.

Package 2 - Gear and Method Options

Gear restrictions include: (1) maximum leader length of five feet between attached weight and farthest hook, (2) no treble hooks allowed, except on floating lures.

Method restrictions include: (1) CH to be released must be kept in water, (2) soft nets must be used when handling CH in areas downstream of Hog Creek.

APPENDIX H

Description of Alternative Suites of Management Actions
(abbreviations described in **APPENDIX A**)

ALTERNATIVE SUITES OF MANAGEMENT ACTIONS

Alternative 1

a. Limit NP CHS to current habitat
b. Reservoir management recommendations designed solely for NP CHS
c. Terminate freshwater harvest of NP CHS

Alternative 2

a. Limit NP CHS to current habitat
b. Reservoir management strategies designed for emphasis on NP CHS
c. Terminate freshwater harvest of NP CHS

Alternative 3

a. Expand natural spawning habitat for NP CHS
b. Reservoir management strategies designed for emphasis on NP CHS
c. Freshwater harvest opportunity for late-run NP CHS

Alternative 4

a. Establish juvenile production in areas not accessible to adult CHS
b. Reservoir management strategies designed for emphasis on NP CHS
c. Freshwater harvest opportunity for mid- and late-run NP CHS

Alternative 5

a. Expand natural spawning habitat for NP CHS
b. Establish juvenile production in areas not accessible to adult CHS
c. Reservoir management strategies designed for emphasis on NP CHS
d. Freshwater harvest opportunity for mid- and late-run NP CHS

Alternative 6

a. Expand natural spawning habitat for NP CHS
b. Reservoir management strategies designed for emphasis on NP CHS
c. Establish freshwater sanctuary area (no fishing) for early-run NP CHS

Alternative 7

a. Expand natural spawning habitat for NP CHS
b. Reservoir management strategies designed for emphasis on NP CHS
c. Specialized regulations for freshwater CHS fisheries

Alternative 8

a. Expand natural spawning habitat for NP CHS
b. Establish juvenile production in areas not accessible to adult CHS
c. Reservoir management strategies designed for emphasis on NP CHS
d. Specialized regulations for freshwater CHS fisheries
e. Increased control of predators

Alternative 9

a. Expand natural spawning habitat for NP CHS
b. Reservoir management strategies designed for emphasis on NP CHS
c. Regional regulations for freshwater CHS fisheries
d. Adjust production goals at Cole M. Rivers Hatchery

APPENDIX H (continued)

PROPOSED MANAGEMENT ACTIONS COMMON TO ALL ALTERNATIVES

Coded management actions are described in **APPENDIX F**

Management Actions Related to the Operation of Lost Creek Lake

A1(a) Request reduced peak flows during egg and sac-fry incubation
A2(a) Request release of coldest water possible during egg and sac-fry incubation
A2(b) Request water temperature modeling from USACE
A3(a) Request minimal flow augmentation during spawning
A4(a) Request USACE employ current criteria to minimize fry dewatering
A4(b) Request USACE development of improved methods to minimize fry dewatering
A6(a) Request reservoir releases to increase smolt survival
A9(a) Request reservoir releases to increase adult survival
A10(b) Request decreased flow augmentation during CHF migration
A10(d) Request water temperature modeling from USACE
A13(c) Request restoration and maintenance of spawning habitat by USACE

Management Actions Related to Other Habitat Issues

A8(a) Support improvements of fish passage facilities
A13(d) If warranted, improve spawning habitat in Big Butte Creek*****
A14(a) Develop landowner education program

Management Actions Related to Other Species of Animals

A7(b) Encourage fishing related mortality on non-native Umpqua pikeminnows
A7(e) ODFW requests that NOAA Fisheries evaluate effects on marine mammals*****

Management Actions Related to Hatchery Fish

(none)

Management Actions Related to Fisheries

A16(g) Promote ethical angling and proper techniques for catch and release.
A16(h) Increase effectiveness of enforcement of fishery regulations.

*** Exception, not included in Alternative 9.**

APPENDIX H (continued)

ALTERNATIVE 1

a. Limit NP CHS to current habitat
b. Reservoir management recommendations designed solely for NP CHS
c. Terminate freshwater harvest of NP CHS

MANAGEMENT SUITE

Coded management Actions are described in **APPENDIX F** and **APPENDIX G**

Management Actions Related to the Operation of Lost Creek Lake

(employs actions common to other alternatives)

A6(b) Request increased reservoir releases in summer
A7(a) Request increased reservoir releases in summer
A9(b) Request increased reservoir releases in late spring and early summer

Management Actions Related to Other Habitat Issues

(employs strategies common to other alternatives)

Management Actions Related to Other Species of Animals

(employs strategies common to other alternatives)

Management Actions Related to Hatchery Fish

(none)

Management Actions Related to Fisheries

(employs strategies common to other alternatives)

A16(d7): Regional (zone) angling regulations employed for the Rogue River. Harvest of NP chinook salmon opens 1 July below Gold Ray Dam and remains closed above Gold Ray Dam.

PRIMARY IMPLICATIONS OF THE ALTERNATIVE

In-river mortality rates of CHF and coho salmon will increase over time, compared with other alternatives, as additional reservoir storage is purchased for consumptive uses. Freshwater harvest of NP CHS is limited to a few late-run fish.

APPENDIX H (continued)

ALTERNATIVE 2

a. Limit NP CHS to current habitat
b. Reservoir management strategies designed for emphasis on NP CHS
c. Terminate freshwater harvest of NP CHS

MANAGEMENT SUITE

Coded management strategies are described in **APPENDIX F** and **APPENDIX G**

Management Actions Related to the Operation of Lost Creek Lake

(employs strategies common to other alternatives, except Alternative 1)

Management Actions Related to Other Habitat Issues

(employs strategies common to other alternatives)

Management Actions Related to Other Species of Animals

(employs strategies common to other alternatives)

Management Actions Related to Hatchery Fish

(none)

Management Actions Related to Fisheries

(employs strategies common to other alternatives)

A16(d7): Regional (zone) angling regulations employed for the Rogue River. Harvest of NP chinook salmon opens 1 July below Gold Ray Dam and remains closed above Gold Ray Dam.

PRIMARY IMPLICATIONS OF THE ALTERNATIVE

Freshwater harvest of NP CHS is limited to a few late-run fish.
In-river mortality rates of CHF and coho salmon may increase.

APPENDIX H (continued)

ALTERNATIVE 3

a. Expand natural spawning habitat for NP CHS
b. Reservoir management strategies designed for emphasis on NP CHS
c. Freshwater harvest opportunity for late-run NP CHS

MANAGEMENT SUITE

Coded management strategies are described in **APPENDIX F** and **APPENDIX G**

Management Actions Related to the Operation of Lost Creek Lake
(employs strategies common to other alternatives, except Alternative 1)

Management Actions Related to Other Habitat Issues
(employs actions common to other alternatives)
A11(a,e) Improve passage for adult CHS at a natural barrier in lower Big Butte Creek.
A12(c) Secure, if opportunity arises, September-October flows needed for adult CHS migration and spawning in Little Butte Creek.

Management Actions Related to Other Species of Animals
(employs actions common to other alternatives)

Management Actions Related to Hatchery Fish
(none)

Management Actions Related to Fisheries
(employs actions common to other alternatives)
A16(d9): Regional (zone) angling regulations employed for the Rogue River. Harvest of NP chinook salmon opens 1 June below Gold Ray Dam, and is open July-August between Gold Ray Dam and Dodge Bridge.

PRIMARY IMPLICATIONS OF THE ALTERNATIVE

Harvest of NP CHS will include some mid-run fish in addition to late-run fish.
Flow in Little Butte Creek will likely need to exceed 120 cfs during 15 September through 15 October in order to establish a naturally spawning population. This volume of water will be difficult to obtain.
In-river mortality rates of CHF and coho salmon may increase.

APPENDIX H (continued)

ALTERNATIVE 4

a. Establish juvenile production in areas not accessible to adult CHS
b. Reservoir management actions designed for emphasis on NP CHS
c. Freshwater harvest opportunity for mid- and late-run NP CHS

MANAGEMENT SUITE

Coded management actions are described in **APPENDIX F** and **APPENDIX G**

Management Actions Related to the Operation of Lost Creek Lake
(employs actions common to other alternatives, except Alternative 1)

Management Actions Related to Other Habitat Issues
(employs actions common to other alternatives)
A11(b) Excess broodstock at Cole M. Rivers Hatchery is transported to habitat not accessible to naturally spawning CHS.

Management Actions Related to Other Species of Animals
(employs actions common to other alternatives)

Management Actions Related to Hatchery Fish
A11(b) Excess broodstock at Cole M. Rivers Hatchery is transported to habitat not accessible to naturally spawning CHS.
E1(a) Adult hatchery fish are trapped from the outflow of Cole M. Rivers Hatchery.

Management Actions Related to Fisheries
(employs actions common to other alternatives)
A16(d8): Regional (zone) angling regulations employed for the Rogue River. Harvest of NP chinook salmon opens 1 May below Gold Ray Dam, and is open July-August between Gold Ray Dam and Dodge Bridge.

PRIMARY IMPLICATIONS OF THE ALTERNATIVE

Harvest of NP CHS will include some early-run fish in addition to mid-run and late-run fish.
Significant numbers of adult CHS will need to be transported from Cole M. Rivers Hatchery for release in non-historic habitat. The survival rate of transported adults may be low, and progeny that survive to maturity would not be able to return to natal areas.
Trapping of adult CHS at the outflow of Cole M. Rivers Hatchery will require a significant amount of engineering and construction.
In-river mortality rates of CHF and coho salmon may increase.

APPENDIX H (continued)

ALTERNATIVE 5

a. Expand natural spawning habitat for NP CHS
b. Establish juvenile production in areas not accessible to adult CHS
c. Reservoir management actions designed for emphasis on NP CHS
d. Freshwater harvest opportunity for mid- and late-run NP CHS

MANAGEMENT SUITE

Coded management actions are described in **APPENDIX F** and **APPENDIX G**

Management Actions Related to the Operation of Lost Creek Lake
(employs actions common to other alternatives, except Alternative 1)

Management Actions Related to Other Habitat Issues
(employs actions common to other alternatives)

A11(a,e) Improve passage for adult CHS at a natural barrier in lower Big Butte Creek.
A11(b) Excess broodstock at Cole M. Rivers Hatchery is transported to habitat not accessible to naturally spawning CHS.
A12(c) Secure, if opportunity arises, September-October flows needed for adult CHS migration and spawning in Little Butte Creek.

Management Actions Related to Other Species of Animals
(employs actions common to other alternatives)

Management Actions Related to Hatchery Fish

A11(b) Excess broodstock at Cole M. Rivers Hatchery is transported to habitat not accessible to naturally spawning CHS.
E1(a) Adult CHS are trapped at the outflow of Cole M. Rivers Hatchery.

Management Actions Related to Fisheries
(employs actions common to other alternatives)

A16(d8): Regional (zone) angling regulations employed for the Rogue River. Harvest of NP chinook salmon opens 1 May below Gold Ray Dam, and is open July-August between Gold Ray Dam and Dodge Bridge.

PRIMARY IMPLICATIONS OF THE ALTERNATIVE

Harvest of NP CHS will include some early-run fish in addition to mid-run and late-run fish.
Significant numbers of adult CHS will need to be transported from Cole M. Rivers Hatchery for release in non-historic habitat. The survival rate of transported adults may be low, and progeny that survive to maturity would not be able to return to natal areas.
Transportation of juvenile steelhead and coho salmon may slightly increase the proportion of hatchery fish among natural spawners.
Trapping of adult CHS at the outflow of Cole M. Rivers Hatchery will require a significant amount of engineering and construction.
In-river mortality rates of CHF and coho salmon may increase.

APPENDIX H (continued)

ALTERNATIVE 6

a. Expand natural spawning habitat for NP CHS
b. Reservoir management actions designed for emphasis on NP CHS
c. Establish freshwater sanctuary area (no fishing) for early-run NP CHS

MANAGEMENT SUITE

Coded management actions are described in **APPENDIX F** and **APPENDIX G**

Management Actions Related to the Operation of Lost Creek Lake

(employs actions common to other alternatives, except Alternative 1)

Management Actions Related to Other Habitat Issues

(employs actions common to other alternatives)

A11(a,e) Improve passage for adult CHS at a natural barrier in lower Big Butte Creek.
A12(c) Secure, if opportunity arises, September-October flows needed for adult CHS migration and spawning in Little Butte Creek.

Management Actions Related to Other Species of Animals

(employs actions common to other alternatives)

Management Actions Related to Hatchery Fish

(none)

Management Actions Related to Fisheries

(employs actions common to other alternatives)

Fishery option A16(d3): Regional (zone) angling regulations employed for the Rogue River. Rogue River is closed to fishing in the area between Elk Creek and the Highway 62 bridge at Shady Cove, May-October .

PRIMARY IMPLICATIONS OF THE ALTERNATIVE

Harvest of NP CHS will include some mid-run fish in addition to late-run fish.
Flow in Little Butte Creek will likely need to exceed 120 cfs during 15 September through 15 October in order to establish a naturally spawning population. This volume of water will be difficult to obtain.
Anglers will not be able to fish for six months in the six miles immediately upstream of the Highway 62 bridge at Shady Cove.
In-river mortality rates of CHF and coho salmon may increase.

APPENDIX H (continued)

ALTERNATIVE 7

a. Expand natural spawning habitat for NP CHS
b. Reservoir management actions designed for emphasis on NP CHS
c. Specialized regulations for freshwater CHS fisheries

MANAGEMENT SUITE

Coded management actions are described in **APPENDIX F** and **APPENDIX G**

Management Actions Related to the Operation of Lost Creek Lake
(employs actions common to other alternatives, except Alternative 1)

Management Actions Related to Other Habitat Issues
(employs actions common to other alternatives)
A11(a,e) Improve passage for adult CHS at a natural barrier in lower Big Butte Creek.
A12(c) Secure, if opportunity arises, September-October flows needed for adult CHS migration and spawning in Little Butte Creek.

Management Actions Related to Other Species of Animals
(employs actions common to other alternatives)

Management Actions Related to Hatchery Fish
(none)

Management Actions Related to Fisheries
(employs actions common to other alternatives)
A16(e4): Specialized angling regulations employed for the Rogue River.
- Harvest Regulations:
  - Mouth to Hog Creek:
    - 1 January to 31 May:
      - Seasonal bag limit of one NP chinook salmon.
      - Nets, if used to land chinook salmon, must be made of soft cotton.
    - 1 June onward: Regional (zone) harvest regulations for chinook salmon.
  - Hog Creek to Gold Ray Dam:
    - 1 January to 30 June:
      - Seasonal bag limit of one NP chinook salmon.
    - 1 July onward: Regional (zone) angling harvest regulations for chinook salmon.
  - Gold Ray Dam to Highway 62 Bridge at McGregor Park:
    - 1 January to 31 July:
      - Seasonal bag limit of one NP chinook salmon.
  - Highway 62 Bridge at McGregor Park to Cole M. Rivers Hatchery:
    - 1 January to 15 September:
      - Seasonal bag limit of one NP chinook salmon.
- Gear Regulations (entire year):
  - Maximum leader length of five feet between attached weight and closest hook
  - No treble hooks, except on floating lures.
- Method Regulations:
  - Chinook salmon to be released must be left in water.

PRIMARY IMPLICATIONS OF THE ALTERNATIVE

Harvest will include early-run, mid-run, and late-run NP CHS.
In-river mortality rates of CHF and coho salmon may increase.

APPENDIX H (continued)

ALTERNATIVE 8

a. Expand natural spawning habitat for NP CHS
b. Establish juvenile production in areas not accessible to adult CHS
c. Reservoir management actions designed for greater emphasis on NP CHS
d. Specialized regulations for freshwater CHS fisheries
e. Increased control of predators

MANAGEMENT SUITE

Coded management actions are described in **APPENDIX F** and **APPENDIX G**

Management Actions Related to the Operation of Lost Creek Lake

(employs actions common to other alternatives, except Alternative 1)

A1(b) Request increased reduction of peak flows during egg and sac-fry incubation.
A2(c) Request that USACE investigate potential to bypass reservoir inflow.

Management Actions Related to Other Habitat Issues

(employs actions common to other alternatives)

A11(a,e) Improve passage for adult CHS at a natural barrier in lower Big Butte Creek.
A11(b) Excess broodstock at Cole M. Rivers Hatchery is transported to habitat not accessible to naturally spawning CHS.
A12(c) Secure, if opportunity arises, September-October flows needed for adult CHS migration and spawning in Little Butte Creek.

Management Actions Related to Other Species of Animals

(employs actions common to other alternatives)

A7(d) Initiate program to decrease numbers of cormorants

Management Actions Related to Hatchery Fish

A5(e) Transport and release juvenile steelhead and coho salmon of hatchery origin downstream of Gold Ray Dam.
A11(b) Excess broodstock at Cole M. Rivers Hatchery is transported to habitat not accessible to naturally spawning CHS.
E1(a) Block hatchery outflow to decrease the number of hatchery fish that spawn naturally.
E1(d) Revise spawning practices to increase harvest rates for CHS of hatchery origin.

Management Actions Related to Fisheries

(employs actions common to other alternatives)

A16(d2,e6): Specialized angling regulations employed for the Rogue River.
- Harvest Regulations:
  - Mouth to Hog Creek:
    - 1 January to 30 June:
      - Limits for NP chinook salmon: one daily, three during season.
    - 1 July onward: Regional (zone) harvest regulations for chinook salmon.
  - Hog Creek to Highway 62 bridge at Shady Cove:
    - 1 January to 31 July:
      - Limits for NP chinook salmon: one daily, three during season
  - Highway 62 Bridge at Shady Cove to Cole M. Rivers Hatchery:
    - 1 January to 31 July:
      - Closed to harvest of NP chinook salmon.
- Gear Regulations (entire year):
  - In addition to the general (statewide) hook and weight regulations, any attached weight may be no more than 5 feet above the lowermost hook.
- Method Regulation:
  - Chinook salmon to be released must be left in water.

PRIMARY IMPLICATIONS OF ALTERNATIVE 8

Harvest will include early-run, mid-run, and late-run NP CHS.
Establishes an upstream “deadline” for the harvest of NP CHS.
Progeny produced from transported adults will not be able to return to natal areas.
Federal authorization is needed to take actions designed to reduce cormorant populations.
In-river mortality rates of CHF and coho salmon may increase.
Increased reductions in peak flows will require that annual releases from Lost Creek Lake exceed the release volume authorized by Congress during “normal” years.

APPENDIX H (continued)

ALTERNATIVE 9

a. Expand natural spawning habitat for NP CHS
b. Reservoir management actions designed for emphasis on NP CHS
c. Regional regulations for freshwater CHS fisheries
d. Adjust production goals at Cole M. Rivers Hatchery

MANAGEMENT SUITE

Coded management actions are described in **APPENDIX F** and **APPENDIX G**

Management Actions Related to the Operation of Lost Creek Lake
(employs actions common to other alternatives, except Alternative 1)

Management Actions Related to Other Habitat Issues
(employs actions common to other alternatives)
A11(a,e) Improve passage for adult CHS at a natural barrier in lower Big Butte Creek.

Management Actions Related to Other Species of Animals
(employs actions common to other alternatives)

Management Actions Related to Hatchery Fish
A5(b) Reduce releases of coho salmon to decrease predation on NP CHS fry.
E1(a) Block hatchery outflow to decrease the number of hatchery fish that spawn naturally.

Management Actions Related to Fisheries
(employs actions common to other alternatives)
A16(d9): Regional (zone) angling regulations employed for the Rogue River. Harvest of NP chinook salmon opens 1 June below Gold Ray Dam, and is open during July-August between Gold Ray Dam and Dodge Bridge.

PRIMARY IMPLICATIONS OF THE ALTERNATIVE

Harvest of NP CHS will include some mid-run fish in addition to late-run fish.
Reduction of coho salmon production at Cole M. Rivers Hatchery should be offset with increased production of CHS in order to (1) compensate for fishery losses and (2) meet intent of mitigation goals.
In-river mortality rates of CHF and coho salmon may increase.

APPENDIX I

Data and Estimates Used during Plan Development

Appendix Table I-1. Estimates of the number of chinook salmon that passed the fish counting station at Gold Ray Dam, 1942-2006. Estimates for 1942-1994 were reported by ODFW (2000) and differ somewhat from other estimates distributed by ODFW.

	Spring chinook salmon			Fall chinook salmon		
Year	Wild	Hatchery	Total	Wild	Hatchery	Total
1942	41,779	a	41,779	1,579	a	1,579
1943	36,136	a	36,136	1,926	a	1,926
1944	30,632	a	30,632	1,307	a	1,307
1945	31,998	a	31,998	1,722	a	1,722
1946	28,374	a	28,374	1,681	a	1,681
1947	33,637	a	33,637	1,103	a	1,103
1948	26,979	a	26,979	763	a	763
1949	18,810	a	18,810	1,218	a	1,218
1950	15,530	a	15,530	1,240	a	1,240
1951	19,543	a	19,543	1,568	a	1,568
1952	15,888	a	15,888	2,600	a	2,600
1953	31,327	138	31,465	2,083	0	2,083
1954	24,585	119	24,704	1,081	0	1,081
1955	15,613	101	15,714	836	0	836
1956	27,751	317	28,068	1,884	0	1,884
1957	16,517	1,193	17,710	1,060	0	1,060
1958	14,486	530	15,016	700	0	700
1959	13,918	54	13,972	735	0	735
1960	24,264	110	24,374	1,843	0	1,843
1961	31,006	769	31,775	1,260	0	1,260
1962	30,965	430	31,395	1,256	0	1,256
1963	39,094	1,473	40,567	960	0	960
1964	36,384	1,006	37,390	1,140	0	1,140
1965	51,807	2,406	49,401	1,701	0	1,701
1966	30,825	953	31,778	1,095	0	1,095
1967	14,627	452	15,079	1,838	0	1,838
1968	20,220	625	20,845	a	a	a
1969	57,797	1,107	58,904	2,039	0	2,039
1970	44,857	692	45,549	3,106	0	3,106
1971	28,761	1,124	29,885	2,400	0	2,400
1972	29,424	818	30,242	2,739	0	2,739
1973	34,987	583	35,570	2,819	0	2,819
1974[b]	16,756	508	17,264	2,322	0	2,322
1975[b]	20,391	1,018	21,409	2,310	0	2,310
1976[b]	20,542	1,153	21,695	2,648	0	2,648
1977[b]	14,884	1,511	16,395	5,181	0	5,181
1978[b]	40,381	6,843	47,224	5,888	0	5,888
1979[b]	29,536	8,996	38,532	3,097	5	3,111

[a] *Estimates could not be developed for these years.*
[b] *Estimates of unmarked hatchery fish were developed from scale analyses of chinook salmon trapped at Gold Ray Dam (ODFW 2000).*

Appendix Table I-1 (continued).

	Spring chinook salmon			Fall chinook salmon		
Year	Wild	Hatchery	Total	Wild	Hatchery	Total
1980[b]	26,484	10,167	36,651	2,853	137	2,990
1981[b]	12,079	5,206	17,285	4,289	480	4,869
1982[b]	21,043	8,900	29,943	4,078	524	4,602
1983[b]	8,957	3,554	12,511	3,607	232	3,839
1984[b]	7,417	5,224	12,641	2,971	215	3,186
1985[b]	24,020	17,020	41,040	6,085	2,367	8,452
1986[b]	41,530	47,992	89,522	10,616	3,623	14,239
1987[b]	33,886	47,696	81,582	8,445	2,255	10,700
1988[b]	52,488	30,397	82,885	9,397	2,106	11,503
1989[b]	14,161	46,169	60,330	5,567	1,336	6,903
1990[b]	8,428	16,162	24,590	3,007	646	3,653
1991[b]	3,991	8,922	12,913	3,042	163	3,205
1992[b]	1,618	4,183	5,801	6,100	697	6,797
1993[b]	8,060	18,043	26,103	6,001	710	6,711
1994[b]	4,470	9,606	14,076	11,014	516	11,530
1995[c]	20,726	61,225	81,951	14,105	261	14,366
1996[c]	10,307	26,314	36,621	11,220	165	11,385
1997[c]	9,599	32,195	41,794	4,780	77	4,857
1998[c]	3,684	12,273	15,957	5,264	68	5,332
1999[c]	5,952	15,029	20,981	3,499	41	3,540
2000[c]	3,443	26,822	30,265	9,861	31	9,892
2001[c]	9,340	23,933	33,273	13,351	255	13,606
2002[c]	6,989	40,792	47,781	18,900	923	19,823
2003[c]	19,270	22,571	41,841	24,088	769	24,857
2004[c]	13,254	25,989	39,243	14,541	466	15,007
2005[c]	5,804	12,286	18,090	8,244	371	8,615
2006[cd]	4,755	6,963	11,718	6,624	281	6,905

[c] *Estimates of unmarked hatchery fish were developed based the difference in the proportions of marked spring chinook salmon at Gold Ray Dam as compared to Cole M. Rivers Hatchery.*

[d] *Preliminary estimates.*

Appendix Table I-2. Estimates of the basic fishery metrics for wild spring chinook salmon in the Rogue Species Management Unit, 1972-2000 brood years. Estimates assume that among spring chinook salmon of the same age, that wild and coded-wire tagged hatchery fish were harvested at the same rate (ODFW 2000).

Brood	# age 2	Ocean	River harvest			River	Harvest				Spawners[k]	
year	in ocean[a]	harvest[b]	total[c]	below[d]	above[e]	return[f]	rate[g]	Recruits[h]	Smolts[i]	Fry[j]	All	no jacks
1972	220,394	61,373	5,436	3,372	2,064	26,362	0.76	87,735	--	--	--	--
1973	184,923	50,969	4,439	2,177	2,261	23,722	0.74	74,691	--	--	--	--
1974	283,162	75,730	8,816	3,152	5,664	38,351	0.74	114,081	--	--	--	--
1975	276,218	79,686	8,857	3,026	5,832	30,559	0.80	110,244	3,694,119	359	17,974	11,974
1976	309,885	93,829	9,691	2,520	7,172	36,939	0.79	130,768	1,962,349	195	17,259	12,991
1977	54,159	15,003	2,484	671	1,813	7,089	0.79	22,092	3,311,710	461	9,750	7,784
1978	108,581	23,715	6,944	2,057	4,887	24,343	0.64	48,059	1,932,632	503	33,862	21,747
1979	102,998	14,983	2,825	1,004	1,821	10,881	0.69	25,864	1,868,784	220	22,297	16,108
1980	162,107	6,683	3,726	876	2,850	18,568	0.41	25,251	916,887	74	20,583	14,333
1981	47,586	2,127	3,471	904	2,567	15,801	0.31	17,929	623,152	--	6,753	4,143
1982	84,630	14,529	4,541	1,104	3,437	21,487	0.53	36,016	1,530,471	318	16,217	8,683
1983	240,005	46,278	11,314	2,145	9,169	58,534	0.55	104,813	4,413,059	162	7,482	5,238
1984	308,914	62,939	17,827	3,999	13,827	67,950	0.62	130,889	892,566	688	6,430	4,099
1985	114,985	21,232	8,224	1,879	6,344	29,167	0.58	50,399	3,037,000	607	17,995	10,945
1986	87,713	23,643	5,327	1,504	3,823	14,310	0.76	37,953	1,471,215	653	35,932	11,749
1987	24,712	3,639	1,771	720	1,051	6,043	0.56	9,683	1,362,577	1,432	27,202	15,817
1988	34,450	4,949	2,341	1,230	1,111	7,827	0.57	12,776	1,945,146	693	39,470	27,247
1989	55,048	9,592	3,788	1,902	1,886	10,985	0.65	20,577	854,673	957	10,631	8,789
1990	30,640	2,743	2,507	1,144	1,363	9,866	0.42	12,609	619,392	561	5,015	4,096
1991	70,118	2,667	8,813	4,021	4,792	24,262	0.43	26,929	538,319	212	3,118	2,510
1992	49,587	3,275	6,294	3,845	2,449	16,385	0.49	19,660	553,457	49	1,163	906
1993	36,409	1,333	3,727	2,045	1,682	12,629	0.36	13,962	496,106	137	6,340	4,762
1994	5,594	362	545	330	215	1,814	0.42	2,176	436,741	--	2,912	2,633
1995	24,920	223	2,670	1,492	1,178	9,327	0.30	9,550	292,964	--	17,826	16,216
1996	3,449	75	381	158	223	1,208	0.36	1,283	332,058	--	8,867	8,477
1997	39,667	1,145	4,146	1,501	2,645	14,587	0.34	15,732	--	--	9,402	9,166
1998	36,031	1,655	3,636	1,344	2,291	11,647	0.40	13,301	--	--	3,672	3,039
1999	57,460	1,774	6,593	2,544	4,049	20,481	0.38	22,255	--	--	5,966	5,799
2000	46,855	3,868	4,620	1,776	2,844	14,966	0.45	18,833	--	--	3,774	2,779

[a] *Estimated number of fish alive in the ocean before any maturation at age 2.*
[b] *Estimated harvest in the ocean fisheries.*
[c] *Estimated number harvested in freshwater.*
[d] *Estimated number harvested in freshwater downstream of Gold Ray Dam.*
[e] *Estimated number harvested in freshwater upstream of Gold Ray Dam.*
[f] *Estimated number that entered freshwater.*
[g] *Estimated as total harvest divided by the number of recruits.*
[h] *Estimated number harvested in the ocean + the number that returned to freshwater.*
[i] *Estimated number of wild fish (estimated from survival rates of hatchery fish).*
[j] *Catch per seine haul, adjusted for the effects of peak flow and water temperature.*
[k] *Estimated number of wild and hatchery fish that spawned naturally.*

Appendix Table I-3. Productivity estimates for spring chinook salmon in the Rogue Species Management Unit, 1972-2000 brood years. Estimates were derived from numbers reported in Appendix Table I-2.

Brood	Recruits/spawner		Smolts/spawner	
year	All spawners	w/o jacks	All spawners	w/o jacks
1972	--	--	--	--
1973	--	--	--	--
1974	--	--	--	--
1975	6.1	9.2	206	308
1976	7.6	10.1	114	151
1977	2.3	2.8	340	426
1978	1.4	2.2	72	112
1979	1.2	1.6	87	120
1980	1.2	1.8	91	130
1981	2.7	4.3	136	221
1982	2.2	4.1	38	72
1983	14.0	20.0	204	292
1984	20.4	31.9	686	1,077
1985	2.8	4.6	50	82
1986	1.1	3.2	84	259
1987	0.4	0.6	54	93
1988	0.3	0.5	34	50
1989	1.9	2.3	183	221
1990	2.5	3.1	170	209
1991	8.6	10.7	199	247
1992	16.9	21.7	463	594
1993	2.2	2.9	87	116
1994	0.7	0.8	170	188
1995	0.5	0.6	24	27
1996	0.1	0.2	33	35
1997	1.7	1.7	35	36
1998	3.6	4.4	--	--
1999	3.7	3.8	--	--
2000	5.0	6.8	--	--