COHO SALMON MASTER PLAN
CLEARWATER RIVER BASIN

Prepared by

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And

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October 2004

Executive Summary

The Nez Perce Tribe has a desire and a goal to reintroduce and restore coho salmon to the Clearwater River Subbasin at levels of abundance and productivity sufficient to support sustainable runs and annual harvest. Consistent with the Clearwater Subbasin Plan (EcoVista 2003), the Nez Perce Tribe envisions developing an annual escapement of 14,000 coho salmon to the Clearwater River Subbasin.

The historical presence of coho salmon in the Clearwater River Subbasin was documented by Schoning (1940, 1947) and Fulton (1968). Nez Perce Tribe elders confirm that coho salmon were present in the mainstem Clearwater River as well as several tributaries, including the North Fork Clearwater River, Lochsa River, Selway River, and South Fork Clearwater River (Paul Kucera, Nez Perce Tribe Department of Fisheries Resources Management, Personal Communication). However, the construction of Harpster Dam in 1910 eliminated coho salmon access to the South Fork Clearwater River. In 1927, the Washington Water Power Diversion Dam was constructed just above the mouth of the Clearwater River. Fish passage facilities were not provided at the time of construction, and retrofitted ladders proved impassable for coho salmon, which were subsequently extirpated from the Clearwater River Subbasin. The Harpster Dam was removed in 1963, and the Washington Water Power Diversion Dam was removed in 1972. However, the North Fork Clearwater River remains inaccessible due to the construction of Dworshak Dam in 1972.

In 1994, the Nez Perce Tribe began coho reintroduction by securing eggs through *U.S. v. Oregon*; by 1998 this agreement provided an annual transfer of 550,000 coho salmon smolts from lower Columbia River hatchery facilities for release in the Clearwater River Subbasin. In 1998, the Northwest Power and Conservation Council authorized the Bonneville Power Administration to fund the development of a Master Plan to guide this reintroduction effort.

This Master Plan describes the results of experimental releases of coho salmon in the Clearwater River Subbasin, which have been ongoing since 1995. These data are combined with results of recent coho reintroduction efforts by the Yakama Nation, general coho life history information, and historical information regarding the distribution and life history of Snake River coho salmon. This information is used to assess a number of alternative strategies aimed at restoring coho salmon to historical habitats in the Clearwater River subbasin. These data suggest that there is a high probability that coho salmon can be restored to the Clearwater River subbasin. In addition, the data also suggest that the re-establishment of coho salmon could be substantially aided by: 1) the construction of low-tech acclimation facilities; 2) the establishment of a “localized” stock of coho salmon; and 3) the construction of hatchery facilities to provide a source of juvenile coho salmon for future supplementation activities.

The Nez Perce Tribe recognizes that there are factors which may limit the success of coho reintroduction. For example, incidental ocean and lower-river commercial harvest

and tribal and non-tribal fisheries, as well as passage at mainstem hydropower facilities will impose mortality on Clearwater River coho salmon. There is also uncertainty regarding the ability of coho salmon from the lower Columbia River to 1) develop and sustain the 500 mile inland migration to the Clearwater subbasin, 2) to spawn in habitat that is dissimilar to the lower Columbia River and 3) to produce viable progeny at a rate that will allow population persistence.

As a result of these uncertainties, the Nez Perce Tribe proposes to utilize a phased approach for coho reintroductions. This Master Plan seeks authorization and funding to move forward to Step 2 in the Northwest Power and Conservation Council 3-Step review process to further evaluate Phase I of the coho reintroduction program, which would focus on the establishment of a localized coho salmon stock capable of enduring the migration to the Clearwater River subbasin. To achieve this goal, the Nez Perce Tribe proposes to utilize space at existing Clearwater River subbasin hatchery facilities in concert with the construction of two low-tech acclimation facilities, to capitalize on the higher survival observed for acclimated versus direct stream released coho. In addition, Phase I would document the natural productivity of localized coho salmon released in two targeted tributaries within the Clearwater River subbasin. If Phase I is successful at establishing a localized coho salmon stock in an abundance capable of filling existing hatchery space, the rates of natural productivity are promising, and the interspecific interactions between coho and sympatric resident and anadromous salmonids are deemed acceptable, then Phase II would be triggered.

Phase II of the coho reintroduction plan would focus on establishing natural production in a number of Clearwater River subbasin tributaries. To accomplish this goal, Phase II would utilize existing Clearwater River subbasin hatchery facilities, and expand facilities at the Nez Perce Tribal Hatchery Site 1705 facility to rear approximately 687,700 smolts annually for use in a rotating supplementation schedule.

The estimated cost of implementing Phase I is $1,672,489, which includes: $100,498 for design, permitting and project administration; $154,284 for capital construction of proposed acclimation facilities; $576,213 for operations and maintenance; and $841,494 for research, monitoring, and evaluation. Component costs for Phase II will be estimated only if the Phase I indicators of success are achieved. The operations and maintenance and research, monitoring and evaluation costs are presently provided to the Nez Perce Tribe by the Pacific Coastal Salmon Recovery Fund through the Columbia River Intertribal Fish Commission. Other agencies, the Idaho Department of Fish and Game, United States Fish and Wildlife Service Lower Snake River Compensation Plan, the Oregon Department of Fish and Wildlife, and the National Oceanic and Atmospheric Administration Department of Fisheries Mitchell Act program provide eggs, fish, and rearing facilities. Costs have been further contained by using existing facilities, and locating juvenile releases to take advantage of existing monitoring programs and infrastructure.

In short, this document identifies a proposed alternative (Phase I), complete with estimates of capital, operations and maintenance, monitoring and evaluation, and permitting that is anticipated to raise average smolt replacement rates from 0.73 (current) to 1.14 using primarily existing facilities, with a limited capital investment for low-tech acclimation facilities. This increase in survival is expected to provide the opportunity for the establishment of a localized broodstock in the near-term, and provide the opportunity to establish natural production over the long-term. Phase II information is presented in this document to clearly articulate the long-term intent and vision of the coho salmon reintroduction program. Phase II would be proposed only if Phase I meets several indicators of success. If Phase I meets all identified indicators of success, authorization for Phase II funding would be pursued via a supplement to this Master Plan.

Finally, it should be noted that preliminary reintroduction efforts have resulted in the return of 3,738 mature coho salmon to Lower Granite Dam in 2004 alone (as of 1 November 2004; http://www.cbr.washington.edu/dart/dart.html).

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Chapter 1: Introduction

In this chapter:

- The purpose of the Master Plan
- Relationship to other programs
- How to use the master plan
- Where to find more information
- Organization of the chapters

1.1 The Purpose of the Master Plan

The Northwest Power and Conservation Council (NPCC; formerly the Northwest Power Planning Council - NWPPC) requires Master Plans for new artificial production programs and facilities proposed to restore salmon populations throughout the Columbia River Basin. The purpose of a Master Plan is to provide the NPCC, program proponents, and others with the information they need to make sound decisions about whether the proposed program should move forward to design, construction, and operation.

In 1997, the NPCC adopted a 3-Step Review Process for new production initiatives:

- Step 1 – conceptual planning, primarily in the form of a Master Plan;
- Step 2 – preliminary design and cost estimation, National Environmental Policy Act (NEPA), and Endangered Species Act (ESA) review;
- Step 3 – final design review prior to new facility construction.

New production initiatives are generally defined as projects that propose to:

a) construct significant new production facilities;
b) begin planting fish in waters they have not been planted in before;
c) increase significantly the number of fish being introduced;
d) change propagated stocks or the number of propagated stocks;
e) change the location of production facilities; or
f) initiate funding of existing facilities with ratepayer funds that were formerly funded otherwise.

This Master Plan involves elements “c” and “f” listed above and fulfills the first step (Step 1) of the planning and approval process.

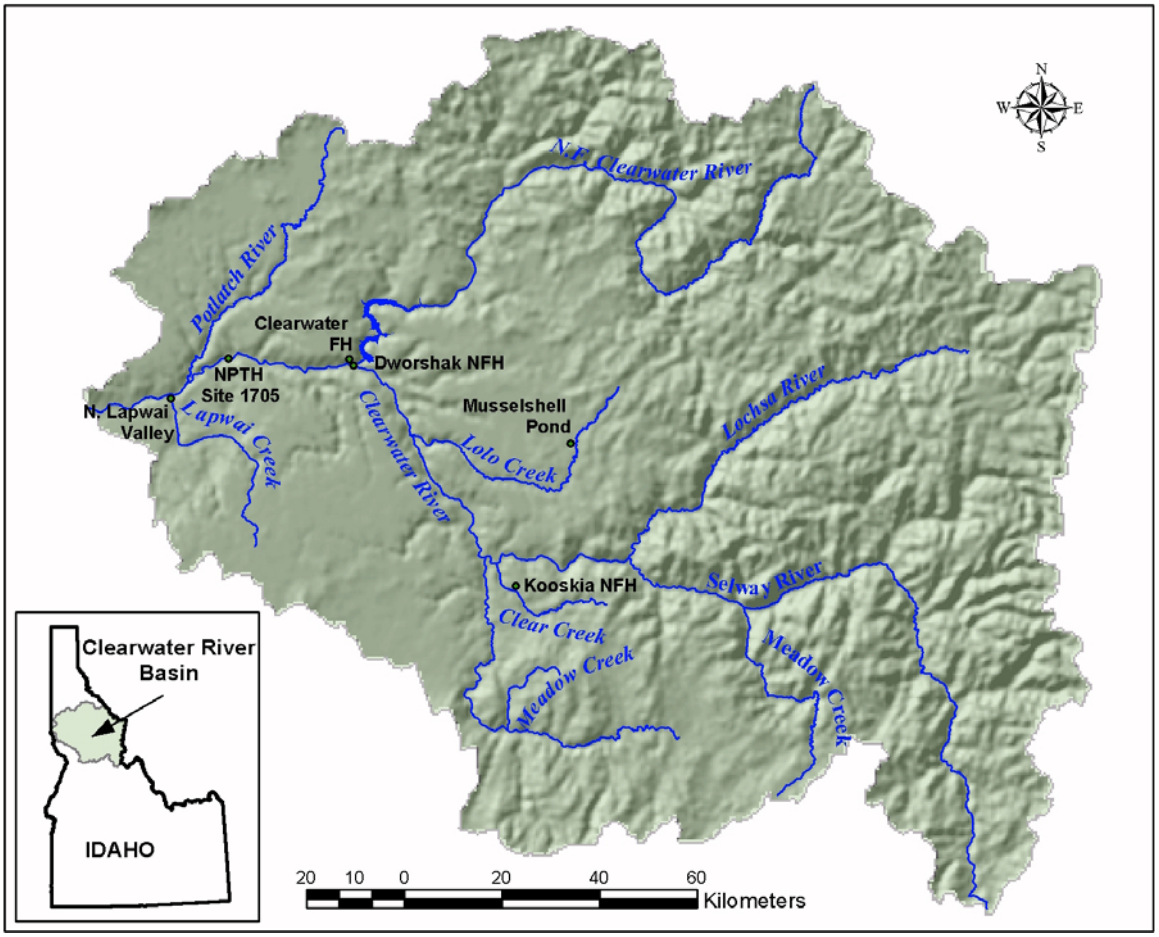

Figure 1-1. Map of the Clearwater River subbasin showing facilities and tributaries pertinent to the coho salmon reintroduction program.

This Master Plan details an integrated recovery program designed to guide the reintroduction of coho salmon (*Oncorhynchus kisutch*) to the Clearwater River Subbasin of Idaho (Figure 1-1), provide the potential for establishment of natural spawning aggregates of coho salmon in targeted watersheds within the Clearwater River Subbasin, and provide for tribal and recreational fishing opportunities.

Coho were declared extirpated from the Snake River Basin in 1986. The opportunity for reintroduction arose when parties to the *U.S. v. Oregon* process reprogrammed production at existing coho salmon hatcheries in the lower Columbia River (LCR). The Nez Perce Tribe (NPT) initiated a reintroduction program in the Clearwater River Subbasin with juvenile coho salmon releases in 1995. Funding for initial releases was obtained from the Bureau of Indian Affairs 638 funds. Monitoring and evaluation funding for initial releases was provided by the Pacific Coastal Salmon Recovery Fund. Since the reintroduction effort is consistent with the Mitchell Act Program, Mitchell Act funding was secured in 1999 and 2000.

In 1998, the (NPT) submitted a proposal for funding a Coho Master Plan to the Columbia Basin Fish and Wildlife Authority (CBFWA) in order to develop a restoration plan for Coho Salmon in the Clearwater River Subbasin. The NPCC authorized funding for the development of a Master Plan in November 1998 (November 13, 1998 letter to Bob Lohn, BPA Fish and Wildlife Division, from John Etchart, Chairman, NPCC). In doing so, the NPCC determined that the coho proposal would initiate the 3-Step Review Process. Once the Master Plan is submitted to the Council, the Step One review will be triggered.

1.2 Relationship to Other Plans, Programs, and Projects in the Region

The Master Plan for the reintroduction of coho salmon in the Clearwater River Subbasin must be consistent and work in concert with other efforts to restore salmon and steelhead in the Clearwater River Subbasin and throughout the Columbia River Basin. The consistency of this Master Plan to the many ongoing efforts is demonstrated in Tables 1-1 and 1-2.

Table 1-1. Relationship of the coho salmon reintroduction program to Fish and Wildlife Program initiatives.

Program/Plan	Manager	Relationship to Master Plan
Nez Perce Tribal Hatchery Operations and Maintenance (BPA 198335000)	NPT	The Nez Perce Tribal Hatchery would provide use of one or more of its satellite facilities for acclimation of coho salmon as well as staff and equipment support. Future expansion of NPTH (should Phase II of the proposed coho program be implemented) would provide coho incubation and rearing.
Nez Perce Tribal Hatchery Monitoring And Evaluation (BPA 198335003)	NPT	This project has been developed to monitor the results of NPTH Chinook salmon supplementation in order to optimize hatchery and natural production, sustain harvest, and minimize ecological impacts. Weirs and screw traps operated by the NPTH RM&E program would be used to monitor juvenile coho emigration and adult returns.
Salmon Supplementation Studies in Idaho Rivers (BPA 198909800, 198909801, 198909802, 198909803)	IDFG NPT USFWS SBT	The goal of this multi-agency effort is to evaluate the utility of supplementation as a recovery/restoration strategy for depressed stocks of spring and summer Chinook. Time series data on spring Chinook salmon condition factor would be used to determine whether competition resulting from the supplementation and subsequent natural production of coho salmon is negatively affecting sympatric spring Chinook salmon.
Idaho Natural Production Monitoring and Evaluation (BPA 199107300)	IDFG	This program monitors the abundance of anadromous salmonid populations using redd counts, carcass recoveries, juvenile emigrant trapping, and snorkel counts.
Protect and Restore Lapwai Creek Watershed (BPA 199901700)	NPT	This project includes several habitat improvement components including channel re-vegetation, riparian fencing, and culvert assessment/replacement. This habitat/watershed project will improve coho salmon spawning and rearing habitat in one of the primary watersheds identified for coho production releases.
Protect and Restore Lolo Creek Watershed (BPA 200002509)	NPT	This project includes several habitat improvement components including road obliteration, channel realignment, channel re-vegetation, riparian fencing, and off sight watering development. This habitat/watershed project will improve coho salmon spawning and rearing habitat in one of the primary tributaries identified for coho restoration.

Table 1-1. Relationship of the coho salmon reintroduction program to Fish and Wildlife Program initiatives.

Program/Plan	Manager	Relationship to Master Plan
Clearwater Focus Program (BPA 199608600, 199706000)	SCC/NPT	Coordination program to implement NWPCC Fish and Wildlife Program; habitat improvement projects ongoing in Idaho, Lewis, Nez Perce SWCD and Clearwater & Nez Perce National Forests; facilitate subbasin-wide Policy Advisory Group; initiated assessment in 1999.
Aquatic Resource Access Restoration	Clearwater NF, NPT	This project will replace culverts in four upper Lolo Creek tributaries (Mox Creek, Chamook Creek, Gold Creek and Musselshell Creek). Increased access to Musselshell Creek would benefit adult coho returning to this watershed from juvenile acclimation in Musselshell pond.

Table 1-2. Relationship of the coho salmon reintroduction program to legal and other initiatives.

Program or Plan	Requirement or Other Connection to Program	Coho Master Plan
Treaty of 1855	The Nez Perce Tribe reserved "The exclusive right of taking fish in all the streams running through or bordering said reservation ...and… taking fish at all usual and accustomed places …".	Restoration of salmon runs resulting from fish production in the proposed facilities would assist in meeting federal obligations to the Nez Perce Tribe.
U.S. v. Oregon	Treaty fishing rights litigation addressing Columbia Basin salmon and steelhead harvest and enhancement goals.	Proposed program would assist in meeting obligations and agreements under the lawsuit.
U. S. v. Oregon Fall Fishery Agreement 2000	Agreement by co-managers that the NPT would develop a coho reintroduction plan for the Clearwater River.	Fulfills agreement.
Scientific Review Team Review of Artificial Production (SRT; Brannon et al. 1999)	Independent scientific review of the Columbia Basin artificial production program, analysis of effectiveness in meeting mitigation responsibilities and enhancing salmonid production, and evaluation of supplementation of natural runs. Describes guidelines that provide the biological basis for NPCC policy on artificial production.	Proposed program is consistent with guidelines and recommendations developed by the SRT for artificial production facilities.
Artificial Production Review (APR; NPCC 1999)	NPCC report to Congress on the use of artificial production in the Columbia Basin that includes recommendations for policy reform and strategies for implementing new policies.	This master plan and the proposed program are consistent with APR recommendations and policies.

Table 1-2. Relationship of the coho salmon reintroduction program to legal and other initiatives (continued).

Program or Plan	Requirement or Other Connection to Program	Coho Master Plan
Pacific Northwest Power Planning and Conservation Act of 1980	This Act established the Northwest Power Planning Council for the purpose of mitigating for the development and operation of hydroelectric projects within the basin. The Council implements the Fish and Wildlife Program to protect, mitigate, and enhance fish and wildlife in the Columbia River basin.	The proposed program would be funded through the Fish and Wildlife Program.
Mitchell Act	The Mitchell Act authorized the Secretary of Commerce to implement salmon hatcheries in Oregon, Washington, and Idaho as a means to mitigate for salmon production lost as a result of the construction of the federal Columbia River hydro-power system.	Lower Columbia River Mitchell Act hatcheries have been reprogrammed to provide coho salmon smolts for release in upriver areas, including the Clearwater River Subbasin. These smolts are the basis for reintroduction efforts discussed in this Master Plan.
Pacific Coastal Salmon Recovery Fund	Established by Congress in FY2000 to provide grants to assist state, local, and tribal salmon recovery efforts, administered by NOAA Fisheries through CRITFC.	Has provided operations and maintenance funding for reintroduction effort. Results from the experimental program are used to quantify the feasibility of reintroduction effort and help determine the future program direction.
Lower Snake River Compensation Plan	The Lower Snake River Compensation Plan was authorized by Congress as part of the Water Resources Development Act of 1976. A major element of this plan provided funding for the design and construction of hatcheries to compensate for the loss of salmon and steelhead resulting from Federal hydropower development.	Although the Lower Snake River Compensation Plan is not legally mandated to compensate for the loss of coho salmon, the program has allowed the use of some existing facilities for coho production.

Table 1-2. Relationship of the coho salmon reintroduction program to legal and other initiatives (continued).

Program or Plan	Requirement or Other Connection to Program	Coho Master Plan
Wy-kan-ush-mi Wa-kish-wit: Spirit of the Salmon Tribal Recovery Plan (NPT *et al.* 1995).	Plan developed by the four Columbia River Treaty Tribes to restore fish runs.	The proposed program is recommended by the Tribal Recovery Plan. The plan sets a return goal of 14,000 adult coho salmon to the Clearwater River Subbasin.

1.3 How to Use the Master Plan

The NPCC has specific requirements including details about program goals and objectives, expected benefits, expected impacts, alternatives, historical information, consistency with other programs, and other information necessary for the NPCC, program proponents, and others to make decisions. In accordance with Section 7.4B of the Fish and Wildlife Program (NPCC 1994) this master plan addresses:

- project goals; (Section 3.1)
- measurable and time-limited objectives; (Section 3.6)
- factors limiting production of the target species; (Chapter 7)
- expected project benefits; (Chapter 2)
- alternatives for resolving the resource problem; (Section 3.3)
- rationale for the proposed project; (Chapter 6)
- how the proposed production project will maintain or sustain increases in production; (Section 3.5)
- the historical and current status of anadromous and resident fish in the subbasin; (Sections 2.2 and 7.5)
- the current (and planned) management of anadromous and resident fish in the subbasin; (Section 3.8)
- consistency of proposed project with Council policies, NOAA Fisheries recovery plans, and other fishery management plans; (Tables 1-1 and 1-2)
- potential impact of other recovery activities on the project outcome; (Section 7.4)
- production objectives, methods and strategies; (Section 3.5)
- broodstock selection and acquisition strategies; (Section 3.5)
- rationale for the number and life-history stage of the fish to be stocked, particularly as they relate to the carrying capacity of the target stream and potential impact on other species; (Section 3.5 and Chapter 6)
- production profiles and release strategies; (Section 3.5)
- production policies and procedures; (Section 4.2)

- production management structure and process; (Section 4.2)
- related harvest plans; (Section 3.8)
- constraints and uncertainties; (Section 3.1 and Chapter 7)
- monitoring and evaluation plans; (Chapter 5)
- conceptual design of the proposed production and monitoring facilities, including an assessment of the availability and utility of existing facilities; (Section 3.1 and Chapter 4)
- cost estimates for various components, such as fish culture, facility design and construction, monitoring and evaluation, and operation and maintenance (Chapter 4).

In addition to the items listed above, this Master Plan also addresses Artificial Production Review (APR) hatchery guidelines (Appendix A).

1.4 Where to Find More Information

The Master Plan contains general and technical information pertinent to the proposed program and alternatives. In addition to the information included in this Master Plan, many supporting documents have been completed during the preparation of the Clearwater River Subbasin Coho Salmon Master Plan:

- Ashe, B. and D.B. Johnson. 1996. Nez Perce Tribe implementation plan for reintroduction of cuhlii (coho salmon) (BY96) in the Clearwater River basin. Nez Perce Tribe Department of Fisheries Resources Management, Lapwai, ID.
- Johnson, D.B. and B. Ashe. 1997. Nez Perce Tribe implementation plan for reintroduction of cuhlii (coho salmon) (BY97) in the Clearwater River basin. Nez Perce Tribe Department of Fisheries Resources Management, Lapwai, ID
- Davenport, C. 2002. Pacific Coastal Salmon Recovery Fund Semi-Annual Report, for the period November 2001-May 2002.
- Davenport, C. 2002. Pacific Coastal Salmon Recovery Fund Annual Report, FY 2001-2002.
- Davenport, C. 2003. Pacific Coastal Salmon Recovery Fund Semi-Annual Report, for the period November 2002-May 2003.

1.5 Organization of the Chapters

- Chapter 2 describes the need for the program;
- Chapter 3 describes the proposed and other alternatives;
- Chapter 4 contains descriptions of proposed facilities and budgets for construction, design, operations and maintenance, research, monitoring, and evaluation, and permitting;
- Chapter 5 describes the research, monitoring, and evaluation plan;
- Chapter 6 provides background information used to formulate and evaluate alternatives; and
- Chapter 7 describes the factors limiting the natural sustainability of coho salmon in the Clearwater River Subbasin;

Chapter 2: Need for the Project

In this chapter:

- The need for action;
- Status of coho salmon in the Clearwater River Subbasin;
- Ecological significance of coho salmon;
- The Nez Perce Tribe; and
- Mitigation

2.1 Need for Action

The Nez Perce Tribe (NPT) motivation for implementing an integrated coho restoration program in the Clearwater River Subbasin arises from the recognition that:

- coho salmon were historically present in the Clearwater River Subbasin and are a natural feature of this complex ecosystem;
- the treaty signed by the United States government with the NPT in 1855 reserved harvest rights for the NPT;
- cuhlii (coho) salmon are of cultural importance to the NPT; and
- the loss of coho salmon from the Snake River Basin remains unmitigated.

Thus, the NPT believes that integrated restoration of coho salmon in the Clearwater River Subbasin is warranted ecologically, legally, and culturally. The factors motivating the NPT to undertake coho reintroduction are not unprecedented. As discussed in section 6.3, the Yakama Nation (YN) recently undertook a similar coho reintroduction in mid-Columbia River subbasins.

In addition, these efforts are consistent with the recently released report of the Artificial Production Review and Evaluation (APRE; NPCC 2003), which states:

> *"Hatcheries could be used to enhance biodiversity by producing a wider variety of salmonid species and life histories. Greater species and life history diversity makes sense ecologically and could provide greater harvest opportunities by enhancing adult returns over a longer time period."*

2.2 History and Status of Clearwater River Subbasin Coho Salmon – Limiting Factors

NPT elders confirm the historical presence of coho salmon in Clearwater River Subbasin tributaries including the Clearwater River, North Fork Clearwater River, Lochsa River, Selway River, and South Fork Clearwater River (Paul Kucera, Nez Perce Tribe Department of Fisheries Resources Management, Personal Communication). Schoning (1940, 1947) and Fulton (1968) also document that residents of the area caught coho salmon in the Clearwater River Subbasin.

Salmon runs in the Clearwater River Subbasin were virtually eliminated by the construction of hydroelectric dams (Mathews and Waples 1991). In 1910, the Harpster Dam, constructed on the lower South Fork Clearwater River, prevented all fishes from returning upstream of Harpster, ID, and eliminated access to over 95% of the watershed and its high quality spawning grounds (Schoning 1940). In 1927, the Washington Water Power Diversion Dam constructed just above the mouth of the Clearwater River eliminated all upriver salmon runs (Parkhurst 1950; USFWS 1962). A crude fish ladder was built on the lower Clearwater River dam, which allowed steelhead passage during higher flow periods, but proved almost impassible during lower flows when salmon arrived (Parkhurst 1950). The ladder was not modified for a period of 12 to 14 years; eliminating all late returning fish, like coho and fall Chinook salmon.

The cumulative loss of anadromous fish to the NPT as a result of these two dams was substantial (Cramer *et al*. 1993). The Harpster Dam was removed in 1963 and the lower Clearwater River dam was removed in 1972, making available most of the salmon production areas in the drainage. However in 1971, Dworshak Dam was built just upstream of the mouth of the North Fork Clearwater River. Dworshak Dam lacks fish passage, resulting in the permanent loss of productive salmonid spawning aggregates and high quality habitat. The lower Clearwater River temperature regime continues to be altered by Dworshak Dam, resulting in warmer water in the winter and cooler water in the summer (Arnsberg *et al*. 1992, Arnsberg and Statler 1995).

From 1962 through 1968, the Idaho Department of Fish and Game (IDFG) attempted to reintroduce coho salmon in the South Fork Clearwater River using hatching channels at Meadow Creek, Red River and Crooked River on the South Fork Clearwater River. A total of 11 million eggs were planted from Eagle Creek National Fish Hatchery (ECFNH), Spring Creek National Fish Hatchery (SCNFH), Abernathy Fish Hatchery (AFH), the Little White Salmon National Fish Hatchery (LWSNFH), and the Washougal National Fish Hatchery (WNFH). These efforts were largely unsuccessful due to ice formation, de-watering, (Richards 1967, Gray 1969), flooding, and siltation (Richards 1966). However, some coho adults were counted at Lewiston Dam from 1965 until 1972, apparently as a result of this program (Table 2-1). Despite the challenges faced by this program, adult coho did return to the Clearwater River Subbasin even with harvest rates of 30-40% in the lower Columbia River and the construction of four mainstem Snake River dams during this period (Ice Harbor, 1961; John Day, 1968; Lower Monumental, 1969; and Little Goose, 1970). Coho salmon were observed spawning in Three Mile Creek, a tributary of the South Fork Clearwater River in November 1968 (Richards

1969). However, systematic monitoring of naturally spawning coho was never undertaken by the IDFG. In 1986, coho were considered extirpated in the Snake River basin (including the Clearwater River Subbasin), as evidenced by subsequent zero counts at Lower Granite Dam (Table 2-2; http://www.cbr.washington.edu/dart/dart.html).

Table 2-1. Counts of adult coho salmon at Lewiston Dam 1965 through 1972.

Year	Adult Coho Salmon
1965	21
1966	115
1967	43
1968	325
1969	31
1970	40
1971	61
1972	9

Table 2-2. Coho salmon counts at Lower Granite Dam from 1977 through 1987.

Year	Adult Coho	Jack Coho
1977	267*	n/a
1978	152*	n/a
1979	158*	n/a
1980	30*	13
1981	1*	16
1982	31*	28
1983	25*	26
1984	0	0
1985	1	0
1986	1	0
1987	0	0

*Coho salmon enumerated in these years may have been returning to the Grande Ronde River Subbasin.

Since the demise of the IDFG coho reintroduction program in 1968, the only coho program operating in the Snake River basin was initiated by the NPT in 1995 (see section 6.2).

Currently, the primary factors expected to limit the success of coho reintroduction include habitat degradation, passage mortality (juvenile and adult), ocean and in-river fisheries, and periods of poor ocean productivity. Numerous habitat restoration initiatives are underway in the Clearwater River Subbasin (see Section 7.4), however it is difficult to quantitatively evaluate the potential direct benefits of these activities for coho salmon. As mentioned previously, the two dams largely responsible for the extirpation of coho salmon have been removed. However, coho salmon returning to the Clearwater River Subbasin must pass eight mainstem hydropower dams; likewise their progeny must successfully navigate these structures during emigration. Although there is considerable debate regarding the quantification of mortality imposed by Snake and Columbia River hydropower facilities, it is generally agreed that these structures limit the sustainability of natural production in upriver areas (NPCC 2001). Finally, in-river and ocean fisheries will impact adult return rates through incidental harvest in selective fisheries and ocean harvest. Given that indicator stocks for Clearwater River Subbasin coho are not available, it is difficult to estimate the potential effects of harvest. However, the RM&E plan (Chapter 5) details a strategy to quantify the effects of harvest by comparing adult returns for double index marked and unmarked release groups.

2.3 Ecological Significance of Coho Salmon in the Clearwater River Subbasin

Salmonids are notable for their diversity of life history strategies, sympatric distribution, contribution to ecological processes, and genetic variation. These factors contribute to salmonid productivity and persistence (Independent Scientific Group 1996). Recently, researchers have recognized that salmon are a key contributor to ecosystem processes in the streams that they inhabit, and the same processes that increase salmonid resiliency likely serve to increase the resiliency of the ecosystems they occupy. A growing number of studies document the importance of marine derived nutrients to the ecosystems that salmon inhabit (*e.g.,* Cederholm *et al*. 1999). Decomposing salmon carcasses are now recognized as a source of marine-derived nitrogen that in large part determines the nature of the food web in a stream, which in turn determines the growth and survival of young salmon (Gresh *et al*. 2000). For example, Bilby *et al.* (1998) found a positive relationship between marine derived nitrogen and smolt production. Similar observations have been made in individual river systems from Alaska to Washington (Piorkowski 1997, Larkin and Slaney 1997, Bilby *et al*. 1996, Kline Jr. *et al*. 1993, and Mathisen 1972).

Given that the abundance of salmonids returning to the Clearwater River Subbasin has decreased dramatically over the last century, the attendant decrease in marine derived nutrients may be negatively affecting the production capacity of streams and those components of forest ecology that rely on in-stream productivity. It follows that successful reintroduction of coho salmon may have ecosystem benefits beyond the simple restoration of a historical ecosystem component.

2.4 The Nez Perce Tribe's Need

The NPT was one of the largest Plateau tribes in the Northwest (Walker 1978; Figure 2-1). Historically, they occupied a territory of over 13 million acres that included what is today North central Idaho, Southeastern Washington and Northeastern Oregon. The persistence of the NPT can be attributed in large part to the abundance of salmon, which has served as a primary food source, trade item and cultural resource for thousands of years. The economy and culture of the NPT evolved around Northwest salmon runs. Despite recent declines in the abundance of salmon, the culture of the NPT remains strongly tied to salmon.

The degree to which the NPT is culturally coupled to salmon was recognized in treaties signed between the tribe and the United States Government. The same treaties that confined the NPT to a fraction of their former territory also guaranteed their access to salmon resources. Article three of the treaty of 1855 guarantees to the tribe:
"The exclusive right of taking fish in all the streams running through or bordering said reservation … as also the right of taking fish at all usual and accustomed places in common with citizens of the Territory."

No subsequent treaty or agreement between the NPT and the United States altered this treaty-reserved right. These treaty-reserved fishing rights are the legal basis for the tribe's involvement, as co-managers, in salmon restoration efforts throughout their former range.

In 1905, the United States vs. Winans case established what a "right" implied. The case involved a non-tribal member who attempted to prevent tribal members from fishing at a traditional site by buying and then claiming absolute title to the land (American Indian Resource Institute 1988). The Supreme Court ruled against this claim and established two important precedents. First, hunting and fishing rights are not rights granted by the government to tribal signatories, but rather they are rights reserved by the tribes in exchange for lands (American Indian Resource Institute 1988). Second, tribal members cannot be barred from accessing their usual and accustomed fishing sites since their reserved right is essentially an easement over private as well as public lands (Cohen 1982).

In 1974, a case tried in Washington Federal District Court established what was meant by the right of tribes to harvest fish "in common" with the citizens of the territory. Judge Boldt determined that two distinct entities were involved during treaty making, Indian tribes and the United States, not just individual tribal members and individual citizens of the state (American Indian Resource Institute 1988). The separation of two political entities effectively denied the assertion that all citizens have the same rights with respect to harvesting fish.

The understanding that there are only two entities involved was then applied to the allocation of harvestable fish. The court interpreted "harvest in common" as an equal distribution between the two entities (American Indian Resource Institute 1988). Judge Belloni applied the 50/50 principle to Columbia River fisheries in *U.S. v. Oregon* in 1975 (Nez Perce Tribe *et al.* 1995). In their treaties ceding land to the United States, the NPT had reserved the right to harvest fish in a manner that allows them to maintain a way of life. But although the rights to take fish and regulate the fishery resource have been clearly upheld in numerous courts, these rights are meaningless if there are no fish to be taken or resources to be managed (Nez Perce Tribe *et al*. 1995).

The legal, historic, economic, social, cultural, and religious significance of salmon to the NPT continues today. This Master Plan is a product of the tribe's continued dedication to restoring salmon runs throughout their usual and accustomed territories.

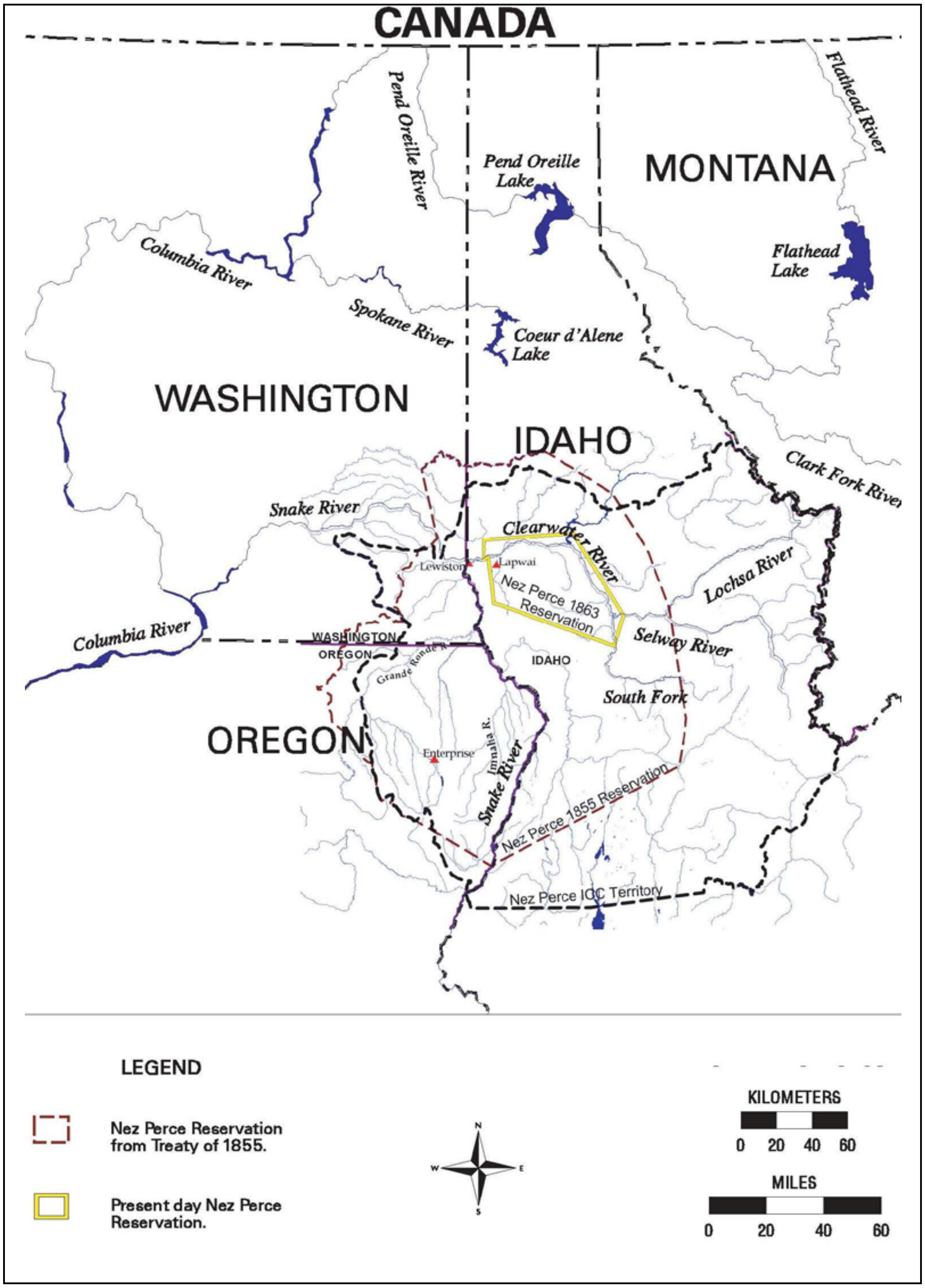

Figure 2-1. Historical Nez Perce Tribe range and reservation sizes under the Treaty of 1855 and Treaty of 1866.

2.5 Lack of Mitigation for the Loss of Coho Salmon

With the exception of a reintroduction attempt by the Idaho Department of Fish and Game from 1962 to 1968 coho salmon have been missing from the Clearwater River Subbasin since their initial extirpation in 1927. The loss of coho salmon has yet to be effectively mitigated. Within the Columbia River Basin, two federal hatchery programs produce salmon to mitigate for the construction and operation of Federal hydropower dams: the Lower Snake River Compensation Plan (LSRCP) and Mitchell Act program. In addition, the Nez Perce Tribal Hatchery, funded by the Bonneville Power Administration Fish and Wildlife Program, was constructed for the purpose of spring and fall Chinook salmon mitigation, and this facility does not currently produce coho salmon.

The LSRCP program was enacted in 1945, when Congress passed Public Law 74, authorizing the construction of four dams on the lower Snake River to provide hydroelectric power generation and navigation (Armacost 1979). These dams (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite) were constructed from 1961-1975. From 1962 to 1975, there was a significant drop in adult migration. It was estimated by federal and state fish and wildlife agencies that the four dams would result in a 48 percent reduction in annual production of Chinook salmon above Lower Granite Dam (U.S. Army Corps of Engineers 1975). To compensate for this loss, Congress authorized the Lower Snake River Compensation Plan (LSRCP) in 1976 (Public Law 94-587) to mitigate for losses of salmon, steelhead and other resources that resulted from construction of the four lower Snake River dams. However, since coho salmon had already been extirpated from the Clearwater River Subbasin they were not included in the plan; and thus not mitigated for.

The Mitchell Act (16 U.S.C. §§ 755-757, May 11, 1938. as amended in 1946) authorized the Secretary of the Interior to carry on activities to conserve fishery resources in the Columbia River Basin. The act authorizes research, surveys, and implementation of methods to improve salmon feeding, spawning, and migration. In practice, the act has funded a number of hatchery programs intended to enhance harvest opportunities within the Columbia River Basin. Unfortunately, most of the facilities constructed under the Mitchell Act are located on the Lower Columbia River, an inequity that is particularly apparent for coho salmon as noted by the APRE (NPCC 2003):

> *"A sizeable majority of Columbia River Basin hatchery production takes place in the lower three provinces. Unfortunately, the communities most affected by the construction of the dams do not share equally in this production."*

The Nez Perce Tribe coho reintroduction program was made possible as a result of agreements in the *U.S. v. Oregon* forum that reprogrammed Lower Columbia River Mitchell Act hatcheries to produce coho salmon for release in the Clearwater River Subbasin. The LSRCP program has contributed to NPT efforts by providing space at the Clearwater Fish Hatchery per a Memorandum of Understanding valid through 30

September 2008. The Corps of Engineers and the United States Fish and Wildlife Service have contributed to the program by providing the use of Dworshak National Fish Hatchery and Kooskia National Fish Hatchery per a Memorandum of Understanding valid through 30 September 2008.

Chapter 3: Proposed Alternative and Other Alternatives

In this chapter:

- Goals and objectives of the program
- Description of the current program
- Development of Phase I alternatives
- Selection of a preferred alternative
- Description of the proposed alternative (Phase I)
- Phase I indicators of success and failure
- Description of the long-term program (Phase II)
- Harvest management

This chapter describes goals and objectives developed for the Clearwater River Subbasin coho program as well as a phased strategy for implementing the reintroduction and restoration program. These goals and objectives are consistent with the Nez Perce Tribes' vision of restoring all fish species native to the Nez Perce Indian Claims Commission (ICC) Treaty territory (Figure 2-1).

3.1 Goals and Objectives of the Program

The Nez Perce Tribe's overall goal is to reintroduce and restore coho salmon to the Clearwater River Subbasin at levels of abundance and productivity sufficient to support sustainable runs and annual harvest. Consistent with the Clearwater Subbasin Plan (EcoVista 2003), the Nez Perce Tribe (NPT) envisions an annual escapement of 14,000 coho to the Clearwater River Subbasin. Based on results from the existing Clearwater River Subbasin coho reintroduction program and experience in managing anadromous fish populations in the Snake River Basin, the Nez Perce Tribe believes this program will require a substantial hatchery production component (at least in the near-term) and the establishment of highly productive naturally spawning coho salmon aggregates.

The Nez Perce Tribe developed measurable and time limited management objectives aimed at achieving the overall goal of the program. These include:

- Establish a localized Clearwater River coho salmon broodstock.

- Establish natural spawning populations of coho salmon in the Clearwater River Subbasin.

- Utilize hatchery production to achieve optimal production effectiveness while meeting priority management objectives for natural production enhancement, diversity, harvest, and minimizing impacts to non-target populations.

- Restore and maintain treaty-reserved tribal and recreational fisheries.

- Monitor and evaluate program activities and communicate program findings to resource managers.

Because the Clearwater River Subbasin coho salmon reintroduction/restoration program is experimental and uncertainties exist about whether an extirpated salmon species can be reintroduced and restored to healthy abundances 500 miles from the ocean above eight mainstem hydroelectric dams using donor stock from the Lower Columbia River, the Nez Perce Tribe decided to develop the reintroduction program in two distinct Phases.

Phase I: Focus on establishing a localized Clearwater River coho salmon broodstock and meeting broodstock needs.

Phase II: Focus on establishing naturally spawning populations of coho salmon in the Clearwater River Subbasin.

The Nez Perce Tribe considered several alternative strategies to achieve its management objectives. The development of these alternative strategies was guided by information from:

- Preliminary Nez Perce Tribe coho reintroduction efforts to date (Section 6.2)

- Results from coho reintroduction in mid-Columbia River tributaries (Section 6.3),

- Coho salmon life history characteristics (Section 6.4), and

- Historical data and life history information for coho salmon in the Grande Ronde River Subbasin (Section 6.5).

From these data sources, the NPT has developed a number of guiding principles that were used to screen alternative strategies and identify a preferred strategy for implementing Phase I. Guiding principles are listed below, and are accompanied by a reference to the section(s) in this Master Plan with background information:

- Acclimation and volitional release provide a survival advantage over direct stream releases of juvenile coho salmon (Sections 6.2 and 6.3) and may provide the added benefit of decreasing in-river densities by extending the period of emigration relative to direct releases.

- Establishing a localized stock of coho salmon (Clearwater Localized Stock - CLS) will increase smolt to adult return rates (Section 6.3).

- Release of juvenile coho salmon at the smolt life history stage increases survival and decreases the potential for competition and predation compared to releases at earlier life history stages (Section 6.2).

- In the short-term, selecting juvenile acclimation and release points closer to the mouth of the Clearwater River will increase adult capture probabilities, compared to more upstream release points (Section 6.2).

In addition to the biologically based guiding principles, a number of programmatic factors were used to screen alternative strategies (Table 3-1).

Table 3-1. Programmatic factors used to screen alternative coho salmon reintroduction strategies.

A maximum of 550,000 smolts are available annually from LCR hatcheries for transfer and subsequent release within the CRS.	
Existing hatchery facilities in the Clearwater River Subbasin that can be utilized to rear coho are currently limited to:	
Clearwater Anadromous Fish Hatchery (CAFH)	CAFH has space available to rear up to 270,000 progeny to the presmolt stage. Juvenile coho salmon must be removed from CAFH no later than September 15th to avoid conflicts with steelhead production.
Dworshak National Fish Hatchery (DNFH)	DNFH has space available to hold at least 502 adults, spawn them, and rear up to 280,000 smolts.
Nez Perce Tribal Hatchery (NPTH) Site 1705	The NPTH Site 1705 facility has S-shaped NATUREs channels that can be used from October 1 through March 15. These channels could be used to grow presmolts from CAFH to the smolt life history stage prior to either on-station release into the mainstem Clearwater River or off-station releases.
Existing hatchery facilities in the Clearwater River Subbasin that can be utilized for coho acclimation are currently limited to:	
Kooskia National Fish Hatchery (KNFH)	KNFH has space to acclimate smolts transported from DNFH prior to release in Clear Creek. Due to fish health management policies, only progeny reared at DNFH can be acclimated at this facility.

Based on the results of reintroduction efforts to date (section 6.2), it appears that coho salmon reared at LCR hatchery facilities are capable of successfully returning to tributaries of the Clearwater River Subbasin. Approximately half of the juvenile coho released in the Clearwater River Subbasin are the progeny of adults that returned to DNFH or temporary weirs. Given the positive results of hatchery efforts to date, it appears likely that a more intensive reintroduction program could successfully establish natural production in the Clearwater River Subbasin.

Currently, the program is constrained by a lack of acclimation facilities. Based on results obtained thus far, securing acclimation facilities will increase SAR's, compared to the use of direct stream release strategies, and would likely increase the probability of successful restoration. However, the NPT recognizes that even with improved acclimation facilities, there is a risk that out-of-basin mortality could limit survival to a degree that restoration is impossible in the near-term. Therefore, Phase I alternatives discussed in the following section range from halting reintroduction efforts to construction of facilities capable of providing rearing and acclimation space within the Clearwater River Subbasin to meet all juvenile production needs (*i.e.,* capable of meeting the Phase II objective). The proposed alternative (Section 3.5) strikes a balance between status quo coho production and facility development, such that rearing utilizes existing space at Clearwater River Subbasin and LCR hatchery facilities, yet provides for the construction of small-scale, low tech acclimation facilities in order to capitalize on survival advantages observed for juveniles acclimated at KNFH (Section 6.2).

In order to facilitate comparison between the alternatives, a description of the current and long-term programs precedes the discussion of alternatives.

3.2 Description of the Existing Coho Production and Release Program

The Clearwater River Subbasin coho reintroduction program currently has three elements:

- Transfer and release of coho salmon **smolts** from the Eagle Creek National Fish Hatchery (ECNFH), located on the lower Columbia River;
- Release of Clearwater Localized Stock (CLS) coho salmon **smolts** derived from adults collected and spawned in the Clearwater River Subbasin; and
- Release of Clearwater Localized Stock (CLS) coho salmon **presmolts** derived from adults collected and spawned in the Clearwater River Subbasin.

The production and release program has varied substantially in total release number, size at release, and release type (acclimated versus direct stream release) since the program began in 1995 (see the supporting documents listed in Section 1.4 and Table 6-1). Although other hatchery origin coho salmon stocks have been utilized in this effort, the Nez Perce Tribe has elected to utilize production from the ECNFH over the long term.

This stock was selected over the other widely available hatchery origin stock (reared at the Willard National Fish Hatchery) because of its earlier relative run-timing, a characteristic thought to more closely match historical run-timing of Clearwater River Subbasin coho salmon. The following description refers to releases planned for 2005 under the status quo program.

3.2.1 Eagle Creek National Fish Hatchery Smolt Transfers

In 2005, approximately 550,000 LCR coho smolts will be transported to the Clearwater River Subbasin from ECNFH, divided into equal groups, and released without acclimation into the Potlatch River and Lapwai Creek. Upon returning to the Potlatch River and Lapwai Creek (in 2006), adults will be collected at temporary picket weirs, and adults will be transported to DNFH and spawned.

3.2.2 Clearwater Localized Stock Smolt Releases

In 2005, approximately 280,000 CLS stock smolts will be available from DNFH. These smolts will be the progeny of adult coho collected at the DNFH and KNFH from previous NPT coho releases, backfilled as necessary using adults returning to the Potlatch River and Lapwai Creek. DNFH smolts will be transported to KNFH for acclimation and released into Clear Creek. Similar to Lapwai Creek releases, DNFH/KNFH releases will primarily serve a broodstock development purpose at this time. Upon returning as adults, coho will be collected at the KNFH and DNFH hatchery ladders and spawned at DNFH.

3.2.3 Clearwater Localized Stock Presmolt Releases

In 2005, approximately 270,000 coho salmon presmolts will be available from CAFH. These presmolts will be the progeny of adults returning to temporary weirs from previous NPT juvenile coho releases, with broodstock backfilled as necessary using adults returning to the Potlatch River and Lapwai Creek. CAFH presmolts will be transported to Lolo Creek for direct release. Upon collection at the weir in Lolo Creek, returning adults will be transported to DNFH for spawning.

3.2.4 Goals and Constraints of the Current Program

The establishment of natural spawning in the Potlatch River and Lapwai Creek is not a goal of this project. These locations were selected to minimize migration distance and maximize capture opportunity for returning adults. Aside from the primary purpose of collecting adult returns for use as CLS broodstock, these locations provide a “filter” for LCR production. That is, as adults are collected in the Potlatch River and Lapwai Creek, the proportion of total juvenile production of LCR origin will decrease as a higher proportion of CLS stock adults are transported to DNFH and potentially back to

ECNFH[1]. This strategy would play an important role in obtaining broodstock for Phase II of the program (Section 3.7).

To date the NPT coho program has relied solely on existing adult collection, rearing, and acclimation facilities. By doing so, the NPT program has substantially minimized the costs associated with collecting, spawning, rearing, and acclimating coho salmon. However, the use of existing facilities has imposed some constraints on the program. For example, the ability to transfer adults or juveniles between facilities is limited in order to minimize the potential for disease transfer between hatchery complexes. For example, this concern limits smolt acclimation at KNFH to smolts reared at DNFH.

Despite the constraints imposed by limited rearing and acclimation facilities, up to half of the current juvenile releases are progeny of adults that have successfully returned to the Clearwater River Subbasin. Based on data from coho releases to date, a substantial survival advantage could be realized by acclimating all juvenile releases. By doing so, the probability of achieving the Phase I goal (securing a localized broodstock) can be increased.

3.3 Phase I Alternatives

Based on the programmatic constraints listed in Table 3-1, four alternatives were considered. A brief description of the alternatives is presented in the following paragraphs.

Alternative 1: Halt all Coho Salmon Releases
Alternative 1 would effectively halt all coho salmon reintroduction activities within the Clearwater River Subbasin. It is likely that ceasing reintroduction efforts would result in near-term extirpation of coho salmon within the Clearwater River Subbasin. At the very least, ceasing reintroduction activities would be unlikely to achieve the NPT coho salmon integrated restoration goal.

Alternative 2: Status Quo
Alternative 2 would maintain operations at the level proposed for 2005. This includes the release of:

- 280,000 CLS stock smolts from DNFH (acclimated at KNFH on Clear Creek),
- 270,000 un-acclimated CLS stock presmolts in Lolo Creek,
- 275,000 un-acclimated LCR stock smolts in Lapwai Creek, and
- 275,000 un-acclimated LCR stock smolts in the Potlatch River.

[1] Should the option to ship gametes to ECNFH be exercised, facilities for isolated incubation would be required.

Alternative 3: Construction of Low-Tech Acclimation Facilities

Alternative 3 proposes the construction of low-tech acclimation facilities in Lapwai and Lolo Creeks to capitalize on the higher observed survival of acclimated releases. Specifically, Alternative 3 requests funding to construct an additional pond at the existing NPTH North Lapwai Valley (NLV) site on Lapwai Creek and provide nets for fish containment at an existing millpond owned by the United States Forest Service (USFS) at the Musselshell work center on Lolo Creek. Under this alternative, LCR smolt releases would cease in the Potlatch River, and:

- 280,000 CLS stock smolts from DNFH would be acclimated and released from KNFH on Clear Creek,

- 270,000 CLS presmolts would be transferred from CAFH to the NPTH Site 1705 facility, reared over winter to the smolt stage in existing S-shaped NATUREs channels, transported to the Musselshell acclimation site, and volitionally released into Musselshell Creek in the spring, and

- 550,000 LCR smolts would be acclimated at the proposed NLV facility and volitionally released into Lapwai Creek.

Alternative 4: Construction of Clearwater River Subbasin Rearing and Acclimation Facilities

Alternative 4 seeks to increase rearing and acclimation facilities available for coho salmon in the Clearwater River Subbasin. In order to scale the size of necessary facilities, alternative 4 must necessarily integrate Phase I and II goals such that production and acclimation facilities developed to meet Phase I goals incorporate the flexibility to meet Phase II needs if the program proves successful.

Alternative 4 would expand hatchery facilities at NPTH to spawn 1,404 adults and rear approximately 687,700 coho salmon smolts for use in the Phase II rotating supplementation schedule discussed in Section 3.7. Initially, broodstock for the expanded NPTH facility would be obtained from adults returning from the release of 550,000 LCR smolts in Lapwai Creek. In the mid-term, this plan will allow the NPTH facility to act as a "filter" such that adults returning from the release of LCR smolts are intercepted, transported to the expanded NPTH facility, and spawned. The resulting CLS progeny would be reared to the smolt stage and released in natural production areas. This strategy was selected to maximize the potential for natural selection to act on first generation LCR smolts and adults prior to their introduction to natural spawning areas. Additionally, this strategy slowly severs reliance on LCR coho salmon transfers such that genetic drift should be minimized, and the full compliment of useful genetic variation present in LCR hatchery broodstocks should be present in the CLS broodstock and Clearwater River Subbasin natural spawning aggregates.

The following releases would be pursued under this alternative:

- 280,000 CLS smolts would be acclimated at KNFH for release into Clear Creek,

- 270,000 CLS presmolts would be transferred from CAFH to the NPTH Site 1705 facility, reared over winter to smolt stage in existing S-shaped NATUREs channels, transported to the Musselshell acclimation site, and volitionally released into Musselshell Creek in the spring,

- 550,000 LCR smolts would be acclimated at the proposed NLV facility, and volitionally released into Lapwai Creek, and

- 729,000 CLS smolts would be divided into three release groups (243,000 per group) for release into the American River, Red River, and Crooked River, for a duration of three years, at which time these releases would cease, and releases would occur in O'Hara Creek, Newsome Creek, and Mill Creek for a period of three years.

3.4 Selection of a Preferred Alternative

In the short-term the coho salmon reintroduction program is necessarily focused on stimulating adequate adult returns to provide broodstock at existing Clearwater River Subbasin hatchery facilities. As discussed in the development of screening criteria, juvenile acclimation, releases at the smolt life history stage, and locating juvenile release points lower in the Clearwater River Subbasin are expected to increase adult return rates. In addition, replacement of LCR coho stocks with CLS coho stocks at the CAFH and DNFH facilities is expected to result in a survival benefit as natural selection acts to increase the prevalence of phenotypes that are beneficial within the environmental context of the Clearwater River Subbasin.

Since broodstock acquisition must be emphasized at this time, it follows that any alternative considered must yield an average replacement rate greater than one. In order to quantitatively predict the potential to achieve the Phase I objective under a range of alternatives, we used a stochastic model to simulate expected adult returns based on the production associated with each alternative. Survival values used in the simulation include juvenile survival to Lower Granite Dam (LGD), Smolt to Adult Return rate (SAR) from LGD to LGD, and adult dropout rate from LGD to collection facilities. Arrays of potential survival and dropout values were populated using observed data collected from preliminary NPT coho reintroduction efforts (Section 6.2). Adult return estimates for given alternatives were calculated by randomly drawing a value from the appropriate arrays for juvenile survival to LGD, SAR from LGD to LGD, and dropout rate, and multiplying the total juvenile release by the randomly selected values. For each release group within each alternative, 32,000 estimates were constructed. Mean adult return estimates and 95% confidence intervals were extracted from each set of estimates and reported for each alternative. Since presmolts have not been previously released, data were not available to directly estimate an expected return for this group. Therefore, we used the upper 95% confidence limit of parr to smolt survival for coho parr released in Lolo Creek (21%) as an assumed value for presmolt to smolt survival. The estimated presmolt to smolt survival, while based on limited data, is similar to the 18.1% mean parr to smolt survival values reported by Kiefer and Lockhart (1997) for spring Chinook salmon in the upper Salmon River measured from 1988 to 1995. After accounting for presmolt to smolt mortality, presmolt survival to LGD was assumed to be equivalent to acclimated CLS smolt survival to LGD. Presmolt SAR from LGD to LGD was assumed to approximate SAR's of acclimated CLS stock smolts, and adult dropout rates were assumed to approximate values observed for CLS smolts.

Production estimates for localized coho salmon in the hatchery environment were calculated assuming 2,100 eggs per female and 70% survival from egg to smolt in the hatchery environment (observed at DNFH). Egg to presmolt survival was assumed to be 75%. Prespawning mortality was assumed to be 10%. Based on recent coho escapement within the Clearwater River Subbasin, we assumed that females constitute an average of 37% of the adult return (including jacks).

Utilizing the stochastic model described above, total adult return, potential presmolt and smolt hatchery production from the estimated adult return, and the juvenile to juvenile replacement rate for each release type (calculated as potential juvenile production in generation two divided by the number of juveniles released in generation one) were estimated (Tables 3-2 to 3-4). Estimates are not provided for alternative one (halting all coho releases), since few data exist to evaluate the natural production potential of adults returning from preliminary juvenile releases.

Table 3-2. Estimated adult return and juvenile production for the currently planned 2005 (Alternative 2; Status Quo) coho salmon releases in the Clearwater River Subbasin.

Stream	Stock	Number Released	Adult Return (95% CI)	Potential Production[1]	Replacement Rate
Clear Creek	CC	280,000 Smolt	578 (464, 593)	282,817	1.01
Lolo Creek	CC	270,000 Presmolt	115 (90, 140)	60,260	0.22
Lapwai Creek[2]	LCR	275,000 Smolt	323 (6, 882)	157,950	0.57
Potlatch River[2]	LCR	275,000 Smolt	323 (6, 882)	157,950	0.57
				Mean Replacement	**0.73**

[1]Potential production refers to the number of smolts (presmolts in Lolo Creek) that could be produced by spawning all returning adults in hatchery facilities.

[2]Return rates based on direct stream release.

Table 3-3. Estimated adult return and juvenile production following implementation of Alternative 3.

Stream	Stock	Number Released	Adult Return (95% CI)	Potential Production	Replacement Rate
Clear Creek	CC	280,000 Smolt	578 (464, 693)	282,817	1.01
Lolo Creek	CC	270,000 Smolt	557 (447, 668)	272,716	1.01
Lapwai Creek[1]	LCR	550,000 Smolt	1,404 (88, 3,186)	687,653	1.25
				Mean Replacement	**1.14**
[1]Return rate based on acclimated release.					

Table 3-4. Estimated adult return and juvenile production following implementation of Alternative 4.

Stream	Stock	Number Released	Adult Return (95% CI)	Potential Production	Replacement Rate
Clear Creek	CC	280,000 Smolt	578 (464, 693)	282,817	1.01
Lolo Creek	CC	270,000 Smolt	557 (447, 668)	272,716	1.01
Lapwai Creek	LCR/CC	550,000 Smolt	1,404 (88, 3,186)	687,653	1.25
American River[1]	CC	243,000 Smolt	500 (402, 601)	Unknown	Unknown
Red River[1]	CC	243,000 Smolt	500 (402, 601)	Unknown	Unknown
Crooked River[1]	CC	243,000 Smolt	500 (402, 601)	Unknown	Unknown
Ohara Creek[2]	CC	243,000 Smolt	500 (402, 601)	Unknown	Unknown
Newsome Creek[2]	CC	243,000 Smolt	500 (402, 601)	Unknown	Unknown
Mill Creek[2]	CC	243,000 Smolt	500 (402, 601)	Unknown	Unknown
				Mean Replacement[3]	**1.14**
[1]Streams in group one of the three year rotating supplementation schedule.					
[2]Streams in group two of the three year rotating supplementation schedule.					
[3]Replacement rate calculated only for Clear, Lolo, and Lapwai Creeks.					

Alternatives 1 and 2 are unlikely, on average, to yield positive replacement rates, and are therefore considered inappropriate. Alternatives 3 and 4 both yield average smolt to smolt replacement rates of 1.14, suggesting that implementation of either alternative would be appropriate. In fact, implementation of Alternative 3 could act as a precursor to implementation of Alternative 4. This would allow the program to proceed as a phased approach wherein immediate implementation of Alternative 3 (as Phase I) would allow the NPT to determine whether adequate broodstock could be collected for activities under Alternative 4 (Phase II), while simultaneously testing whether the establishment of natural production can be accomplished in a subset of natural production areas. Implementing such a phased approach would enable the NPT to conduct these tests with a limited initial capital investment (construction of two low-tech acclimation facilities). Should Phase I goals and objectives be achieved, Phase II (Alternative 4 - construction of an expansion to the NPTH facility) would be pursued via a supplement to this Master Plan.

The following sections detail a proposal to implement Alternative 3 as Phase I of the reintroduction program, and provide a roadmap for potential transition to Alternative 4 as

Phase II of the program. The transition to Phase II would occur only if the Phase I indicators of program success (Section 3.6) are achieved.

3.5 Description of the Proposed Reintroduction Program (Phase I)

The proposed coho reintroduction program would implement Alternative 3 (hereafter "Phase I"). The primary goal of Phase I is the establishment of:

- A sustainable return of 954 Clearwater Localized Stock (CLS) adult coho salmon to capture facilities to fulfill broodstock needs for existing Clearwater River Subbasin facilities (452 for CAFH and 502 for DNFH)

- A sustainable return of an additional 1,404 adults to capture facilities to ensure that broodstock will be available for an expansion of the NPTH facility if Phase II is implemented.

The completion of four tasks will aid in achieving the Phase I goal:

- Task One: Continue to optimize production at existing spawning and rearing facilities in the Clearwater River Subbasin and maintain the transfer of 550,000 LCR stock coho smolts for release in Lapwai Creek.

- Task Two: Construct low-tech facilities to acclimate all coho juveniles prior to release in areas with existing adult collection facilities to enable broodstock collection.

- Task Three: Conduct tests of supplementation aimed at determining whether returning adult coho can spawn under natural conditions and produce viable progeny.

- Task Four: Implement a Research Monitoring and Evaluation (RM&E) program capable of providing information necessary to inform management, quantitatively track progress toward meeting Phase I goals, Phase II triggers, and determining the optimal size of release groups for establishing natural production.

3.5.1 Phase I Tasks One and Two

For the duration of Phase I, 550,000 coho salmon smolts would be transported to Lapwai Creek from ECNFH (LCR stock) for acclimation in the newly constructed pond at the NPTH NLV satellite site (Section 4.1). These coho would be volitionally released, and upon return adults would be collected in Lapwai Creek using a temporary picket weir. Adults would be held at DNFH for use as CLS broodstock.

Fertilized eggs from up to 452 adults collected on Lapwai Creek (held and spawned at DNFH) would be transported to CAFH. These eggs would give rise to an average of 270,000 presmolt coho salmon that would either be released in Lolo Creek or transferred to the NPTH Site 1705 facility where they would be reared until the smolt stage. At the smolt stage, juveniles from NPTH Site 1705 would be transported to the Musselshell Pond (proposed for modification; Section 4.1) on Lolo Creek. Juveniles would be acclimated and volitionally released from Musselshell Pond, and upon return adults would be collected for broodstock using a temporary picket weir on Lolo Creek that is currently operated for spring Chinook salmon as part of ongoing NPTH operations. These adults would be used as CLS broodstock at DNFH.

DNFH would hold and spawn up to 502 adults, collected at KNFH on Clear Creek, to produce an average of 280,000 coho salmon smolts. Smolts would be transported to KNFH for acclimation, and volitionally released into Clear Creek. Upon return, adults would be collected at an existing weir on Clear Creek operated by the USFWS, and transported to DNFH for spawning and use as CLS broodstock.

3.5.2 Phase I Task Three

The ultimate goal of the coho reintroduction program is the establishment of coho natural production within the Clearwater River Subbasin that in concert with hatchery production can sustain tribal and recreational fisheries. While the primary goal of Phase I is acquisition of a CLS broodstock, a comprehensive evaluation of natural production is planned in order to determine whether CLS coho salmon are capable of spawning under natural conditions and producing viable progeny. If natural production is documented in a limited set of streams, managers could more confidently implement Phase II, wherein the reestablishment of natural production is the primary goal.

Locations for testing natural production were screened using the following criteria:

- Natural production tests should be conducted in tributaries with established RM&E programs to allow cost sharing;

- Tests should be conducted in areas with existing infrastructure (*e.g.*, weirs and screw traps) to enumerate adult escapement and estimate juvenile production; and

- Sites should be selected to minimize logistical challenges, such that operations and maintenance costs can be minimized.

Then following goals were established for testing natural production:

- A target of 250 adults should be released in test locations, such that natural production can be readily evaluated;

- Where possible, adult escapement should be enumerated, such that subsequent redd counts can be used to estimate the number of adults per redd; and

- Juvenile production should be estimated, to determine whether reintroduced coho salmon can produce viable progeny.

Using these screening criteria, Lolo and Clear Creeks are proposed for testing natural production in Phase I. Natural production tests would be pursued by releasing a target of 250 adults above the adult collection weirs on Lolo and Clear Creeks. Since broodstock collection is the first priority during Phase I, adults would be released for natural production only in years when adult returns to Lapwai, Clear, and Lolo Creeks are surplus to broodstock needs at CAFH and DNFH. A limited fishery may be opened on a case-by-case basis to harvest excess adults.

3.5.3 Phase I Task Four

In years when escapement allows the release of surplus adults into natural production areas, redd counts would be performed in Lolo and/or Clear Creeks (if adults are released in both locations), such that an estimate of the number of adults per redd can be evaluated. In addition, the existing screw traps would enumerate juvenile coho salmon emigrants the subsequent year, such that natural production can be documented. Additional detail is provided in the RM&E plan (Chapter 5).

3.6 Phase I Indicators of Success and Failure

A number of time-limited indicators of success and failure have been compiled that are amenable to evaluation using the RM&E program (Chapter 5). The primary objective of Phase I is securing a localized Clearwater River Subbasin coho salmon broodstock (CLS stock). To achieve this goal, the NPT would use existing spawning and rearing facilities in the Clearwater River Subbasin in concert with rearing space at LCR hatcheries to meet juvenile release goals capable of returning an average of 2,358 adult coho salmon to adult capture facilities in the Clearwater River Subbasin for use as broodstock. Aside from hatchery production, Phase I of the reintroduction project has an experimental supplementation component. While the bulk of supplementation would occur during Phase II of the program, RM&E of limited supplementation in Phase I (in Clear and Lolo Creeks) is expected to guide Phase II activities. Therefore, indicators of program success and failure for Phase I have a broodstock component and a natural production component. RM&E components are summarized below for the purposes of establishing indicators of success and failure. More detailed RM&E plan information is available in Chapter 5.

3.6.1 Phase I Broodstock Indicators of Success and Failure

Broodstock goals for Phase I have two associated indicators of success (Table 3-5):

- A return of 954 Clearwater Localized Stock (CLS) adult coho salmon, in three years out of the nine year evaluation period, to fulfill broodstock needs for existing Clearwater River Subbasin facilities (452 for CAFH and 502 for DNFH)

- A return of an additional 1,404 adults, in three years out of the nine year evaluation period, to ensure that broodstock would be available for an expansion of the NPTH facility if Phase II is implemented.

Escapement would be measured at capture facilities on Lolo Creek, Clear Creek, Lapwai Creek, and at DNFH under RM&E Objective 1 (Chapter 5). Enumeration of an average of 2,358 adult coho at capture facilities over one three-year period within nine years (three generations) after implementation of Phase I would be an indicator of success. Failure to achieve a three-year average of 2,358 adult coho at capture facilities within this period would indicate failure. The second component of broodstock acquisition is the replacement of LCR origin coho with CLS stock coho. Establishment of 100% CLS broodstocks at CAFH and DNFH within nine years of the implementation of Phase I would indicate success, failure to achieve this goal within this period would indicate failure. In short, activities in Phase I must demonstrate that a sustainable broodstock source is available for DNFH, CAFH, and an expansion of NPTH, prior to construction of the NPTH expansion.

Table 3-5. Indicators of success for Phase I broodstock acquisition.

Phase I: Broodstock Acquisition		
Location	**Escapement**	**Origin**
CAFH	452	Naturalized CC Stock
DNFH	502	Naturalized CC Stock
Lapwai/Potlatch	1,404	LCR and CC Stock
Total	2,358	Total Escapement Past LGR

3.6.2 Phase I Natural Production Indicators of Success and Failure

There are two components to natural production monitoring that must be completed during Phase I:

- Establishment of baseline production and productivity estimates for naturally spawning coho in Clear and Lolo Creeks

- Establishment of measures of competition between coho and spring Chinook salmon and steelhead in Clear and Lolo Creeks.

The long-term success of coho salmon reintroduction requires that adult coho return to a targeted tributary, spawn, and produce viable progeny. During Phase I, RM&E Objective 2 (Chapter 5) would establish a baseline that yields natural production estimates in Clear and Lolo Creeks. At a minimum these measures would require a means to capture representative juvenile samples in both Clear and Lolo Creeks (preferably using a rotary screw trap) sufficient to allow estimation of total juvenile coho salmon abundance. A means for estimating adult escapement (preferably a weir) must be available in both Clear and Lolo Creeks to allow estimation of adult coho salmon escapement. Together, these two measures would allow an estimate of productivity (number of smolts divided by the number of adults). Finally, multiple pass redd counts should be performed in both Clear and Lolo Creeks in order to estimate the number of adults per redd. Indicators of success (Table 3-6) would be the establishment and operation of adult and juvenile capture facilities within a statistically valid experimental design. Indicators of failure would be an inability to capture juveniles and adults in an abundance allowing estimation of juvenile production and adult escapement and redd production.

In addition to the establishment of production and productivity estimates for coho, RM&E Objective 5 (Chapter 5) would implement a competition study in both Clear and Lolo Creeks. At a minimum this study would enable a comparison of condition factors of juvenile spring Chinook salmon and steelhead prior to substantial coho salmon supplementation, and in the presence of coho salmon. Indicators of success (Table 3-6) would be the establishment of a statistically valid comparison of condition factors of spring Chinook salmon and steelhead in Clear and Lolo Creeks prior to and following coho supplementation. Failure would be indicated by the inability to implement a statistically valid competition study.

Table 3-6. Indicators of success for Phase I production, productivity, predation, and competition studies.

Phase I: Natural Production Survival/Interactions Indicators of Success	
Clear and Lolo Creeks	**Baseline Coho Production and Productivity**
	Juvenile Abundance
	Adult Escapament (Hatchery and Natural)
	Redd Counts
Clear and Lolo Creeks	**Competition**
	Juvenile Chinook and Steelhead Condition Factor

3.6.3 Triggers for the Implementation of Phase II

Phase II would expand facilities at the NPTH to hold and spawn 1,404 adult coho and rear up to 687,700 coho salmon smolts. Coho salmon smolts produced at the expanded NPTH facility would be used in the rotating supplementation schedule discussed in Section 3.7.2. Three triggers have been identified after which the program would progress to Phase II:

- Achieving all Phase I indicators of success;
- Establishing that competition has not surpassed acceptable limits due to the reintroduction of coho salmon; and
- Confirming the availability of LCR coho salmon smolts for a minimum of six years (two generations) following completion of the NPTH expansion.

Measuring the achievement of indicators of success is relatively straightforward, and ensuring the availability of LCR smolts is a planning exercise. Defining acceptable limits of competition is more challenging. For the purposes of this project, a statistically significant decrease in the condition factors of juvenile steelhead or Chinook salmon following the introduction of coho salmon would be considered unacceptable. If unacceptable levels of competition are observed, coho salmon reintroduction would be reevaluated.

3.7 Description of the Long-Term Coho Reintroduction Program (Phase II)

If all indicators of Phase I success (Section 3.6) are achieved, the long-term coho reintroduction program would implement Alternative Four (hereafter "Phase II") via a supplement to this Master Plan. The primary goal of Phase II would be the initiation of a rotating supplementation program designed to reintroduce coho salmon to several tributaries within the Clearwater River Subbasin. Achieving this goal would require the construction of additional Clearwater River Subbasin rearing facilities for coho salmon. Four tasks are associated with the Phase II goal:

- Task One: Continue development of a Clearwater River Subbasin localized coho salmon stock (CLS stock).
- Task Two: Construct facilities at the Nez Perce Tribal Hatchery (NPTH) to accommodate holding and spawning 1,404 adults and rearing 687,700 smolts.
- Task Three: Increase supplementation using a rotating release schedule.
- Task Four: Provide harvest opportunities for tribal and recreational anglers.

3.7.1 Phase II Tasks One and Two

Implementation of Phase II would require the establishment of a CLS broodstock to populate an expansion of the existing NPTH facility. Since CAFH and DNFH should have a sustainable broodstock source prior to implementation of Phase II (Section 3.6), adult returns to Lapwai Creek would be reprogrammed to serve as broodstock for the expanded NPTH facility. On average, the annual release of 550,000 LCR smolts from the NPTH NLV acclimation facility would return 1,404 adult coho salmon to Lapwai Creek. These adults would be spawned at the expanded NPTH facility yielding an average of 687,700 smolts for use in supplementation activities.

3.7.2 Phase II Task Three

Since data regarding the historical abundance and distribution of coho salmon is limited, the NPT would approach Phase II using a rotating supplementation schedule aimed at quickly determining which Clearwater River Subbasin tributaries have the potential to support natural production. Initially, juvenile coho salmon from the Phase II expansion of the NPTH would be released in Newsome Creek, Red River, and Crooked River for a period of three years (one generation). Supplementation would then cease in these locations and begin in Lolo Creek, O'Hara Creek and Clear Creek for a period of three years (one generation). This rotating supplementation schedule was designed to:

- Aid in monitoring and evaluation;
- Quickly determine which streams are most likely to support natural production; and
- Limit the size of rearing facilities necessary to support supplementation objectives.

Staggering supplementation activities between stream groups for a period of three years allows the program to take advantage of the three-year generation length of coho salmon, such that in each set of streams one generation of adult returns is dominated by hatchery origin adults, and the next generation is dominated by natural origin adults (Table 3-7). This structure allows M&E activities to more easily estimate adult return rates and productivity of hatchery and natural origin individuals. In addition, one set of streams can act as a reference for the other set of streams, enabling researchers to statistically control for the effects of environmental fluctuation on survival of juveniles and adults of natural and hatchery origin. Finally, after one generation of supplementation, adult returns and juvenile productivity in the following generation should indicate which streams within a set of targeted streams provide the greatest potential for the establishment natural production (*i.e.*, those streams exhibiting the highest natural production and productivity). Those streams exhibiting relatively high rates of natural production would be eligible for another three year treatment period, while those streams that fail to support natural production, or in which negative side effects of supplementation (*e.g.,* high rates of competition) are observed would be abandoned. Several candidate streams (Table 3-8) have been identified as alternates should supplementation fail to establish natural production in the streams identified in the rotating supplementation schedule. The candidate streams would also be eligible for supplementation if it is determined that continued supplementation is unnecessary in the first two sets of streams.

Finally, the rotating supplementation schedule allows the project to move forward in a more cost effective manner by building a rearing facility approximately half of the size that would be required if all streams were supplemented simultaneously. Simply stated, since half of the targeted streams would be supplemented in a given year, the program requires only half of the total number of juveniles than would be necessary if all streams were supplemented simultaneously.

Table 3-7. Juvenile release and adult return schedule in stream sets included in the rotating supplementation schedule (listed years are arbitrary, and are provided for illustration purposes only).

Year	Juvenile Releases	Adult Returns		
2005	**HSR**			
2006	**HSR**	**HR**		
2007	**HSR**	**HR**		
2008	*HSR*	**HR**		
2009	*HSR*	*HR*	**NR**	
2010	*HSR*	*HR*	**NR**	
2011	**HSR**	*HR*	**NR**	
2012	**HSR**	**HR**	*NR*	**HR + NR**
2013	**HSR**	**HR**	*NR*	**HR + NR**
2014	*HSR*	**HR**	*NR*	**HR + NR**
2015	*HSR*	*HR*	**NR**	*HR + NR*
2016	*HSR*	*HR*	**NR**	*HR + NR*
2017		*HR*	**NR**	*HR + NR*

Bold text indicates release and return schedule in the first set of streams, italicized text represents release and return schedule in the second set of streams.
HSR = hatchery smolt release.
HR = hatchery adult return.
NR = natural adult return.

Table 3-8: Alternative streams identified for potential supplementation using the rotating supplementation schedule.

Stream	Location
Pete King Creek	Lochsa River
Fish Creek	Lochsa River
Asotin Creek	Snake River
Potlatch River	Lower Clearwater River
Tucannon River	Lower Snake River

3.7.2.1 Deriving the Size of Release Groups

Determining the optimal number of juveniles to release per year in a given stream was based on two considerations: 1) release size should be large enough to generate an ecological impact (positive or negative) such that the efficacy of coho reintroduction can be statistically evaluated and 2) juvenile release groups should be large enough to reasonably ensure that enough adults return to initiate a healthy natural spawning aggregate. Minimum release sizes were estimated using genetic principles and a cohort-based approach.

The Clearwater River Subbasin constitutes a somewhat novel environment for LCR coho salmon. There are several obvious environmental differences between Clearwater River Subbasin and LCR tributaries (*e.g.*, distance from the ocean), suggesting that LCR origin coho may not be optimally adapted for the Clearwater River Subbasin environment. Therefore, it is likely that natural selection will serve to increase the prevalence of traits that are beneficial within the environmental context of the Clearwater River Subbasin. Such selection is expected to be beneficial for the program, however it may be useful to balance selection for phenotypes of immediate value (*e.g.*, ability to sustain a prolonged migration) against the potential for a management induced "genetic bottleneck" that might result from prematurely isolating Clearwater River Subbasin broodstock from LCR production. To avoid such a bottleneck, the NPT program proposes to slowly phase out the use of LCR transfers by releasing first generation LCR juvenile transfers only in Lapwai Creek. Upon return, these adults would be spawned to create first generation CLS stock coho salmon smolts for use in supplementation activities. In this manner, Lapwai Creek acts as a "filter" allowing some immediate selection on LCR phenotypes, while simultaneously maintaining gene flow between the original broodstock source and supplemented tributaries.

The number of smolts released for supplementation purposes can likewise be guided by genetic considerations. Release groups should be large enough that subsequent adult escapement to the targeted tributaries maintains abundance capable of minimizing the random loss of genetic variation (genetic drift) typical of small populations. Directly measuring the maintenance of quantitative genetic variation among coho aggregates in targeted streams is beyond the scope of this program, however genetic principles can still be employed to minimize genetic drift. The following calculations assume that there are a number of alleles within the source population at a given locus, and that these alleles are of equal phenotypic value (*i.e.*, they are selectively neutral). Therefore, the probability of an allele being perpetuated into the next generation is related to the proportion of individuals possessing that allele in the current generation. This probability can be calculated using binomial probability as follows (adapted from Kincaid 1997):

$PR = 1-(1-p)^{2Ne}$
PR = probability of maintaining an allele
p = frequency of the allele
N_e = effective population size

Using this equation, one can determine how large a parental population must be to avoid the random loss of an allele. To do so, one first defines how large the effective population size must be to maintain genetic variation at a specified level. For example, to maintain a 95% probability of maintaining an allele that occurs at a frequency of 5% or greater (for one generation) requires an effective population size equal to 30 in the parental generation. Second, one must have an estimate of the ratio of effective spawners to total spawners (N_e/N) in the parental generation. Since the coho salmon used for NPT reintroductions originated from LCR hatcheries, an N_e /N estimate (0.065) was obtained for an LCR hatchery from Simon *et al.* (1986). Third, the N_e /N ratio can be used to estimate a minimum adult escapement necessary to achieve an N_e of 30, approximately

470 adults in this case. Therefore, a minimum escapement of 470 adults per treatment stream is necessary to probabilistically meet the criterion of maintaining a 95% probability that alleles occurring at a frequency of 5% or greater are not lost as a result of genetic drift for a period of one generation.

In order to determine how many juveniles must be released in a particular stream in order to return 470 adults in the next generation, data from NPT reintroduction activities (Section 6.2) were employed. On average, releasing 229,000 acclimated CLS stock smolts would return 470 adults in the next generation.

3.7.3 Phase II Task Four

Hatchery production would serve to supply juveniles for supplementation and to provide harvest opportunities for tribal and recreational anglers. Production from DNFH/KNFH would continue in order to provide supplementation opportunities in Clear Creek. Production from CAFH would continue as a means to provide presmolts for final rearing at the NPTH 1705 facility for supplementation in Lolo Creek. LCR coho releases in Lapwai Creek would proceed into the foreseeable future to provide first generation CLS stock adult returns for use as broodstock to provide smolts for the rotating supplementation schedule.

Harvest of Clearwater River Subbasin coho in ocean and mainstem Columbia River fisheries is expected to occur. Targeted Clearwater River Subbasin harvest opportunities are expected to arise under two circumstances:

- The abundance of natural origin adults allows for ample escapement for natural spawning while simultaneously providing for some of the broodstock needs. Using a fraction of natural origin adults for broodstock should result in a surplus of hatchery origin adults that could be targeted in a fishery.

- If supplementation activities successfully establish highly productive naturally spawning coho salmon aggregates, the number of locations and the size of supplementation release groups could be scaled down. If this occurs, production from the expanded NPTH facility could provide a targeted fishery.

3.8 Harvest Management

Given that the success of coho salmon reintroduction is unpredictable, it is premature to speculate on the number of coho salmon that may eventually be available for harvest. In addition, it is impossible to speculate whether fisheries would take the form of targeted terminal tributaries or selective/non-selective mainstem harvest. However, some assumptions regarding Tribal, State, and Federal management of coho fisheries are possible.

Management of Tribal fisheries for coho salmon would provide for the release of all protected species. Bag limits, gear restrictions, seasons, and areas restrictions would be employed to regulate harvest of coho salmon and protect other fish. Tribal harvest would be adjusted annually to provide for adequate escapement of broodstock and natural spawners. The impacts of coho salmon fisheries would be monitored under Objective 4 of the RM&E program (Chapter 5). Harvest management in the Clearwater River Subbasin would be coordinated with regional co-managers under RM&E Objective 6 (Chapter 5).

Fisheries co-managers would likely open a season for coho salmon in the Clearwater River Subbasin once it has been determined that a surplus is available. Since coho salmon return to the Clearwater River Subbasin during fall months, harvest is expected to be concurrent with steelhead harvest; primarily during the mid-September and October fishery. The State steelhead sport fishery occurs in the mainstem Clearwater River upstream to the mouth of the South Fork Clearwater River (RM 74.7) and in the South Fork to Castle Guard Station (RM 30.7).

Management of State sport fisheries by IDFG provides for the release of all protected species. Bag limits, gear restrictions, seasons, and area restrictions would be employed to regulate harvest of coho and protect other fish. Sport harvest would be adjusted annually to provide for adequate escapement of coho for broodstock and natural spawners. Sport harvest would be coordinated with the Nez Perce Tribe.

Chapter 4: Proposed Phase I Facility Modifications and Operations

In this chapter:

- Description of existing hatchery facilities involved in producing Clearwater coho salmon
- Description of proposed hatchery facilities and construction costs for Phase I
- Facility management
- Description of Clearwater coho production proposed in this master plan
- Summary of Operations and Maintenance; Research, Monitoring, and Evaluation; Permitting; Design; and Construction costs

This chapter contains a description of the production program at existing and proposed facilities that would occur if this master plan is approved and funded. It also contains a description of the agreements that exist between co-managers for production of Clearwater coho at existing hatchery facilities and conceptual design and cost estimates for proposed acclimation facilities. Annual operation and maintenance and monitoring and evaluation costs for the proposed production program are also detailed. The Clearwater River Subbasin coho reintroduction program currently has three elements:

- Transfer of 550,000 coho salmon smolts from the Eagle Creek National Fish Hatchery (ECNFH), located on the lower Columbia River;
- Release of 280,000 Clearwater Localized Stock (CLS) coho salmon smolts derived from adults collected and spawned in the Clearwater River Subbasin; and
- Release of 270,000 Clearwater Localized Stock (CLS) coho salmon presmolts derived from adults collected and spawned in the Clearwater River Subbasin.

4.1 Existing Hatchery Facilities Producing Clearwater Coho Salmon

Dworshak and Kooskia National Fish Hatcheries
Dworshak National Fish Hatchery (DNFH) is located on the south bank of the North Fork of the Clearwater River, 1.5 miles downstream from Dworshak Dam and 72.5 river miles upstream from Lower Granite Dam. Dworshak NFH is operated by the U.S. Fish and

Wildlife Service (USFWS) and produces spring chinook salmon for the Lower Snake River Compensation Plan and steelhead for Dworshak Dam mitigation.

Kooskia National Fish Hatchery (KNFH) is located 1.5 miles southeast of Kooskia, Idaho near the confluence of Clear Creek and the Middle Fork Clearwater River. The facility is operated by the USFWS as a satellite facility to DNFH. Kooskia NFH is used for adult collection and rearing only (spawning and incubation occur at DNFH). Kooskia NFH produces spring chinook salmon to help restore depleted upriver salmon stocks.

The NPT and the USFWS have a Memorandum of Understanding (MOU) in place that details the coho salmon production operations at both DNFH and KNFH. The USFWS operates the adult fish ladder at DNFH and the weir on Clear Creek at KNFH during October - November to assist with capturing coho salmon for broodstock. The USFWS provides holding for up to 500 adult coho salmon at DNFH. Coho salmon are spawned at DNFH and eggs are incubated for production at DNFH and Clearwater Anadromous Fish Hatchery (CAFH). Eggs for production at CAFH are incubated to the eyed stage at DNFH and then transported to CAFH for incubation and rearing. The USFWS provides egg incubation and juvenile rearing space for up to 320,000 coho salmon at DNFH and final rearing and acclimation for 280,000 coho salmon smolts at KNFH. Coho smolts are released from KNFH in May. The Nez Perce Tribe is responsible for all phases of fish culture. This includes cleaning, feeding, sampling, treating, hauling and releasing. In addition, the Tribe is responsible purchasing fish tags and coordinating all fish marking. Finally, the Tribe contracts with the State or a Federal entity for fish health certifications.

Clearwater Anadromous Fish Hatchery

Clearwater Anadromous Fish Hatchery (CAFH) is located on the North bank of the North Fork of the Clearwater River, 1.5 miles downstream from Dworshak Dam and 72.5 river miles upstream from Lower Granite Dam. CAFH is a Lower Snake River Compensation Plan facility, operated by the Idaho Department of Fish that produces spring chinook salmon and steelhead for release in the Clearwater River. The NPT and the IDFG have a MOU in place that details the coho production operations at CAFH. Adult coho salmon are not held or spawned at CAFH. Eggs for production at CAFH are imported at the eyed stage from DNFH or Eagle Creek National Fish Hatchery if there is a shortage in Clearwater stock. The IDFG provides egg incubation and juvenile rearing space for up to 270,000 coho salmon. Similar to the DNFH/KNFH MOU, the Nez Perce Tribe is responsible for all phases of fish culture. This includes cleaning, feeding, sampling, treating, hauling and releasing. In addition, the Tribe is responsible purchasing fish tags and coordinating all fish marking. Finally, the Tribe contracts with the State or a Federal entity for fish health certifications.

Coho salmon are reared to presmolt stage (50 fpp), transported to Lolo Creek, and direct stream released in late September or early October. With the construction of facilities proposed in this master plan, these fish would be transferred from CAFH to Nez Perce Tribal Hatchery for final rearing to smolt stage. Smolts would then be transferred to

Musselshell Pond for acclimation from late March to early April, and released into Musselshell Creek, a tributary to Lolo Creek.

Nez Perce Tribal Hatchery
Nez Perce Tribal Hatchery (NPTH) is located at river mile 32 on the Clearwater River, and is operated by the Nez Perce Tribe Department of Fisheries Resources Management. NPTH is authorized through the Columbia Basin Fish and Wildlife Program to produce spring chinook and fall chinook salmon for release in the Clearwater River. Currently, no coho salmon are reared at NPTH. With the construction of facilities proposed in this master plan, presmolts (50 fpp) from CAFH would be transferred to NPTH for final rearing to smolt stage. Smolts would then be transferred to Musselshell Pond for acclimation from late March to early April, and released into Musselshell Creek.

Eagle Creek National Hatchery
Eagle Creek National Fish Hatchery (ECNFH) is located at river mile 25 on Eagle Creek in the Willamette River Basin. Eagle Creek NFH was authorized under the Mitchell Act and currently operates as part of the Columbia River Fisheries Development Program. ECNFH is operated by the USFWS to help compensate for fish losses in the Columbia River Basin caused by mainstem dams. The USFWS produces coho salmon for the NPT through the *US v Oregon* Fall Season Agreement and Court Order. The USFWS spawns coho salmon at ECNFH to produce 550,000 coho smolts. These smolts are transported and released into the Clearwater River basin in March (275,000 to Lapwai Creek and 275,000 to the Potlatch River). Additional eggs may be taken at ECNFH, incubated to eye-up and transported to CAFH to backfill production if there is a shortage of Clearwater broodstock.

4.2 Phase I Proposed Acclimation Facilities

The construction of two low-tech acclimation facilities is included in the proposed alternative. The facility proposed at the existing NPTH NLV satellite on Lapwai Creek would be used to acclimate up to 550,000 coho smolts. An existing millpond in the Lolo Creek watershed at the United States Forest Service (USFS) Musselshell Work Center would be modified to provide acclimation for 270,000 CLS stock coho smolts. Completion of these facilities would provide acclimation for coho salmon that are currently direct stream released, resulting in 100% acclimation for all coho salmon production in the Clearwater River Subbasin.

4.2.1 North Lapwai Valley Acclimation Site

This Master Plan proposes to modify an existing Nez Perce Tribal Hatchery facility known as the North Lapwai Valley (NLV) acclimation site. NLV is operated by the NPT with funding from the Columbia Basin Fish and Wildlife Program, and is located approximately 0.75 miles upstream of the confluence of Lapwai Creek and the Clearwater River in Nez Perce County, Idaho. The NLV is currently used to acclimate fall Chinook salmon subyearling smolts, which precludes the use of existing facilities for the acclimation of coho salmon. The NLV satellite currently has two ponds, with approximately 13,150 cf of rearing space each, with both a surface and groundwater supply system that can be mixed to control water temperature. An assessment of water quality suggests that this site meets established standards from peer-reviewed literature (Table 4-1). The ponds are located in the higher elevation area of the site with discharge entering Lapwai Creek near the State Highway Route 95 bridge crossing. The site was designed for additional pond construction and has adequate living quarters for personnel to occupy during acclimation. The following modifications are proposed at this site:

- Excavate a pond to acclimate up to 550,000 coho salmon down slope from the existing ponds (Figure 4-1). The proposed pond would be 23,000 cubic feet, allowing the acclimation of 550,000 coho smolts at a density index (Piper et al. 1982) of 0.3.

- Tap into the existing pond overflow, well, and surface water head tank.

- Construct a first pass water supply through the overflow of the existing head tank, and allow for diversion of second pass water through the overflow from existing ponds.

- Construct small check dams to impound a series of small pools along the existing overflow ditch leading to Lapwai Creek.

Preliminary cost estimates are presented in Table 4-2.

4.2.2 Musselshell Pond

This master plan also proposes to modify an existing mill pond in the Lolo Creek drainage known as Musselshell Pond. This modification would allow acclimation of 270,000 smolts. The current production at CAFH is 270,000 presmolt coho salmon. These presmolts will be transported to NPTH where they will be reared until the smolt stage. At the smolt stage, juveniles will be transported to the Musselshell Pond, acclimated and volitionally released.

Nets would be placed into Musselshell Pond to prevent juveniles from leaving the pond until they are acclimated. The nets would be doubled across the outfall area of the pond allowing for a net to be removed for cleaning while still retaining the fish within the pond. At smolting the nets would be removed, thus allowing volitional release. Analysis of water samples from this site suggest that water quality is acceptable for acclimation (Table 4-1). A preliminary cost estimate for modifications to Musselshell Pond is presented in Table 4-4.

Upon return, adults could be captured at an existing NPTH adult collection facility on Lolo Creek. The proposed trap site is located approximately 13 miles upstream of the confluence of Lolo Creek with the Clearwater River. Currently a portable weir and trap at this site is fished from July to September for spring Chinook salmon. The trap could be operated through November to collect coho salmon. Returning fish would swim into a trap box, be netted out and placed into a 500-gallon transport tank on a one-ton vehicle, and transported to holding ponds at DNFH, or allowed to pass the weir and spawn in the Lolo Creek watershed.

It should be noted that the Musselshell facility, though intended solely for use as a coho acclimation facility at this time, could provide an acclimation opportunity for steelhead or Chinook salmon. Development of this facility would therefore provide additional flexibility for fisheries comanagers.

Table 4-1. Literature standards and surface water quality measurements for proposed acclimation sites.

Parameter	Daily and Economon 1983	ADFG 1983	Wedemeyer and Wood 1974	Piper *et al.* 1982	Musselshell Creek	Lapwai Creek
Alkalinity - ppm	20.0	NR	20.0 - 200.0	10.0 - 400.0	11.0	365.0
Aluminum - ppm	0.01	0.01	NR	NR	0.06	0.04
Un-ionized Ammonia - ppm	0.02	0.0125	0.012 - 5.0	0.01	NR	NR
Arsenic - ppm	0.05	0.05	NR	NR	NR	NR
Barium - ppm	5.0	5.0	NR	NR	0.013	0.048
Calcium - ppm	52.0	NR	52.0	4.0 - 160.0	2.5	30.5
Copper - ppm	0.03	0.03	0.03	NR	NR	0.001
Fluoride - ppm	0.5	0.5	NR	NR	NR	0.2
Iron - ppm	0.1	0.1	1	0.5	0.12	0.05
Lead	0.02	0.02	NR	0.03	NR	NR
Magnesium - ppm	15.0	15.0	NR	NR	0.5	11.2
Managanese - ppm	0.01	0.01	NR	0 - 0.01	0.006	0.007
Mercury - ppm	0.2	0.0002	NR	0.002	NR	NR
Nitrate - ppm	1.0	1.0	NR	0.0 - 3.0	NR	0.7
Nitrite - ppm	1.0	0.1	0.55	0.1 - 0.2	NR	NR
Nickel	0.01	0.01	NR	NR	NR	NR
pH	6.7 - 8.6	6.5 - 8.0	6.7 - 9.0	6.5 - 8.0	6.76	8.34
Potassium - ppm	5.0	5.0	NR	NR	0.6	3.4
Sodium - ppm	75.0	75.0	NR	NR	2.6	16.6
Sulfate - ppm	50.0	50.0	NR	NR	0.7	7.1
Total Dissolved Solids - ppm	400.0	400.0	400.0	NR	62.0	201.0
Zinc	0.005	0.005	0.04	0.03	NR	NR

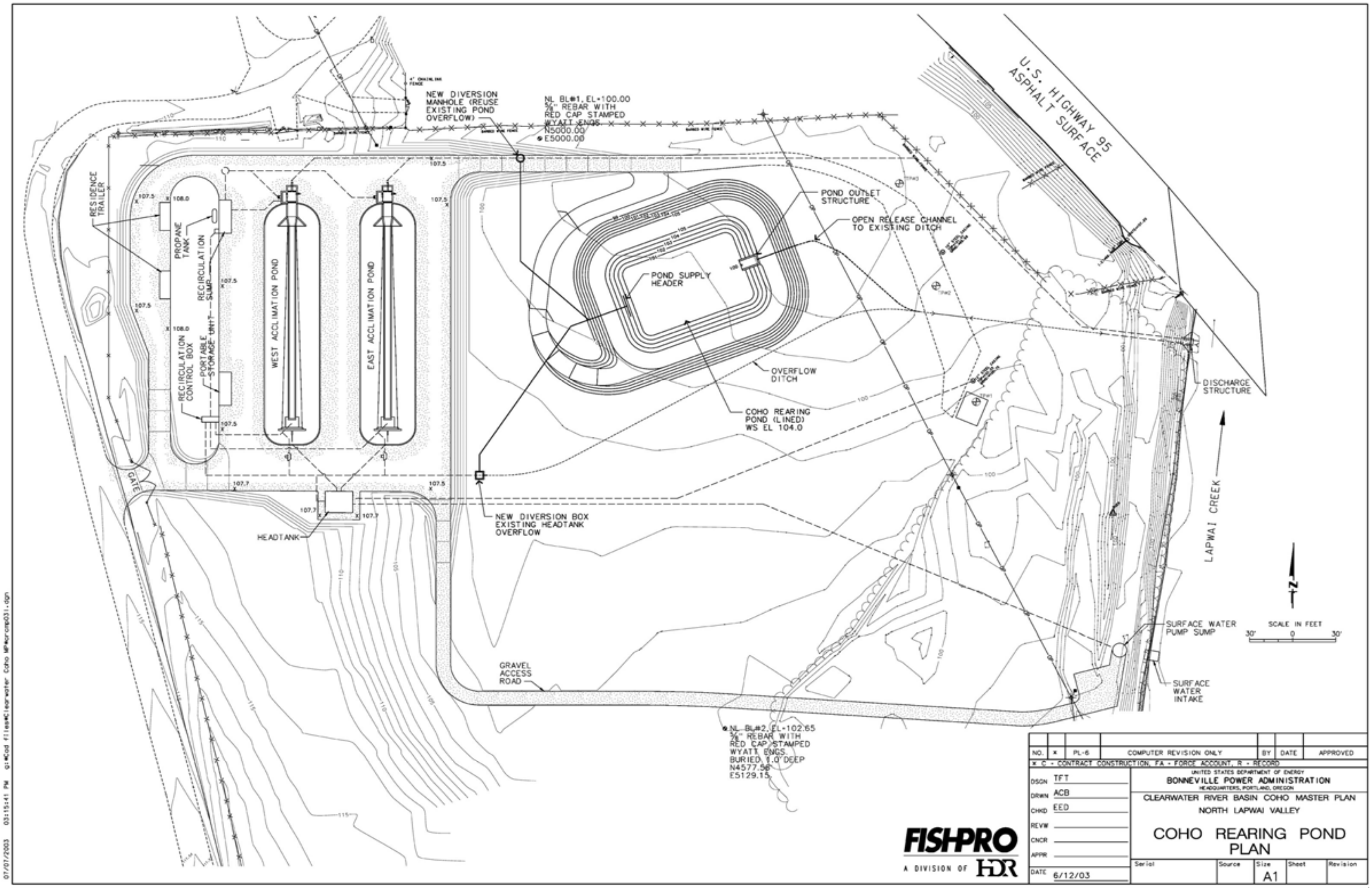

Figure 4-1. Preliminary design for the NLV coho acclimation facility at the NPTH.

Table 4-2. Estimated budget for the construction of the proposed coho acclimation pond at the NPTH NLV satellite facility.

Item	Activity	Quantity	Unit	Cost	Amount	Total
Pond						$60,708
	Excavation	356	CY	$15.00	$5,340	
	Fill	1,500	CY	$15.00	$22,500	
	Grading	19,200	SF	$0.25	$4,800	
	Sand Liner Bedding	150	CY	$0.45	$68	
	Lining	12,000	SF	$1.50	$18,000	
	Supply Header	1	LS	$3,000.00	$3,000	
	Outlet Structure	1	LS	$7,000.00	$7,000	
Piping						$41,825
	Reuse Diversion Manhole	1	EA	$10,000.00	$10,000	
	Overflow Diversion Manhole	1	EA	$10,000.00	$10,000	
	24" Schedule 40 PVC	150	LF	$75.00	$11,250	
	18" Schedule 40 PVC	120	LF	$60.00	$7,200	
	24" Schedule 40 PVC Drainpipe	45	LF	$75.00	$3,375	
Pond Access						$11,445
	Excavation	67	CY	$15.00	$1,005	
	Fill	312	CY	$15.00	$4,680	
	Grading	3,600	SF	$0.25	$900	
	Base Grael 8"	72	CY	$45.00	$3,240	
	Top Gravel 3"	27	CY	$60.00	$1,620	
New Open Channel to Existing Ditch						
	Excavation	100	LF	$45.00	$4,500	$4,500
Subtotal Material Cost						$118,478
Contingency (25%)						$29,619
Total Site Cost						**$148,097**

Table 4-3. Estimated budget for the modification of the existing Musselshell Pond.

Item	Quantity	Unit	Cost	Amount	Total
8' x 200' Nets	2	EA	$2,250	$4,500	
End Anchors	2	EA	$500	$1,000	
Total Material Cost					$5,500
Contingency (25%)					$1,375
Total Site Cost					**$6,187**

4.3 Facility Management

Facilities utilized for incubation, early rearing, final rearing, and acclimation of coho salmon will continue to be operated by the current facility agency and co-manager. The acclimation facilities proposed in this document will be operated by the NPT. The Tribe will development agreements with the USFS for Musselshell Pond.

The Nez Perce Tribe would function as the lead agency for the coho reintroduction program and therefore, would be primarily responsible for planning, operation and maintenance, and monitoring and evaluation of the reintroduction program as it is described in the Master Plan. Continued optimization of hatchery production will be pursued under RM&E Objective 3 (Chapter 5), which is aimed at determining optimal release rearing, release, and marking strategies. RM&E Objective 2 (Chapter 5) will evaluate whether hatchery practices ensure the maintenance of genetic diversity and life history traits.

The NPT will continue to participate in the development of the Clearwater Annual Operating Plans (AOPs) to coordinate coho project operations with its co-managers. The AOPs include:

- Details of day-to-day project operation;
- A fish production plan that identifies stocks and number of fish produced by the project during the fiscal year, release locations, life stages, numbers, and dates;
- Tasks required to complete general project objectives; and
- An identification of personnel required to complete the tasks and duties outlined in the AOP

4.4 Proposed Production Program Summary

This section contains an overview of the production program at existing and proposed facilities that would occur if this master plan is approved and funded.

Adult Collection and Spawning

The Nez Perce Tribe currently operates temporary weirs consisting of tripods, picket panels, and trap boxes in Lapwai Creek and Lolo Creek from early October to mid-December to collect adult coho salmon. This trapping would continue under the proposed program. Protocols for operation follow basic adult trapping and handling procedures consistent with IHOT guidelines (IHOT 1995). The weir/traps are monitored 24 hours a day and routinely checked for accumulation of debris and proper operation. Design of the weir allows for unimpeded upstream and downstream movement of juvenile fish, as well as controlled movement of adult sized fish. Captured adults are sampled daily. Adults taken for broodstock are transferred to a vehicle and transported to DNFH. These fish are placed in an adult holding pond for spawning. Adults released for natural spawning are returned to the stream upstream of the weir.

A semi-permanent weir on Clear Creek is currently operated by the USFWS at KNFH. This trapping would continue under the proposed production program. The weir operates from early October to mid December each year. Adults taken for broodstock are transferred to a transportation vehicle and transported to DNFH. These fish are placed in an adult holding pond until spawned. Currently, no adults are released above the weir for natural spawning. However, as part of the reintroduction effort, adults may be passed at Clear Creek. The number of adults passed is determined by broodstock needs and harvest and natural production goals.

A fish ladder and trap on the North Fork of the Clearwater River is currently operated by the USFWS at DNFH. This trapping would continue under the proposed program. The ladder operates from early October to mid December. The ladder is open 24 hours a day until the USFWS collects approximately 500 steelhead. Once the steelhead goal is met, the ladder is opened a few days a week to allow for additional coho salmon collection. Fish in the ladder are sorted weekly, and coho salmon are placed in the adult holding pond until spawned.

Spawning typically begins in mid October and is completed by mid December. Once a week, ripe females are spawned with at least one male. In most cases, a 1:1 male to female ratio is maintained.

Egg Incubation and Juvenile Rearing

Eggs from adults captured in Lapwai Creek, Lolo Creek, Clear Creek and North Fork Clearwater River are incubated at DNFH and CAFH. Additional eggs from these adults may be incubated to eye-up and transported to CAFH. At hatch, fish are transferred to indoor vats and reared until steelhead rearing space is needed. Fish (typically 600-800 fish per pound (fpp)) are then moved to the outdoor concrete raceways and reared to the smolt stage (20 fpp).

Eggs from both ECNFH and DNFH are incubated at CAFH. At hatch, fish are transferred to indoor vats and reared to approximately 500 fpp. These fry are then transferred to outdoor raceways and reared to presmolt stage (50 fpp). Due to water limitations at CAFH, these fish are transported off station by late September or early October.

Smolt Release

Under the proposed production program, during the second week of March, 550,000 coho salmon smolts would be transported from ECNFH to the Clearwater River basin for release into the North Lapwai Valley Acclimation Pond. Smolt size at release is 20 fpp. Under the current program (Section 3.2) these smolts are direct stream released into Lapwai Creek (275,000) and the Potlatch River (275,000).

Coho salmon reared at DNFH are transferred to fish transportation trucks and taken to KNFH during the first week of April. These fish are acclimated for six weeks and volitionally released into Clear Creek. There would be no change to this production under the proposed production program.

Under the proposed production program, during the last week of September or first week of October, presmolts (50 fpp) from CAFH would be transported to NPTH. Fish would be reared to the smolt stage (20 fpp) and transferred to the Musselshell Pond in late March for acclimation. Smolts would be volitionally released into Musselshell Creek. This would constitute a change from a direct-stream presmolt release to an acclimated smolt release.

Fish Health Monitoring
A systematic fish health monitoring and disease control program is currently in place and referenced in the Memoranda of Understanding (MOU) with both DNFH and CAFH. Fish health monitoring and disease control will follow the respective hatcheries' guidelines. It is the goal of these control measures to:

- Document occurrence of disease(s) in wild/natural population.

- Monitor adult mortalities and spawned adults for presence of viral, bacterial, fungal and parasitic agents.

- Conduct examinations at all life stages when unusual loss occurs to determine cause of loss and recommend preventative and therapeutic treatment.

Disease control and monitoring practices conform to standards developed by the Nez Perce Tribe Fish Health Policy, the Integrated Hatchery Operations Team (IHOT 1995), and other standard fish culture disease monitoring protocols. The Nez Perce Tribe Fish Health Policy defines policies, goals, and performance standards for fish health management, including measures to minimize impacts to wild fish.

4.5 Budgets

Cost estimates for the new facilities are shown in Table 4-4. Cost estimates for construction of facilities were prepared by HDR Inc.

Table 4-4. Estimated expenditures for the Clearwater River Coho Salmon Project.

Expenditure	Estimated Cost
Planning: • Design @ 10 percent of construction costs ($15,498), • NEPA/ESA costs ($50,000), • and 0.5 FTE for project administration ($35,000)	$100,498
Construction (includes capital, engineering, and construction administration)	$154,284
Project-wide O&M (FY 2006)	$576,213
Project-wide M&E (FY 2006)	$841,494
Total	**1,672,489**
Note: Estimates are in 2004 dollars	

Both the Operations and Maintenance (O&M) and Research, Monitoring, and Evaluation (RM&E) budgets have start-up capital costs including one-time purchases of a rotary screw trap and data loggers ($22,000 in RM&E), and trailers and tanks ($50,000 in O&M). The outyear costs are reduced by these one-time purchase amounts and increased by the standard 3% annually (Table 4-5).

Table 4-5. O&M and RM&E budget estimates for implementation of Phase I of the Nez Perce Tribe Clearwater River Subbasin coho salmon reintroduction project.

Fiscal Year	O&M	RM&E
2006*	$576,213	$841,494
2007	$541,999	$844,079
2008	$558,259	$869,401
2009	$575,007	$895,483
2010	$592,257	$922,348

*2006 budget estimates include one-time purchases of a rotary screw trap and data loggers ($22,000 in RM&E), and trailers and tanks ($50,000 in O&M).

Chapter 5: Research Monitoring and Evaluation

In this chapter:

- Management goals and objectives
- Assumptions associated with management objectives
- Monitoring and evaluation goals and objectives
- Annual monitoring and evaluation budget estimates

5.1 Coho Salmon Restoration Program Management Goals and Objectives

The Nez Perce Tribe's overall goal for coho salmon in the Clearwater River Subbasin is to reintroduce and restore coho salmon to levels of abundance and productivity sufficient to support sustainable runs and annual harvest. Accompanying that goal are related objectives that detail a level of annual escapement and state the need to maintain genetic attributes and life history characteristics of naturally spawning coho salmon that support:

- Protection, mitigation, and enhancement of Columbia River Basin anadromous fish resources;
- Long-term harvest opportunities for tribal and non-tribal anglers; and
- Maintaining ecological and genetic impacts to non-target populations within acceptable limits.

5.2 Assumption Associated with Management Objectives

The following objectives were formulated to meet the goals stated above and to address management needs. Assumptions were developed for each objective. To achieve success, the following assumptions must be met for each management objective.

Management Objective 1: Develop a localized Clearwater River coho salmon broodstock to support components of the restoration program.

- Localized broodstock will be more effective in establishing natural production.
- Hatchery escapement meets identified broodstock goals.

Management Objective 2: Establish natural production of coho salmon in the Clearwater River subbasin.

- Hatchery escapement meets identified natural production goals.
- Adult returns from natural production are detected.
- Stream fidelity among returning hatchery and natural origin spawners is high.

Management Objective 3: Operate the hatchery program so that life history characteristics and genetic diversity support natural production of coho salmon.

- Genetic structure of the founding population is diverse and robust enough to support local adaptation over time.

Management Objective 4: Keep impacts of the hatchery program on non-target species within acceptable limits.

- Natural production of steelhead and Chinook salmon is not adversely effected.

Management Objective 5: Restore and maintain treaty-reserved tribal and recreational fisheries.

- Hatchery and natural-origin adult returns can be adequately forecasted to guide harvest opportunities.
- Hatchery adult returns are produced at a level of abundance adequate to support fisheries in most years with an acceptable level of impact to natural-spawner and broodstock collection.
- Ocean and Lower Columbia River fisheries do not constrain broodstock and natural escapement.
- In-basin fisheries do not constrain broodstock and natural production escapement.

Management Objective 6: Operate the hatchery programs to achieve optimal production effectiveness while meeting priority management objectives for natural production enhancement, diversity, harvest, and impacts to non-target populations.

- We can identify the most effective rearing and release strategies.
- Management methods (weirs, juvenile traps, harvest, adult out-plants, juvenile production releases and marking strategies) can be effectively implemented as described in management agreements and monitoring and evaluation plans.

Management Objective 7: Coordinate monitoring and evaluation activities and communicate program findings to resource managers.

- Coordination of needed and existing activities within agencies and between all co-managers occurs in an efficient manner.
- Accurate data summary is continual and timely.
- Results are communicated in a timely fashion locally and regionally.
- The RM&E program facilitates scientifically sound adaptive management of the coho salmon restoration program.

5.3 Monitoring and Evaluation Goals and Objectives

Based on the above management objectives and assumptions, underlying Research, Monitoring, and Evaluation (RM&E) objectives were developed to assess the results of the supplementation efforts so that operations can be adaptively managed. We organized the methodology section of the RM&E plan according to RM&E objectives relevant to the management objectives. These RM&E objectives required quantifiable measures that describe structural and functional attributes of interest as well as progress toward meeting the objective.

The goal of the Nez Perce Tribe coho salmon reintroduction RM&E program is to monitor and evaluate the results of the coho restoration program so that operations can be adaptively managed to optimize hatchery and natural production, and minimize deleterious ecological impacts. Pursuant to this goal, research data collection and analysis for the coho restoration RM&E program endeavors to:

1) provide science-based recommendations for management and policy consideration;

2) demonstrate when the reintroduction program meets its restoration goals; and

3) assist in the re-establishment of tribal and recreational fisheries.

This document should be viewed as an adaptable tool that describes the scope of research, the approach towards monitoring and evaluation efforts, and the existence of ongoing research, monitoring and evaluation projects and their relationship to the coho salmon restoration program. As such, the associated methods to accomplish the objectives are subject to modification as critical uncertainties are addressed, new technology is developed and new questions arise. We also desire to be consistent and coordinated with other regional monitoring and evaluation plans and subbasin planning recommendations.

5.3.1 RM&E Objective 1. Determine If Program Targets for Contribution Rate of Hatchery Fish Are Being Achieved and if They Can Be Improved.

Information gathered under this M&E objective is intended to evaluate how well hatchery production techniques are working and whether certain practices can be modified to improve benefits. The program objectives include both developing a localized coho salmon broodstock and optimizing hatchery product performance. Sampling under this objective is designed to address the following management assumptions:

1. Localized broodstock will be more effective in establishing natural production.

2. Hatchery escapement can meet identified broodstock goals.

3. We can identify the most effective rearing and release strategies.

Management methods (weirs, juvenile traps, harvest, adult out-plants, juvenile production releases and marking strategies) can be effectively implemented as described in management agreements and monitoring and evaluation plans.

5.3.1.1 Task 1.A. Monitor fish culture and hatchery operational practices at each of the facilities utilized for the Nez Perce Tribe coho restoration program.

In-hatchery guidelines have been established by the Integrated Hatchery Operations Team (IHOT 1995). Each of the hatcheries involved with the reintroduction effort are required to follow the IHOT guidelines. Documentation of fish performance and rearing conditions will follow IHOT (1995) protocols and include: egg-take, egg-to-fry, and egg-to release survival rates; daily mortality; rearing densities and loading factors; calculation of growth rate; monthly fish health examinations of dead and live fish; and the size, condition, number, date, and location of release.

- Activity 1.A.1. Develop NPT coho salmon annual operation plan. This includes documenting the juvenile rearing and release activities at all Nez Perce Tribe coho restoration program facilities. This activity will be a cooperative effort between the Monitoring and Evaluation project and the Production Division within the tribe.

  - Subactivity 1.A.1.1. Determine egg-to-fry, fry-to-parr, parr-to-presmolt, and presmolt-smolt survival rates for each release group of coho.

  - Subactivity 1.A.1.2. Document numbers, size, time of release, and release location for all NPT coho reintroduction/supplementation fish.

  - Subactivity 1.A.1.3. Conduct periodic monitoring for size during rearing.

  - Subactivity 1.A.1.4. Participate in planning processes for ponding and rearing.

  - Subactivity 1.A.1.5. Prepare and submit tag, mark, and release reports.

- Subactivity 1.A.1.6. Summarize and evaluate the results of subactivities 1.A.1.1 - 1.A.1.4.

5.3.1.2 Task 1.B. Estimate the number of smolts and adults produced from each hatchery by treatment and rearing strategy.

The Nez Perce Tribe coho restoration program strategies are intended to produce a sufficient number of smolts to support a localized Clearwater River broodstock, to be utilized for rebuilding natural production and supporting harvest. The numbers of fish to be released was based on assumptions about the number of smolts and adults that would result, on average, from each reintroduction strategy. Accordingly, these numbers need to be evaluated to determine whether adjustment is needed to meet program objectives. This evaluation will be completed through three activities described below.

- Activity 1.B.1. Mark a portion of the hatchery-reared coho salmon with a unique mark so they can be detected as smolts and as adults.

Coded Wire Tags (CWT), Passive Integrated Transponder (PIT) tags, and other marks will be used on some fish for specialized purposes, as described in the following three subactivities. New marking techniques will be evaluated to obtain a mark that has the least impact to the fish.

- Subactivity 1.B.1.1. CWT tag a portion of the hatchery release groups differentially to indicate release strategy and location.

A total of 825,000 coho will be marked (Table 5-1). CWT's are used so a wand detector can be used to distinguish them from naturally produced fish. Such opportunities will be available whenever juveniles are captured by seining or at traps, and whenever adults are recovered in harvest, passing weirs, entering hatcheries, or as carcasses. This will require the personnel conducting the various field sampling tasks carry the hand-held wands that detect CWT's, and that all fish captured be checked with the wand.

Table 5-1. Coho salmon production numbers for release into the Clearwater Subbasin.

Location	Life Stage	Number Released	PIT Tags	CWT	Adult Collection	Adipose Fin Clip	Juvenile Trap
Mussellshell-Lolo Creeks	Smolt	270,000	1,500	270,000	Yes		Yes
Lapwai Creek	Smolt	550,000	2,000	275,000	Yes	50,000	No
Clear Creek	Smolt	280,000	1,500	280,000	Yes		Yes
Dworshak	-	-	-	-	Yes		-

- Product: Representative CWT groups released in reintroduction streams.

  - ❑ Subactivity 1.B.1.2 . PIT tag fish from each of the release groups so that survival to Lower Granite Dam can be estimated.

A group of PIT-tagged fish will be included with each release group that represents a particular strategy in a particular stream. Detections of these PIT-tagged fish as they pass screw traps and dams in the Snake and Columbia rivers will enable estimation of emigration timing, travel time, and survival for that strategy. Detection probability for PIT- tagged spring Chinook salmon yearlings passing Lower Granite Dam (LGR) often ranges from 20% to 45% (Smith *et al*. 1994). Further, survival of smolts migrating from Snake River tributaries to LGR is typically 75-85% for yearling spring Chinook salmon (Smith *et al*. 1998). Thus, for PIT-tagged coho salmon leaving NPT reintroduction streams, we might expect 15-40% of yearling smolts to be detected as they pass LGR. If a particular release strategy includes dispersal of hatchery fish to multiple release points within a stream, then the PIT-tagged fish will be evenly divided in proportion to all fish released at each point.

- Products:

    1. Representative PIT tag group released with each treatment in each stream.
    2. Estimated mean difference in survival to LGR between release groups.
    3. Estimated egg-to-smolt and release-to-smolt survival for each release group.
    4. Differentiation of individuals of localized versus lower Columbia River stock origin.

  - ❑ Subactivity 1B.1.3. Estimate harvest rates of Clearwater coho salmon in the ocean and Columbia River.

A group of smolts to be released into Lapwai Creek will be double index marked with adipose fin clips (50,000) and CWT's (100,000). This marking will occur in conjunction with marking subactivity 1.B.1.1. This subactivity deals only with the estimation of harvest rate (percentage of population harvested) in the ocean, Columbia River, and Clearwater River. Because CWT recoveries of NPT coho salmon from ocean and river catches are likely to be low for the next decade or more, we will use the differences in survival rates between the adipose-clipped and CWT marked adult returns vs. the CWT only adult returns.

  - ❑ Subactivity 1.B.1.4. Conduct tests for each type of marking to estimate rates of tag loss, tag detection efficiency, and post-tagging mortality.

Rates of long-term CWT loss will be determined from the number of readable CWT's recovered from hatchery fish that are adipose fin clipped. Rates of PIT tag shedding will be determined from experiments coordinated with other entities using PIT tags in the Snake River basin each year, such that results can be pooled. Efficiencies for detecting either PIT tags or CWT's when fish are captured as juveniles at traps or by seining will be evaluated. Efficiencies for detecting CWT's in unmarked adults will be performed at the hatcheries where fish can be thoroughly examined to see if CWT's are being missed, and which detection strategies are most effective. Initially, a hand wand will be used in the same way applied to spawning surveys, and then all fish be subjected to a more thorough second examination with another CWT detector. Results from the first and second checks will be compared to estimate the percentage of CWT's missed during the first examination.

- Products:

    1. Estimate of delayed mortality after either PIT or CWT tagging.

    2. Estimated percentage of sampled fish with PIT tags or CWT's that are correctly identified as having a tag.

    3. Tag retention estimates

- Activity 1.B.2. Estimate abundance of hatchery fish departing as smolts from selected treatment streams.

Emigration from the stream is expected to proceed directly following release. The number of fish released will be interpreted as equivalent to the number of fish that emigrated. The dates that smolts pass any of the mainstem dams will be detected from PIT-tagged fish, and can be used to verify that immediate migration occurred.

- Product: Number of coho salmon smolts stocked in each treatment stream.

    - Subactivity 1.B.2.2. Assemble PIT tag detections throughout the Columbia basin for fish tagged in NPT coho reintroduction streams, and estimate abundance passing Lower Granite Dam (LGR).

Numbers of PIT-tagged fish reaching LGR from each treatment stream will be estimated by the SURPH.1 model (Lady *et al*. 2001). Due to sample size constraints, the SURPH.1 model will be used to calculate a point estimate of total fish arriving at LGR. Therefore, the survival of PIT-tagged hatchery fish reaching LGR from NPT releases can be estimated. PIT tag detections at mainstem dams will be downloaded from the PTAGIS database.

- Products:

    1. Estimate and 95% confidence interval for the number of smolts from each stream that reach LGR or other mainstem dams.

    2. Time frequency distribution of passage at LGR or other mainstem dams for each release group.

- o Activity 1.B.3. Estimate total hatchery adults produced from each release in each stream.

A portion of hatchery-reared adults will bear CWT's, so the number returning can be estimated from recoveries in fisheries, at hatcheries or on the spawning grounds. Sampling to estimate the abundance of adults will include operation of weirs, returns to hatcheries, and carcass surveys.

- ❑ Subactivity 1.B.3.1. Operate weirs and ladders or conduct spawning surveys to estimate escapement of hatchery-produced coho salmon into reintroduction streams.

Spawner abundance will be estimated in all reintroduction streams. Adult coho salmon entering Lapwai Creek, Lolo Creek, Clear Creek (Kooskia National Fish Hatchery), and Dworshak National Fish Hatchery will be counted at temporary weirs constructed across those streams or permanent ladders at existing hatcheries. Each weir will have a fish trap so that all fish passing the weir can be counted, measured, sampled for scales and tissue, examined for marks or tags, given a secondary mark, and released above the weir or transferred to a holding pond for broodstock.

Temporary weirs are excellent tools for monitoring adult escapement into streams where flows are typically less than 1,000 cfs during the passage season. We must plan for the likelihood that some fish will pass upstream during high flows in each stream when the weirs are not operating. Accordingly, a mark will be applied to each fish trapped at each weir so that marked to unmarked ratios during spawning ground surveys (Subactivity 1.D.3.2) can be used to estimate the total number of adults entering that stream.

In Lolo Creek, the abundance of spawners will be estimated from spawning ground surveys. Surveys will be conducted as described under Subactivities 1.D.3.1 and 1.D.3.2. Carcasses will be marked returned to the river, and redds will be marked during each of the three ground surveys per season in Lolo Creek. To estimate total escapement, the redd count will be multiplied by 2.07 redds per female (Berghe and Gross 1983) and multiplied by male to female ratios that are recovered from other NPT adult collection sites (Activity 1.B.3). This estimated total escapement for a particular return year will be separated into brood year returns based on age composition determined from scale samples. Total return for each brood year will be calculated by summing the estimated escapement of each age group in different run years.

Spawner abundance in the mainstem Clearwater River will be conducted by the NPTH RM&E project through their weekly fall Chinook salmon spawning ground surveys. Low numbers of spawners in the large river channels make ground surveys ineffective. To estimate total escapement in this area, the redd count will be multiplied by 2.07 redds per female (Berghe and Gross 1983) and multiplied by male to female ratios that are observed at other adult collection facilities (Activity 1.B.3) Aerial surveys are described further under Subactivity 1.C.1.1.

- Products:

    1. Estimate of hatchery and natural escapement by age at weirs or ladders on Lapwai Creek, Lolo Creek, Clear Creek (Kooskia National Fish Hatchery), and Dworshak National Fish Hatchery.

    2. Estimated number of spawners in the mainstem Clearwater River.

- Activity 1.B.4. Estimate smolt-to-adult survival for each treatment based on smolt abundance from Activity 1.B.2 and adult abundance in Activity 1.B.3.

Smolt-to-adult survival is strongly influenced by factors that are independent of supplementation practices, so estimates of this parameter are needed to understand how out of subbasin effects, such as variation in ocean survival or variation in mainstem passage survival, may have influenced the number of surviving adults. The most reliable estimator of smolt-to-adult survival will be the number of adults arriving at Lower Granite Dam divided by the estimated number of smolts passing LGR (subactivity 1.B.2.2).

The number of surviving adults can be expressed in a variety of forms including the number of adults returning to Lower Granite Dam or total catch plus spawner escapement. Each of these abundance estimates requires that the age of adult fish be determined wherever they are recovered, so that fish of each age can be assigned to their broodyear of origin. For a portion of the hatchery fish, the CWT's will reveal their brood year. Scale sample analysis and CWT recoveries will be used for age determination. The most reliable estimate of smolt abundance will be for numbers arriving at Lower Granite Dam in the case of coho salmon (released as parr and smolts). Smolt-to-adult return rates will be estimated for the coho with the greatest degree of resolution; release location, release timing, and pre-release rearing.

- Product: Estimated mean difference in smolt-to-adult survival between released groups.

- Activity 1.B.5 Document adult returns to each weir/broodstock collection site.

    - Subactivity 1.B.5.1. Determine size, age, sex, and origin of adult coho returning to each weir/broodstock collection site.

- Subactivity 1.B.5.2. Document run-timing, spawning-timing, pass/keep scenarios, and spawning matrices for each weir/broodstock collection site.

- Subactivity 1.B.5.3. Prepare and submit tag and mark recovery reports.

- Subactivity 1.B.5.4. Summarize results of Subactivities 1.B.5.1 and 1.B.5.2.

5.3.1.3 Task 1.C. Determine the effects of rearing and release treatments on the dispersal of juveniles and adults returning to occupy available habitat in the target streams.

It is assumed that juveniles will disperse after release to evenly fill the available high quality coho salmon habitat in a treated stream. However, the available habitat is spread over hundreds of miles of stream, and the methods for stocking fish so that they disperse to all of this habitat is uncertain. Dispersal rates are likely to differ between point release and scattered releases. Fish released as smolts are expected to migrate following release. Additionally, movements of juveniles will be detected at screw traps, and dispersal of adults upon return will be assessed through spawning surveys.

- Activity 1.C.1. Determine the effects of treatments on spawning distribution by conducting spawner surveys.

In order for supplementation to achieve the intent of filling available habitat for natural production, spawning of hatchery fish should be dispersed throughout the available habitat. This desired result may be difficult to achieve, because access points for stocking the treatment streams are limited. Recoveries of CWT's from spawning surveys will be used to characterize the density distribution of spawners from each treatment in each stream. Differences between treatments, streams and years in the dispersal of spawners, relative to the release locations, will be examined for possible correlations to factors of the treatment or the environment.

Redd surveys will be conducted throughout the extent of probable spawning habitat and will be repeated at least three times (about 1 week apart) during the typical spawning period. Reaches where fish choose to spawn may be related to time of spawning, temperature, substrate size, etc. with later maturing fish tending to spawn further downstream. If spawning is not well dispersed, possible causes will be investigated. These will include location and method of stocking, weir impedance, stream temperatures at time of spawning, and gravel quality. If spawners are keying on areas where temperatures are desirable at the time of their spawning, we may find that the inherited time of spawning from the founding population determines the stream reach that will have suitable temperatures at the time of spawning. In order to detect these effects survey areas will be subdivided to look at redds/km within survey sections over time.

- Subactivity1.C.1.1. Conduct helicopter surveys weekly over larger river reaches and remote stream reaches during the coho salmon spawning season (October through early December).

Spawner abundance in the mainstem Clearwater River will be conducted by the NPTH M&E project through their weekly fall Chinook aerial spawning ground surveys. Portions of the reintroduction streams are only accessible by aerial flights. Flights will be conducted at an elevation of 200 feet above the water surface, and the observers will count the number of new redds, live fish and carcasses. Each redd will be marked on a map. Aerial redd count surveys will be conducted in cooperation with state and federal agencies so that duplication of effort is eliminated.

Carcass examinations will be necessary to estimate the proportions of hatchery and natural fish constructing redds. Locations of carcasses sighted from the air are recorded and the carcasses are retrieved later if possible with the use of jet or drift boats. Retrieved carcasses will be measured (hypural length), examined for marks and tags, sampled for scales and tissues, examined for percentage spawned, and cut in half to avoid re-counting. Measurements and samples taken here will provide data on hatchery/natural composition, brood year composition, percent spawned, age and size at ocean entry, disease incidence and gene frequencies.

- Products:

    1. Total redds and estimated number of spawners in each reach surveyed.

    2. Time frequency distribution of redd construction in each reach surveyed.

- ❑ Subactivity 1.C.1.2 Conduct weekly spawning ground surveys.

Redds and carcasses will be counted during foot surveys in spawning areas from early October through November. Stream reaches to be surveyed include all reintroduction streams and selected large river reaches where spawning is expected. Ground surveys in the large river systems or remote stream reaches will only be opportunistic to recover carcasses observed during aerial counts, as described in the previous subactivity. New redds will be marked and counted, live fish counted, and carcasses will be recovered and processed. Redds will be marked with flagging that records date, identification number, and will be color-coded for each survey period. Marking redd locations with flags (colored washers or rocks in large streams) and recording notes on each redd has been beneficial in areas where multiple redds occur. Processing of carcasses will include measurement of hypural length, examination for marks and tags, scale sampling, examination for percentage spawned, jaw tagging, and return to the flowing river. Recovery of jaw-tagged carcasses on subsequent surveys will be used for mark-recapture estimates of spawner abundance.

- Products:

    1. Percentage of total redds contained in discrete stream sections.

    2. Time-frequency distribution of redds within each stream section.

- Subactivity 1.C.1.3. Monitor an index of prespawning mortality by recording gamete retention in carcasses during spawning surveys.

Prespawning mortality is an important life history parameter, but is difficult to monitor until adult returns increase. The only index of prespawning mortality that can be obtained with at low fish densities is the percentage of fish recovered on spawning surveys that have retained a majority of their gonads. The focus will be on the percentage spawned in females, as determination of percentage spawned in males is difficult to assess. This will be measured by cutting open each carcass and recording the approximate percentage of gonad that has been retained. The percentage of fish with retained gonads should be nominal when prespawning survival is high, but can increase to a high percentage in years and locations where prespawning mortality is high.

- Product: Annual estimates of the percentage of carcasses that are less than 80% spawned in each stream.

  - Subactivity 1.C.1.4. Count fish collected for hatchery brood stock.

All fish collected for hatchery broodstock by any method will be measured (hypural length), examined for marks and tags, and scale sampled. Numbers of fish entering hatchery ladders will be counted at least weekly and tagged so that time of entry can be compared quantitatively between years and possible treatments so that time of return can be evaluated.

- Products:

  1. Time-frequency distribution of arrival at brood collection points.

  2. Counts of hatchery coho salmon, by age, taken for brood stock.

5.3.2 RM&E Objective 2. Determine the Increases in Natural Production That Results from Supplementation of Coho Salmon in the Clearwater River Subbasin, and Relate Them to Limiting Factors.

One of the primary benefits to be derived from the Nez Perce Tribe coho reintroduction program is the restoration of full natural production of coho salmon to the Clearwater River subbasin. This objective is intended to measure those benefits and refine our understanding of carrying capacity and other factors that affect program success. Sampling under this objective is designed to address the following management assumptions:

1. Hatchery escapement meets natural production goals.

2. Adult returns from natural production are detected.

3. Stream fidelity among returning hatchery and natural origin spawners is high.

5.3.2.1 Task 2.A. Determine the extent of natural production in Lolo Creek and Clear Creek.

A major premise for the Nez Perce Tribe coho restoration program is that habitat for coho salmon is abundant, but nearly vacant in the Clearwater River Subbasin. Further, it is assumed that stocked hatchery fish of Columbia River ancestry will seek find and utilize this habitat, and reproduce naturally. However, the available habitat is distributed over hundreds of miles of stream, and the methods for stocking fish so that they disperse and utilize this habitat are uncertain. There may also be environmental factors that will result in more fish being produced from one portion of a stream than another. Studies of anadromous salmonid rearing in well seeded streams indicate that habitat use by fish is patchy (Hankin and Reeves 1986), and that juveniles use different habitats as they grow and as stream temperatures change. This sampling will monitor the changes in natural production of parr, smolts and adults across years.

- Activity 2.A.1 Estimate adults produced naturally from in Lolo Creek and Clear Creek.

  - Subactivity 2.A.1.1. Mark hatchery fish released into Lolo Creek and Clear Creek so that hatchery and natural fish can be distinguished.

Marking of hatchery fish was also listed under Activity 1.B.1, and is listed here again to emphasize that marking of hatchery fish is to estimate abundance of natural fish as well as hatchery fish. Hatchery fish are likely to be numerically dominant within the reintroduction streams for the near future, so a small proportion of unmarked hatchery fish could greatly confound the estimation of contributions to catch and spawner escapement by natural fish. All methods for estimating abundance of naturally produced fish also depend on the ability to distinguish natural and hatchery fish. Accordingly, all hatchery fish released in Lolo Creek and Clear Creek will be marked with coded-wire tags (CWT's), but not adipose fin-clipped, so a wand detector can be used to distinguish them from natural fish. The focus of this phase (phase I) of the restoration program is to establish a localized broodstock. It is assumed that Natural production will be extremely low or nonexistent for the next few years for two reasons: 1) prior releases of coho salmon utilized parr, which are expected to survive at a low rate based on similar experiments performed with spring Chinook salmon and 2) most returning adults will be retained for broodstock, hence limiting natural production. Once a localized broodstock has been established for the entire Clearwater River Subbasin, the natural production phase (phase II) will be expanded with extensive monitoring of natural production.

  - Subactivity 2.A.1.2. Operate weirs or conduct spawning surveys to estimate escapement of naturally-produced coho salmon into treatment streams. (Same as Subactivity 1.B.3.1).

- Activity 2.A.2. Survey the spatial and temporal distribution of natural origin coho salmon spawning in the reintroduction streams.

We need to determine how well the spawners are dispersing throughout the available spawning habitat. Spawning surveys to detect dispersal of hatchery fish were described under Activity 1.D.1, and the sampling under that activity is the same as that required to detect dispersal of natural spawners under this activity. A full description of the sampling is not repeated here, but a summary of each subactivity is given as a reminder of the sampling that is planned.

  - Subactivity 2.A.2.1. Conduct helicopter surveys weekly over the larger river reaches and remote stream reaches during the coho salmon spawning season (October through early December).

Spawner abundance in the mainstem Clearwater River will be conducted by the NPTH M&E project through their weekly fall Chinook aerial spawning ground surveys. Portions of the reintroduction streams are only accessible by air.

- Products:

    1. Total redds and estimated number of spawners in each reach surveyed.

    2. Time frequency distribution of redd construction in each reach surveyed.

  - Subactivity 2.A.2.2. Conduct weekly ground surveys of spawning.

Redds and carcasses will be counted from foot or boat surveys in spawning areas from early October through November. Stream reaches to be surveyed include all reintroduction streams and selected large river reaches where spawning is expected. Ground surveys in the large river systems or remote stream reaches will only be opportunistic to recover carcasses observed during aerial counts, as described in the previous subactivity.

Products:

1. Percentage of total redds enumerated in discrete stream sections.

2. Time-frequency distribution of redds within each stream section.

  - Subactivity 2.A.2.3. Count fish collected for hatchery broodstock.

Hatchery adults collected at weirs or hatcheries for hatchery broodstock must also be accounted for. Accordingly, all fish collected for hatchery broodstock by any method will be measured (hypural length), examined for marks and tags, and scale sampled. Numbers of fish entering hatchery ladders will be counted at least weekly and tagged so that time of entry can be compared quantitatively between years, and possible treatments for time of return can be evaluated.

- Products:

    1. Time-frequency distribution of arrival at brood collection points.

    2. Counts of hatchery coho salmon, by age, taken for broodstock.

- Activity 2.A.3. Survey the spatial and temporal distribution of juvenile coho salmon rearing in target streams.

    - Subactivity 2.A.3.1. Perform snorkel surveys in reintroduction streams to estimate parr densities in systematic reaches.

Snorkeling counts will be the main sampling tool used to determine densities (an index of abundance) of natural salmonids by habitat type (*i.e.,* pool, riffle, pocket water and run). Marks on hatchery fish will not be visible underwater, so the percentage of juveniles that are hatchery fish in Lolo Creek and Clear Creek will be determined from fish that are captured during seining. Densities of other fish species will also be determined during snorkel surveys. The purpose of these surveys is not to estimate total juvenile abundance, but rather to evaluate how juveniles are dispersed throughout the habitat that supplementation treatments are intended to fill. Streams in the Clearwater River Subbasin generally have high transparency allowing effective snorkeling. Snorkeling will be performed at least once in each stream during July through mid-September of each year.

Surveys will cover stream reaches that are systematically spread over the length of the stream. The cumulative length of these reaches will compose at least 20% of the total stream length expected to be utilized by juvenile coho salmon. Each survey reach will be composed of contiguous stream segments that include a minimum of 10 pools, and 10 riffles. Each diver will count all salmonids, by species, in 2-inch length increments (usually starting at 2-4 inches) within the lane of his visibility range, which usually will extend 1.5- 3.0 m (5-10ft) on each of his sides [3 to 6 m (10 to 20 ft) total width per lane]. Coho salmon will be identified as sub-yearlings or yearlings. Visibility width of each lane will be recorded, so that fish densities are calculated per area of actual observation. Water clarity at the time of each survey will be recorded as the distance (in feet) over which a fellow diver is clearly visible. Visibility must be 5 feet or greater for divers to confidently distinguish fish species underwater.

Survey teams will consist of 3 to 5 members. One member will carry equipment and record data while the other 2-4 members snorkel in an upstream direction to minimize disturbance of fish prior to enumeration. Fish counts and physical characteristics will be recorded separately for each habitat unit (*i.e.,* pool, riffle, pocket water, or run). Snorkelers will move slowly but steadily upstream in an assigned lane, with one lane along each shoreline. The number of snorkelers is dependent upon visibility and width of the stream. Water temperature must be at least 13^{o} C before snorkeling, because the proportion of fish taking refuge in the substrate begins to increase at lower temperatures.

- Products:
  1. Annual estimates of parr/m2 in pool, riffle, pocket water and run habitats, by reach, of each reintroduction stream.

  2. Multiple regression or multi-variate model relating parr density to spawner abundance and habitat features in each stream.

o Activity 2.A.4. Monitor the timing, size and abundance of juvenile coho salmon emigrating from each target stream.

Rotary screw traps will be fished to monitor emigration of juvenile coho salmon from Lolo Creek and Clear Creek, as described in subactivity 1.B.2.1. Coho salmon captured in the traps will be anesthetized, scanned for tags, and natural fish over 60 mm may be PIT tagged as described by Prentice *et al*. (1990). Length, weight and fish condition will be recorded for all PIT tagged fish. Scales (subsample) will be collected and used to determine the age of emigrating fish. PIT tagged fish will be placed in a recovery bucket for a short time (30 - 60 minutes) and released back into the river. Where possible, PIT tagged fish may be held for longer periods (24 to 48 hours) to better estimate tagging mortality. Where extended holding opportunities are not available, mortality rates from hatchery PIT tagging may be applied.

- Products:

  1. Population estimates and 95% confidence intervals for juvenile coho salmon passing the trap as parr (June 1 through August 31), presmolts (September 1 through December 31), and smolts and fry (January 1 to July 31 – weather permitting).

  2. Time-frequency distribution of passage for each life stage.

  3. Mean and 95% confidence interval of mean length for each life stage or date.

5.3.2.2 Task 2.B. Measure life history traits that may reflect limitations to natural production.

We will sample to detect two types of mechanisms that limit natural production: density dependence and quantitative genetic variation. As coho salmon fill the habitat to capacity, density-dependent mechanisms should begin functioning and reveal that capacity limits are being approached. Life history traits that are known to be influenced by fish density include growth, migration timing, and survival. Accordingly, we will conduct sampling to detect changes in these parameters within Lolo Creek and Clear Creek. The key, however, will not be simply to detect change, but to detect when the density-dependent changes are sufficient that no more adults are produced per spawner.

Evidence of limitations of quantitative genetic variation should be expressed by differential survival of inherited life history strategies, such as egg-to-fry survival for different spawning times, parr-to-adult survival for fish that smolt as either subyearlings or yearlings, and survival to ocean entry for fish that move downstream from natal areas in the first summer-fall compared to those that hold until they are yearling smolts. Because the stocks used to initiate the Nez Perce Tribe coho restoration program are not specifically native to the target streams, there is likely to be some change in life-history traits that will gradually result over time from natural selection. The unique balance of habitat quantity and quality for summer rearing and over-winter refuge is likely to vary between streams, so natural selection may gradually alter the proportion of fish that drift downstream for rearing, and the proportion that smolt as either subyearlings or yearlings.

- Activity 2.B.1. Estimate growth, migration timing, and survival of coho salmon.

Under this activity, natural coho salmon will be: captured in rearing areas to measure their growth and tag them for survival estimates; captured in screw traps to determine size and time at emigration; have scale samples taken to establish circuli patterns reflecting growth rate; and interrogated for PIT tags as they pass mainstem dams.

  - Subactivity 2.B.1.1. Seine for coho salmon parr periodically through the summer to monitor increase in length and to tag parr for survival estimates.

Expression of density-dependent growth is most likely to occur during summer low flow, so we will capture rearing parr to track changes in average length. Density-dependent limitations on growth are generally observed by comparing growth rates between years, and this effect is a measurable indicator that carrying capacity for rearing is being reached (Cramer *et al*. 1985).

Age 0+ coho salmon will be captured by beach seines (100' x 6' x 3/16" mesh and 50' x 4' x 3/16" mesh) and electrofishing once a month from May through September in selected reintroduction streams. Snorkelers will be used to locate concentrations of fish that can be captured by seine. Length measurements (50 fish per sample date) and scale samples (20 fish per sample date) will be dispersed among several sites, to ensure that a representative sample of the population is obtained. All captured fish will be scanned for PIT tags and CWT’s. Previously PIT-tagged fish will be recorded and measured.

The timing and survival of out-migrants can be estimated for PIT-tagged fish as they are detected passing Snake River dams (1.B.2.3). Survival to LGR can all be estimated fairly accurately with as few as 200 PIT-tag detections at LGR per stream. This small number of fish is useful, because detection probabilities at LGR can be estimated from PIT-tagged fish released throughout the Snake River Basin, as was demonstrated by Cramer (1996a and 1996b).

This subactivity deals with tagging of natural parr, so enough parr must be tagged to have 200 or more survive to the smolt stage. Walters *et al.* (1999) reported that detection rates of spring Chinook parr and pre-smolts (fall migrants) from the Clearwater River Subbasin were about one fourth and one half, respectively, of that for Chinook salmon PIT-tagged as smolts. Based on these expected recovery rates, we set PIT deployment goals of 1000 parr, 500 pre-smolts or 250 smolts per selected reintroduction stream each season. If double or triple this base number can be tagged, then survival could be estimated separately for different periods of tagging. In order to achieve these tagging minimums, up to 150 fish per sample date (8-10 sample dates) will be PIT tagged. Each fish >60 mm will be tagged as described by Prentice *et al.* (1990), and will be measured and weighed. PIT tagged fish will be placed in net pens or aerated buckets and allowed to recover 30-60 minutes before release.

- Products:

    1. Regression of mean length on Julian Day for each stream each year.

    2. Multiple regression accounting for variation between years in mean length by July 1(parr) or September 1 (presmolt) as a function of parr density, stream temperature, and flow.

    3. PIT tagged parr to be used for estimating timing of passage and survival to passage to the screw trap and mainstem dams.

- ❑ Subactivity 2.B.1.2 Fish screw traps to determine size and time at emigration and to estimate passage of tagged fish.

Operation of screw traps to estimate size, timing and abundance of emigrants was described under subactivity 1.B.2.1. Here, we add the element of recapturing the fish that were PIT tagged as parr from the previous subactivity. There is no change in sampling with the traps for this subactivity, only the identified need to scan all fish captured for the presence of PIT tags.

Recoveries of PIT tagged parr will enable estimation of survival to smolting, and abundance of parr. Survival to smolting will be determined by estimating total passage of PIT tagged fish at the screw trap (PIT tag catch/trap efficiency). Then, survival can be estimated by expanding PIT tag recoveries. If tagging and recapture rates are sufficient, it may be possible to estimate survival from different periods of the summer in which parr were tagged. Captures of all coho salmon in the traps will also be used to establish the proportion of fish that were PIT-tagged, and that in turn can be used to estimate the abundance of parr, based on the known number of fish that were PIT tagged.

- Products:

    1. Estimate of parr abundance, based on marked-to-unmarked ratio of fish arriving at the screw trap.

    2. Estimate of survival from parr to smolt in each treatment stream.

3. Multiple regression accounting for variation between years in mean length of fall presmolts or spring smolts as a function of parr density, stream temperature, and flow.

4. Multiple regression accounting for variation between years in ratio of presmolt to smolt migrants as a function of parr density, stream temperature, and flow.

- Subactivity 2.B.1.3. Assemble PIT tag detections throughout the Columbia Basin for fish tagged in reintroduction streams, and estimate abundance and survival to Lower Granite Dam (LGR).

Numbers of PIT-tagged fish reaching LGR will be estimated by the SURPH.2 model (Lady *et al.* 2001). PIT tag detections at mainstem dams will be downloaded from the PTAGIS database. Methods are described under Subactivity 1.B.2.3.

PIT tag recoveries at mainstem dams will enable estimation of smolt migration rates, survival rates from the natal stream to LGR, and total smolts reaching LGR from those streams with rotary screw traps. Migration rates will be calculated as days of travel from release to detection at LGR. Arrival timing at each dam will be summarized by each release group where a minimum of 30 observations are obtained. Survival rate to LGR will be calculated as the number reaching LGR divided by the number leaving each rotary screw trap. Those leaving the screw trap will be the sum of fish tagged at the screw trap, and the estimated number of previously tagged fish pass the screw trap. In study streams without screw traps, the survival rate will be estimated for parr to LGR based on the number of parr that were PIT tagged. In the case of streams with a screw trap, the estimated fraction of the population tagged at the screw trap can be used along with the estimate of PIT tags reaching LGR to estimate total smolts from the study stream reaching LGR.

- Products:

1. Estimate and 95% confidence interval for the number of smolts from each stream that reach LGR or other mainstem dams.

2. Estimate and 95% confidence interval of survival from parr or tributary mouth to LGR or other mainstem dams.

3. Median, 20th percentile, and 80th percentile travel times (days) and arrival times from the screw traps to LGR.

- Subactivity 2.B.1.4. Sample scales from parr and smolts in selected reintroduction streams to characterize circuli number and spacing that will later be measured on adult scales to determine successful time and size at smolting.

Because new scale circuli are deposited at a consistent rate of about one every 2 weeks, a regression of circuli number on Julian day can be used to estimate dates of life history events that cause a distinct change in growth rate. For example, date of ocean entry and age at ocean entry can be determined from scales. Further, scale radius is highly correlated to fish length at a distinct event, such as ocean entry or annulus formation, and can be used to estimate the size of the fish at that event.

In addition to scales collected during seining, scales will be randomly collected from 25 coho salmon of each age, and 25 steelhead juveniles of each 5 cm size interval for each trap and each month. These scales will be used to establish the relationship of fish length to scale radius, and of date to circuli number. They will also distinguish yearling and subyearling coho salmon during June or July when there may be some overlap in size.

- Products:

    1. Regressions of circuli number on Julian Day for each stream each year. This will enable estimation of dates corresponding to a distinct change in scale patterns, like spring growth or ocean entry.

    2. Regression of length on scale radius, so that size at ocean entry can be estimated on adult scales.

- Activity 2.B.2 Estimate age at maturity, time of river entry and spawning, and prespawning survival of natural and hatchery adults.

    - Subactivity 2.B.2.1. Determine age at maturity from scales of returning adults handled at weirs, in hatcheries, or on spawning surveys.

Coho salmon collected at weirs, hatcheries, or carcass surveys examined for any marks/tags and measured to the nearest 0.5 cm for fork and hypural lengths. Scales will be read to determine freshwater, ocean, and total age, so each fish can be assigned to a brood year of origin. Age composition within size strata (primarily jack versus adult) will be applied to population estimates for those strata to determine total escapement from each brood in each run year.

- Product: Percentage that each age composes of the returns, by sex, to each stream.

    - Subactivity 2.B.2.2. Monitor an index of prespawning mortality by recording gonad retention in carcasses during spawning surveys. Methods are described under Subactivity 1.C.1.3.

- Product: Annual estimates of the percentage of carcasses that are less than 80% spawned in each stream.

5.3.2.3 Task 2.C. Determine the influence of environmental variation on natural production.

Growth, survival and carrying capacity for coho salmon in streams are likely to vary between years due to environmental fluctuation. Accordingly, the influence of environmental variables on the previously estimated parameters of rearing densities, juvenile growth rates, migration timing, and survival rates need to be determined, so that any observed changes in those parameters can be assigned to the proper cause.

- o Activity 2.C.1. Monitor environmental variables affecting fish in the treatment and reference streams.

Temperature and flow are each environmental variables that have been demonstrated to influence coho salmon, and which may vary substantially between years. Each of these parameters will be monitored in each reintroduction stream, so they can be used in analyses of cause-effect relationships.

- Product: Data set of daily flow and temperature in each reintroduction stream.

- o Activity 2.C.2. Calculate the correlation of environmental variation to variation in coho salmon population parameters.

Because environmental factors vary, their effects on life-history parameters of salmonids are generally only detectable after a long time series (10-15 years) of data have been assembled. Each of these variables has distinct mechanisms by which they can influence coho populations, but there is a high degree of covariance in these factors that may confound attempts to distinguish their separate effects in a natural stream. These two environmental variables will be examined as independent variables in multiple regression analysis of most population parameters estimated in this M&E plan, but information from studies elsewhere will be needed to deduce the separate effects of these variables.

- Product: Multiple regressions or analyses of covariance for various life history parameters, with environmental variables included as independent variables.

5.3.2.4 Task 2.D. Determine the spatial and temporal distribution of returning adult coho salmon in the Clearwater River Subbasin.

Previous monitoring of adult coho salmon returns has observed a high drop-out rate from Lower Granite Dam to Clearwater River tributaries. This task is designed to better quantify this loss by active and passive tracking of returning adults. In addition, straying, harvest and other potential sources of drop-out may be identified.

- o Activity 2.D.1. Provide sampling protocol for use in the separation system at the Lower Granite Dam Adult Fish Facility.

The origin of fish is determined using visible marks (adipose fin clip) or tags (either coded wire or passive integrate transponder). Female and male fish (adults and jacks) are tagged to obtain information on the movements of all age groups and both sexes.

- Activity 2.D.2. Provide radio tags and data sheets for NOAA Fisheries personnel at Lower Granite Dam.

A total of 50 radio tags will be purchased for this study. Additional tags may be available from an ongoing study conducted by the University of Idaho. These additional tags depend upon angler return rate, and the battery life of returned tags.

- Activity 2.D.3. Capture and radio tag at least 50 adult coho salmon at Lower Granite Dam.

Fish are captured and radio tagged at the Lower Granite Dam Adult Fish Facility. Fish are anesthetized before tagging. Radio tags are coated with glycerin and inserted into the esophagus of study fish. The radio tag used for this study weighs 16 grams (Lotek MCFT-3).

- Activity 2.D.4. Establish fixed monitoring stations.

Fixed-telemetry receivers are maintained and operated by the USFWS and the University of Idaho. In the Clearwater River, fixed telemetry stations are located near the Potlatch Mill (river mile 5) and above Orofino at the NPT Fisheries Office (river mile 47). Tracking data are downloaded from these receivers periodically. Receivers indicate when an individual radio tag (fish) arrived and departed, and in some cases, which direction (upriver or downriver) the fish was traveling.

- Activity 2.D.5. Monitor tagged fish movement via vehicle, boat and aircraft.

Mobile tracking is conducted by the NPT. Tracking effort may be augmented by the University of Idaho and the USFWS. Portions of the Snake River reservoirs are surveyed weekly using fixed-wing aircraft. The roaded sections of the Snake and Clearwater rivers are surveyed weekly via automobile. Portions of the un-roaded section of the Snake River are surveyed weekly by boat and helicopter (while conducting redd searches).

- Activity 2.D.5. Coordinate with NOAA Fisheries, the US Army Corps of Engineers, the US Fish and Wildlife Service, the University of Idaho and other existing telemetry studies for additional radio tracking assistance and data sharing from fixed monitoring sites.

The potential exists for a great deal of cost sharing through coordination of effort with existing research in the Snake and Clearwater rivers. Personnel from other studies may be available to assist with fish handling and tagging at the Lower Granite Adult Facility.

5.3.3 RM&E Objective 3. Utilize genetic data and analyses to adaptively manage broodstock and supplementation activities.

The geographic structure of genetic variation within salmon species has to a large extent dictated the manner in which salmon have been listed under the Endangered Species Act (ESA; Waples *et al*. 1991, Waples 1995, Marshall *et al.* 1995), and to a lesser degree to inform broodstock management and supplementation activities. Since the Clearwater River Subbasin coho salmon reintroduction project utilizes surplus hatchery origin juveniles from lower Columbia River hatchery facilities, the emphasis of genetic monitoring is aimed at adaptive management.

It is generally accepted that genetically diverse populations exhibit greater resiliency to environmental change than less diverse populations. Therefore, it follows that reintroduction programs utilizing a stock(s) with greater genetic variation may be more successful than programs utilizing stocks with less genetic variation. In the case of the Clearwater River Subbasin coho reintroduction program, the ECNFH has been selected as the primary source population. Clearly, the introduction of this stock to the Clearwater River Subbasin will test the adaptability of this stock. Successful colonization of the Clearwater River Subbasin will require a prolonged migration and the ability to spawn in habitat that differs substantially from the lower Columbia River. The success of the reintroduction program rests, in part, of the following assumptions:

1. The ECNFH stock maintains ample phenotypic plasticity and diversity to allow successful colonization of a novel environment.

2. Broodstock and program management activities can successfully maintain genetic and phenotypic variation.

In the strictest sense, natural selection acts on phenotypes (behavioral and physical outcomes of genetic diversity under a given environment context) to determine the fitness of individuals. The expression of genetic diversity as a physical or behavioral trait (phenotype) results from a complex interaction with environmental factors, hence it is not typically possible to select individuals that are expected to exhibit the highest fitness *a priori* using genetic profiles. Therefore, broodstock management typically focuses on implementing practices aimed at maintaining all genetic variation regardless of its value. Presumably, those phenotypes exhibiting the highest survival and fitness will be better represented over time at the expense of less valuable phenotypes. The benefit of such a strategy is that managers do not attempt to directly impose selection, they merely take advantage of natural selection to “fine tune” the stock.

In the case of the Clearwater River Subbasin coho salmon reintroduction, managers will attempt to ensure that all genetic variation present in the founder stock (ECNFH) is initially represented in transfers to the Clearwater River Subbasin. Further, the size of the juvenile release groups has been structured to probabilistically ensure that genetic variation will not be lost as a result of random processes (genetic drift; see section 3.7.2.1), typical of small populations. This strategy is intended to ensure that the reintroduced stock will exhibit the largest possible range of phenotypes on which natural selection can act.

It is difficult to determine *a priori* how large the Clearwater River coho salmon broodstock will need to be in order to maintain genetic diversity. Likewise the optimal size of juvenile release groups is difficult to predict. Therefore, a number of genetic comparisons are recommended to ensure that the coho program is adequately maintaining genetic diversity. These comparisons will require the following minimum sampling:

1. Tissue samples from a minimum of 60 juvenile coho salmon should be collected from ECNFH and each Clearwater River Subbasin hatchery facility rearing CLS stock coho salmon.

2. Tissue samples from at least 60 tissue samples should be collected from adult broodstock at ECNFH and each Clearwater River Subbasin facility with coho broodstock.

Tissue samples should be assayed for variation at several microsatellite markers, and the resulting data should be analyzed to estimate allelic diversity and effective population size (N_e). Allele frequencies and allelic diversity should be compared between all the sample groups recommended above for a minimum period of six years (two generations), and periodically thereafter. Significant differences between sample groups would indicate that genetic drift (the random loss of genetic variation) may be occurring. Such a result might indicate that broodstock size is too small, or that the rate of mortality is high enough to warrant larger release groups. Similarly, estimates of N_e should be compared within and among groups over time, to determine whether broodstock and juvenile release groups are large enough to ensure a high probability that genetic variation will not be lost as a result of random processes.

It should be noted that the genetic analyses recommended do not directly measure the process of local adaptation. Rather, these analyses provide diagnostic tools to determine whether hatchery and supplementation activities are deficient relative to the maintenance of genetic variation.

- Products:

    1. An evaluation of the success or failure of the program to provide a broad base of genetic variation in the reintroduced stock.

    2. An evaluation of the effectiveness of the program in maintaining genetic variation.

5.3.4 RM&E Objective 4. Determine how harvest opportunities on coho salmon can be optimized for tribal and non-tribal anglers within Nez Perce Treaty Lands.

It is expected that the harvest of coho salmon in the Clearwater River subbasin will occur during fall, after run sizes reach harvestable levels. It is anticipated that excess hatchery fish will be available for harvest long before natural production reaches carrying capacity. Harvest opportunities are likely to develop in different years in different streams, so the regulation of harvest seasons, locations, and methods will be managed opportunistically through an annual review process. Because fisheries will be adaptively managed, and we do not know which year they will begin, we cannot design a specific monitoring plan for an actual fishery at this time. However, we can identify the basic types of monitoring data that will be necessary for the effective management of harvest. Sampling under this objective is designed to address the following management assumptions:

1. Hatchery and natural-origin adult returns can be adequately forecasted to guide harvest opportunities.

2. Hatchery adult returns are produced at a level of abundance adequate to support fisheries in most years with an acceptable level of impact to natural-spawner and broodstock collection.

3. Ocean and Lower Columbia River fisheries do not constrain broodstock and natural escapement.

4. In-basin fisheries do not constrain broodstock and natural production escapement.

The Nez Perce Tribe is likely to manage harvest by zones within the Clearwater Basin. The Nez Perce Tribe divided the Clearwater River subbasin into five harvest zones:

- Zone 1 - Mouth of the Mainstem Clearwater River to Lolo Creek at River Mile (RM) 54.1;

- Zone 2 - Mainstem of the Clearwater River from Lolo Creek to the mouth of the Lochsa River and to Selway Falls (RM 18.6) on the Selway River;

- Zone 3 - The mainstem Selway River above Selway Falls;

- Zone 4 - The mainstem Lochsa River; and

- Zone 5 - The mainstem South Fork Clearwater River.

Utilization of these zones may be appropriate for Chinook as well. Harvest seasons for spring, early fall, and fall Chinook salmon are expected during the period June through

October. Management of Tribal fisheries will provide for the release of all protected species.

5.3.4.1 Task 4.A. Estimate total harvest mortality on hatchery and natural coho salmon from the NPT reintroduction streams.

In most years, coho salmon ocean and in Columbia River harvest would provide the most abundant catch. The collective run passing above Bonneville is supplemented by hatchery production in the middle Columbia River basin. Consistent harvest is not expected from Clearwater, Kooskia, or Dworshak hatcheries until smolt-to-adult survival rates increase from improved conditions in the migration corridor and ocean. In the short term, harvest will focus on the Columbia River harvest zones, and at existing hatcheries in and surrounding the North Fork Clearwater, and Clear Creek.

- o Activity 4.A.1. Use harvest-rate estimates for ocean and Columbia River.

Harvest rates (percentage of population harvested) in the ocean and Columbia River are estimated annually by the Pacific Salmon Commission.

- Product: Estimated fraction of coho salmon harvested by age each year (1) in the ocean and (2) within the Columbia River.

- o Activity 4.A.2. Survey fishermen in the Clearwater River subbasin to estimate total catch of NPT hatchery and natural coho salmon.

Creel surveys designed to estimate total catch of hatchery and natural fish will be implemented at the time that any fishing seasons for coho salmon are permitted.

- Product: Estimated number of coho salmon harvested by age, and hatchery/natural origin each year within the Clearwater River subbasin.

5.3.4.2 Task 4.B. Determine the influence of release strategies on fish availability for harvest in NPT reintroduction streams.

Release strategies can influence ocean migration patterns, age at maturity, and the locations at which maturing fish congregate as they return. Each of these factors will influence harvest. Patterns of ocean and river harvest will be assessed through recoveries of CWT’s.

- o Activity 4.B.1. Analyze the age and spatial distribution for freshwater landings of coho salmon to determine how they differ between groups from different release strategies.

When return and harvest numbers of coho salmon reach projected capacities, the recoveries of CWT’s will provide an opportunity to analyze proportionate age composition of the catch from a particular brood, and the spatial distribution of catches in freshwater.

The location at which coho salmon are released influences the location at which adults will hold upon their return to the river. Manipulation of release locations is often used as a tool to enhance fisheries in a particular area. Creel surveys in the Clearwater River subbasin will be structured to record catch locations so that influences of release practices on local distribution of adult catch can be analyzed. Such information may be useful to the Nez Perce Tribe in balancing their desire to harvest coho salmon with their desire to enhance natural production.

- Products:

    1. Estimate of difference between treatment groups in the age composition of fish landed in Columbia River fisheries.

    2. Estimated differences between treatment groups in spatial distribution of catches within the Clearwater River subbasin.

5.3.4.3 Task 4.C. Develop run prediction and harvest monitoring to allow harvest of only the surplus fish from the Nez Perce Tribe coho restoration program.

Given that harvest will be managed to take only the fish that are excess to spawner escapement goals, it will be necessary to predict run sizes and manage harvest to target only those fish that are excess.

- o Activity 4.C.1. Develop run-size predictor for hatchery and natural fish in each stream.

Analysis of data gathered under other monitoring activities will be used to evaluate alternative approaches to predicting run sizes for each harvest area. Predictors to be evaluated include estimated smolt number passing LGR or John Day Dam, estimated number of jacks returning from the same cohort, number of fish landed in ocean fisheries, and counts of adult coho salmon passing mainstem dams. Development of a run size predictor will be an ongoing process, in which the predictive function will be upgraded each year as information becomes available.

- Product: Procedure for predicting run size separately for hatchery and natural coho salmon returning to NPT streams one year in advance.

5.3.5 RM&E Objective 5. Monitor ecological interactions.

Hatchery reared coho salmon can potentially compete with other fish species for food and space (NMFS 1999) and can serve as hosts for disease and parasites. The organisms and processes which are involved represent biological interactions in which the coho play a direct role. The interactions may have little or no effect on the outcome of supplementation, either because they are benign, can be manipulated or affect other species (Steward 1996). Changes in the program may be necessary if the effects are deleterious. This objective addresses ecological interaction concerns as provided in the National Marine Fisheries Service Biological Opinion on Artificial Propagation in the Columbia River Basin (1999).

Realistically, sufficient funds do not exist to study every stream in detail and answer every uncertainty. We will examine emigration timing of PIT tagged coho from supplemented streams to compare with emergence timing and rearing of juvenile fall Chinook in the lower Clearwater River. This would identify periods of overlap in coho smolt emigration and juvenile fall Chinook rearing. Sampling under this objective is designed to address the following management assumption:

- Natural production of steelhead and Chinook salmon is not negatively affected by coho salmon reintroduction activities.

5.3.5.1 Task 5.A. Monitor the ecological interactions of residual coho salmon, hatchery reared coho, and naturally produced coho juveniles with other fish species.

- Activity 5.A.1. Conduct a literature review of coho salmon ecological interactions with other salmonid species and identify key food and space related limitations for monitoring. Coordinate with other ongoing research to apply study results as appropriate.

- Activity 5.A.2. Determine emigration timing of PIT tagged coho parr and smolts to describe the overlap with juvenile fall Chinook rearing in the lower Clearwater River.

- Activity 5.A.3. Document presence/absence and number of adult coho salmon spawners in the lower mainstem Clearwater River to examine potential competition for spawning sites with fall Chinook salmon.

- Activity 5.A.4. Compare condition factor of steelhead and Chinook salmon in reintroduction streams before and after coho salmon releases. Where possible, assess changes in egg to emigrant or parr to emigrant survival of spring Chinook salmon and steelhead prior to and following the release of juvenile coho salmon.

5.3.6 RM&E Objective 6. Effectively communicate monitoring and evaluation program approach and findings to resource managers.

Timely and thorough communication of the program's status and performance is critical in the adaptive management process at the project level. Adaptive management program framework involves elements of communication throughout the entire M&E program. Common to all M&E plan infrastructure elements are information sharing, information management, and summary reporting. This process will be conducted by the NPT, so those most familiar with the facilities, their design, and the characteristics of the fish being produced will guide the process. This information will then be shared with co-managers through several ongoing regional communication and review processes such as ESA consultation, performance review symposia, and co-management meetings. Activities under this objective are designed to address the following management assumptions:

- Coordination of needed and existing activities within agencies and between all co-managers occurs in an efficient manner.

- Accurate data summary is continual and timely.

- Results are communicated in a timely fashion locally and regionally.

- The M&E program facilitates scientifically sound adaptive management of the coho salmon restoration program.

- Hatchery escapement meets identified broodstock goals.

5.3.6.1 Task 6.A. Facilitate effective data management and dissemination.

We will utilize region-wide data bases that have been developed to centralize data associated with widely used and standardized activities.

- Activity 6.A.1. Provide data summary to StreamNet.

The NPT will provide data summaries of fish population status and select environmental/habitat conditions (adult escapement, juvenile density, stream temperature) to StreamNet on an annual basis. The NPT database will be structured to be compatible with StreamNet, consistent with ongoing NPT contributions to StreamNet.

- Activity 6.A.2. Send PIT tag files to the PIT Tag Information System (PTAGIS).

All PIT tag files will be validated and electronically submitted to the Pacific States Marine Fisheries Commission (PSMFC). PTAGIS will be used to organize tagging and interrogation data from fish marked with PIT tags. Interrogation summary reports will be downloaded and utilized in NPT data analysis.

- Activity 6.A.3. Report Coded-Wire Tagging summary reports to the Coded-Wire Tag (CWT) database.

We will provide fish marking summaries and CWT tag information to the Columbia River Intertribal Fish Commission staff for incorporation into the CWT database. The Coded-Wire Tag database is operated by the PSMFC for the tracking of CWT marking and recovery.

5.3.6.2 Task 6.B Communication of Results and Transfer of Technology.

- Activity 6.B.1 Develop Annual Statement of Work.

A Statement of Work (SOW) will guide annual activities and will be based on the Nez Perce Tribe coho restoration monitoring and evaluation program (Everett & Sprague 2001 Draft). Activities detailed in the SOW for the coho restoration M&E program will be reviewed by the Nez Perce Tribe for scientific validity, programmatic need, and compliance with project objectives. Funding agencies will also review and approve annual SOW's for contractual compliance and obligations.

- Activity 6.B.2 Develop quarterly reports.

The Nez Perce Tribe will communicate M&E status and results through quarterly reports to Bonneville Power Administration. The quarterly reports are a listing of activities conducted and general summary of data collected during the reporting period. Activities are identified by the Statement of Work's objective and task numbers.

- Activity 6.B.3 Develop summary reports.

Summary reports will provide results of population status or supplementation activities that occur on a regular basis that do not require statistical analysis or detailed interpretation. Production/stocking reports will include species, brood source, rearing location, brood year, number released, life stage at release, size at release, release location, release date, and type and number of marks applied. This summary will be updated as fish are released throughout the year and the final version will be distributed annually. Adult escapement will also be communicated through summary reports (weir/ladder capture and redd counts). In-season adult salmon weir/ladder capture reports will be produced on a weekly basis and with a final report distributed annually. Weir reports will include totals of natural and hatchery fish captured by sex and the numbers and disposition of fish kept for broodstock and released for natural production. Redd counts summaries will be included within the NPT DFRM spawning ground summary report distributed annually in January. Estimates of natural juvenile production in relation to overall carrying capacity in reintroduction streams will be prepared for use in determining quantity of NPT production to be outplanted annually. Summary reports will have a wide distribution including those agencies conducting research within affected stream reaches, with special consideration to agencies monitoring juvenile migration and distribution. These reports will be posted electronically.

- Activity 6.B.4. Develop Endangered Species Act Section 7 and 10 Summary Reports.

Endangered Species Act Section 7 and 10 permits require annual summary reports. These reports are required to provide summaries of collection methods used and total number of fish "taken". Take of fall Chinook, steelhead, bull trout by all NPT Department of Fisheries Resources Management research and production projects are covered. Deviations from the permitted activities are highlighted.

- Activity 6.B.5 Develop annual reports.

Annual reports will be developed to provide summary data, data analysis, and data interpretation in relation to coho restoration RM&E program objectives and tasks. The report will include a summary and analysis of all data collected as part of the coho restoration M&E program with recommendations for NPT coho salmon management. Specific questions to be evaluated are:

1. Are the methods being used to collect data appropriate and the most effective to meet M&E objectives?

2. Is the quality (level of statistical power) of data being collected sufficient for management recommendations?

3. Has any of the uncertainty been removed and can any M&E activities be discontinued.

4. Are the M&E findings sufficient to recommend program operation modification prior to five-year review?

Information provided in summary and technical reports will also be included in the annual report. Recommendations will be developed to address critical uncertainties and hypotheses. These reports will be posted electronically.

- Activity 6.B.6. Develop Peer Reviewed Journal Publications

Professional journal publications will be developed. The complexity and scope of the NPTC M&E project prohibits a single publication. Publications will focus on analysis of critical uncertainties that have regional application.

- Activity 6.B.7. Participate in regional conferences and workshops.

NPT staff will attend and present results of the coho restoration M&E at regional workshops. The information summarized in annual reports and other coho restoration program documents will be presented as appropriate at American Fisheries Society meetings. Information on specific components of the coho restoration monitoring and fish population status will be summarized in short presentations (15 to 20 minutes long). Staff will attend technical workshops in order to maintain professional skills, knowledge, and relationships.

  - Subactivity 6.B.7.1. Attend Idaho American Fisheries Society (AFS) Annual Meeting

  - Subactivity 6.B.7.2. Attend Western Division (AFS) Annual Meeting.

- Subactivity 6.B.7.3. Attend Fish Culture Conference.

- Subactivity 6.B.7.4. Attend Smolt Workshop.

- Subactivity 6.B.7.5. Attend PIT Tag Workshop.

- Subactivity 6.B.7.6. Attend the Native Fish and Wildlife Society Annual Meeting.

5.3.6.3 Task 6.C. Develop and maintain open communications with all resource managers.

Coordination of the Nez Perce Tribe coho restoration M&E program activities is a continual process within the NPT and with co-managers in the Columbia River basin. Annual and semi-annual meetings with co-managers in the Clearwater subbasin will be facilitated and attended to coordinated production and research activities.

- Activity 6.C.1. Facilitate Nez Perce Tribe coho restoration program annual review and operating plan modification.

Annual coho restoration program management review will be facilitated by the Research and Production divisions of NPT. The coho restoration M&E will utilize information from the M&E reports (summary, technical, and annual). Annual review will address:

1. Assessment of data and recommended changes to the risk levels assigned to all of the critical uncertainties.

2. Evaluation of NPT Coho Restoration Program performance in relation to the goals and objectives.

3. Review of recommendations made in the Nez Perce Tribe coho restoration M&E annual report.

- Subactivity 6.C.1.1. Conduct Annual Operating Plan review with Clearwater River subbasin co-managers.

Results and recommendations developed from the NPT Coho Restoration annual review will be presented at the Annual Operation Plan (AOP) meeting. A draft AOP for the coho restoration program will be coordinated and reviewed with co-managers. This process will be similar to the AOP review conducted for the Nez Perce Tribal Hatchery and will include presentations of M&E results and planned activities.

- Activity 6.C.2. Attend research and production coordination meetings.

NPTC M&E staff will participate in the meetings between NPT, IDFG, USFWS which plan the production management and outplanting of the Clearwater Anadromous Fish

Hatchery, Dworshak and Kooskia National Fish Hatcheries and research within the Clearwater River subbasin.

- Subactivity 6.C.2.1. Attend Dworshak coordination meetings.

- Subactivity 6.C.2.2. Attend Forest Service coordination meeting.

5.3.6.4 Task 6.D. Facilitate Nez Perce Tribal Coho Restoration Program review.

We will implement a five-year review process for incorporating Nez Perce Tribe coho restoration M&E information into the adaptive management process.

- Activity 6.D.1. Conduct five-year NPT Coho Restoration Program performance review symposium.

Every five years NPT management and technical staff will facilitate a symposium to review NPT Coho restoration performance and status. The purpose of the performance review will be to:

1. Ensure adequate monitoring and evaluation is being conducted to evaluate whether production is meeting its defined purpose and the efficacy of operations relative to improved survival and minimization of adverse impacts.

2. Evaluate the Nez Perce Tribe coho restoration program for consistency with policies.

3. Evaluate the Nez Perce Tribe coho restoration program in terms of performance standards and identification of deficiencies.

In addition to the NPT directed review of the coho restoration program, information from several regional processes will be considered in the adaptive management of the coho restoration program. Information from independent audits of anadromous fish hatchery performance initiated by the Council, using performance measures developed by Independent Hatchery Operations Team (IHOT) and Artificial Production Review (NPPC) will be utilized in the review process. The Nez Perce tribe coho restoration RM&E program will also be coordinated with the Regional RM&E program currently being developed.

Chapter 6: Background Information Used to Guide Coho Salmon Reintroduction

In this chapter:

- Management context
- Preliminary reintroduction results
- Results from the Yakama Nation coho reintroduction program
- Guidance from published literature
- Life history characteristics of Grande Ronde coho salmon
- Integration of data sources

6.1 Management Context

Very little is known about the life history and population biology specific to coho salmon that historically inhabited the Clearwater River Subbasin. This lack of information increases challenges associated with the reintroduction program. In addition, the only donor stocks available for reintroduction efforts are located in the lower Columbia River (LCR). Although adult returns from preliminary reintroduction efforts are promising, it remains to be seen how successful LCR stocks will be at providing the foundation for a stock that must endure a 500 mile migration and emigration, including the passage of eight mainstem dams. Guidance for the proposed program has been derived in large part from four sources:

1. Preliminary results from NPT coho reintroduction efforts in the Clearwater River Subbasin;

2. Results from reintroductions of coho salmon in mid-Columbia River tributaries;

3. Speculation of historical run-timing, abundance, and distribution based on temperature profiles and habitat quality; and

4. Life history characteristics of coho salmon inhabiting the neighboring Grande Ronde River subbasin.

6.2 Preliminary Reintroduction Results

Short-term Clearwater River Subbasin coho reintroduction plans were developed for the *U.S. v Oregon* Production Advisory Committee in 1996 (Ashe and Johnson 1996) and amended in 1997 (Johnson and Ashe 1997). The Clearwater River Subbasin coho reintroduction program has been adopted as part of the Fall Fisheries Agreement developed through *U.S. v Oregon*. The program was authorized by NOAA Fisheries in their Snake River Basin Hatchery Biological Opinion (NOAA 1999).

The NPT coho reintroduction began in 1995 with the release of 622,227 parr originating from Cascade National Fish Hatchery (CNFH; Table 6-1). The program is ongoing and continues to derive the majority of its production from juveniles reared at LCR hatcheries. However, a progressively larger component of Clearwater River Subbasin coho production is obtained using adults returning to the Clearwater River Subbasin collected from Clear Creek at the Kooskia National Fish Hatchery (KNFH). These adults are spawned at the Dworshak National Fish Hatchery (DNFH) where progeny are reared to the smolt stage for acclimation at KNFH and release into Clear Creek. In addition, adults collected at temporary weirs located on Lapwai Creek, the Potlatch River, Meadow Creek (Selway River drainage), and Lolo Creek are spawned at the DNFH, and their progeny are reared for release into Lolo Creek. In recent years production at DNFH has produced 280,000 smolts for release into Clear Creek, while production at CAFH will allow the release of 270,000 presmolts into Lolo Creek in 2004. Hence, the transition from LCR stock coho salmon to CLS coho has already been initiated.

Preliminary results from NPT coho reintroduction efforts indicate that a substantial survival benefit can be realized by acclimating juveniles prior to release and/or using CLS stock as a brood source (Table 6-2). Acclimation, and/or use of CLS broodstock (or some combination of these factors) appears to increase post-release survival to Lower Granite Dam (LGD). Unfortunately, data are insufficient to determine whether the observed survival benefit results primarily from acclimation or from using CLS broodstock. The preliminary results do show a clear survival advantage for smolt versus parr releases. Finally, adult collection facilities that are located lower in the Clearwater River Subbasin appear to decrease losses due to “drop out” between LGD and capture facilities.

To date, the primary focus of preliminary reintroduction efforts has been the formation of a Clearwater Localized Stock (CLS) of coho salmon. Hence, substantial effort has been expended in attempting to capture all returning adult coho salmon. However, weirs on the Potlatch River and Lolo Creek are not 100% efficient, and redd surveys have documented coho salmon redds in these locations (Table 6-3). The presence of these redds suggests that adult coho salmon returning from the release of lower Columbia River hatchery origin juvenile coho salmon can construct redds. However, since the number of adults that constructed the redds is unknown, and since juvenile trapping activities for coho salmon are opportunistic, it is impossible to estimate productivity.

Finally, the number of adult coho passing Lower Granite Dam (LGD) has been increasing steadily since 1997 (Table 6-4; http://www.cbr.washington.edu/dart/dart.html), suggesting that preliminary reintroduction efforts have successful at stimulating adult returns.

Table 6-1. Summary of NPT juvenile coho releases in the Clearwater River subbasin.

Release Year	Life Stage	Brood Source[1]/Hatchery[2]	Number Released	Release Location
1995	Parr	LCR/CNFH	142,456	Potlatch River
	Parr	LCR/CNFH	49,849	Orofino Creek
	Parr	LCR/CNFH	94,777	Eldorado Creek
	Parr	LCR/CNFH	335,145	Meadow Creek (SR[3])
			622,227	
1998	Parr	LCR/BFH	175,000	Potlatch River
	Parr	LCR/BFH	125,000	Eldorado Creek
	Parr	LCR/BFH	150,000	Meadow Creek (SR)
			450,000	
	Smolt	LCR/WNFH, LCR/BFH	244,640	Lapwai Creek
	Smolt	LCR/WNFH, LCR/BFH	231,076	Potlatch River
	Smolt	LCR/WNFH, LCR/BFH	218,501	Clear Creek
			694,217	
1999	Parr	LCR/BFH	175,000	Potlatch River
	Parr	LCR/BFH	125,000	Eldorado Creek
	Parr	LCR/BFH	150,000	Meadow Creek (SR)
			450,000	
	Smolt	LCR/WNFH, LCR/BFH	290,176	Lapwai Creek
	Smolt	LCR/WNFH, LCR/BFH	276,682	Potlatch River
	Smolt	LCR/WNFH, LCR/BFH	245,168	Clear Creek
			812,026	
2000	Parr	LCR/ECNFH, LCR/WNFH	124,470	Eldorado Creek
	Parr	LCR/ECNFH, LCR/WNFH	148,578	Meadow Creek (SFCR4)
	Parr	LCR/ECNFH, LCR/WNFH	149,300	Meadow Creek (SR)
			422,348	
	Smolt	LCR/WNFH	267,102	Lapwai Creek
	Smolt	LCR/WNFH	267,166	Potlatch River
	Smolt	CLS/DNFH	280,750	Clear Creek
			815,018	
2001	Fry	LCR/ECNFH	**23,000**	Mission Creek
	Parr	CLS/CAFH, LCR/ECNFH	140,000	Eldorado Creek
	Parr	LCR/ECNFH	120,000	Meadow Creek (SFCR[4])
	Parr	LCR/ECNFH	85,000	Meadow Creek (SR)
			345,000	
	Smolt	LCR/WNFH, LCR/ECNFH	286,504	Lapwai Creek

	Smolt	LCR/WNFH, LCR/ECNFH	275,688	Potlatch River
	Smolt	CLS/DNFH	30,191	Clear Creek
			629,283	
2002	Fry	LCR/ECNFH	**25,000**	Mission Creek
	Parr	CLS/CAFH, LCR/ECNFH	140,000	Eldorado Creek
	Parr	LCR/ECNFH	120,000	Meadow Creek (SFCR)
	Parr	LCR/ECNFH	85,000	Meadow Creek (SR)
			345,000	
	Smolt	LCR/ECNFH	275,000	Lapwai Creek
	Smolt	LCR/ECNFH	552,298	Potlatch River
	Smolt	CLS/DNFH	236,692	Clear Creek
			1,063,990	
2003	Parr	LCR/CAFH	157,012	O'Hara Creek
	Parr	LCR/CAFH	121,920	Eldorado (Lolo) Creek
	Parr	LCR/CAFH	135,500	Meadow Creek (SFCR)
			414,432	
	Smolt	LCR/ECNFH	274,125	Potlatch River
	Smolt	LCR/ECNFH	279,500	Lapwai Creek
	Smolt	CLS/DNFH	293,879	Clear Creek
			847,504	
2004	Parr	LCR/ECNFH	150,000	Eldorado (Lolo) Creek
	Parr	LCR/ECNFH	75,000	Lolo Creek
	Parr	LCR/ECNFH	75,000	Musselshell Creek
			300,000	
	Smolt	LCR/ECNFH	297,271	Potlatch River
	Smolt	LCR/ECNFH	299,084	Lapwai Creek
	Smolt	CLS/CAFH, LCR/ECNFH	356,323	Clear Creek
			952,678	
2005	Smolt	LCR/ECNFH	275,000	Potlatch River
	Smolt	LCR/ECNFH	275,000	Lapwai Creek
	Smolt	CLS/CAFH, LCR/ECNFH	280,000	Clear Creek
			830,000	

[1]Refers to progeny from Lower Columbia River (LCR) origin adults, or Clearwater River localized stock (CLS).

[2]Refers to the hatchery facility that reared the juveniles:

CNFH = Cascade National Fish Hatchery
BFH = Bonneville Fish Hatchery
WNFH = Willard National Fish Hatchery
ECNFH = Eagle Creek National Fish Hatchery
DNFH = Dworshak National Fish Hatchery
CAFH = Clearwater Fish Hatchery

[3]SR refers to the Selway River watershed.

[4]SFCR refers to the South Fork Clearwater River watershed.

Table 6-2. Summary of observed survival rates of NPT coho release groups.

Stream	Stock	Life Stage	Survival to LGR (%)[1]	SAR LGR to LGR (%)	Dropout LGR to Trap (%)
Clear Creek	CLS	Smolt	56.2 - 75.0	0.5 - 0.6	49.1
Potlatch River	LCR	Smolt	8.6	1.1	60.0
Lapwai Creek	LCR	Smolt	24.2	0.2	51.5
Meadow Creek SR	CLS	Parr	2.4 - 10.4	NS[2]	100.0
Eldorado Creek	CLS	Parr	5.9 - 8.0	NS[2]	92.0

[1]Calculated using SURPH 2.1 (Lady *et al.* 2001)

[2]Sample size was insufficient for calculation.

Table 6-3. Number of coho salmon redds enumerated in the Potlatch River and Lolo Creek from 1999 through 2003.

Year	Redds		
	Potlatch River	Lolo Creek	Total
1999	11	N/A	11
2000	14	N/A	14
2001	32	0	32
2002	20	0	20
2003	15	1	16

N/A - Redd counts were not conducted in Lolo Creek in 1999 and 2000.

Table 6-4. Counts of adult and jack coho salmon passing LGD from preliminary NPT coho salmon reintroduction efforts.

Year	Adult Coho	Jack Coho	Total
1997	84	10	94
1998	10	1	11
1999	250	42	292
2000	883	35	918
2001	937	111	1,048
2002	247	149	396
2003	1,129	130	1,259
2004*	3,291	97	3,388

*Adult returns as 27 October 2004.

6.3 Yakima Subbasin Coho Reintroduction

The Nez Perce Tribe carefully reviewed information from the Yakama Nation (YN) coho reintroduction program during the development of this plan. Similar to the Clearwater River Subbasin, coho salmon inhabiting tributaries of the mid-Columbia were extirpated in the early 1900's (Dunnigan 1999). In 1995, the YN began a program to reintroduce coho salmon to the Methow, Wenatchee, and Yakima Rivers (BPA Project 1996-040-000). Also, similar to the NPT reintroduction, no local sources of broodstock and/or juveniles were available for the reintroduction effort, and subsequently the YN relied on juvenile production from LCR coho hatcheries.

The YN program followed a phased reintroduction approach wherein the bulk of initial juvenile releases were acclimated and released in locations with adult capture facilities. Adults returning to the juvenile release location were either retained for broodstock or released to study spawning effectiveness and inter-specific interactions. The remainder of juvenile releases occurred in targeted habitat selected for suitability to coho, minimizing the potential for interspecific interactions, and with adequate access to allow researchers to conduct competition and predation studies. As the results of adult and juvenile interactions became available, juvenile releases shifted to emphasize releases in targeted coho habitat.

The following paragraphs summarize those results from the YN coho reintroduction program that were helpful in guiding NPT efforts; specifically, broodstock development, juvenile release characteristics, predation data, and competition data. Data are summarized from Murdoch et al. (2004).

6.3.1 Broodstock Development

Broodstock development for the YN program was based on the assumption that LCR hatchery origin coho were capable of enduring a prolonged migration to mid-Columbia River tributaries, and that upon return would be capable of spawning naturally and/or return in an abundance that would allow broodstock collection. In 2003 the YN program released 911,422 coho smolts into the Wenatchee River Basin. Of these 96% were Mid-Columbia Brood Coho, and the remaining 4% were LCR coho. Preliminary analysis from the Icicle Creek acclimation site show the SAR of mid-Columbia River origin smolts was 0.51% versus 0.31% for smolts of LCR origin, suggesting that the YN program has realized a survival advantage for “localized” broodstock (Murdoch et. al, In Prep) in fewer than three full generations (nine years) since the program inception.

6.3.2 Acclimation

The YN program relies on “low-tech” facilities for acclimation of all coho salmon smolts. In most cases these acclimation facilities consist of natural impoundments or impoundments constructed for other purposes (e.g., an overflow channel for a gravel pit). The YN program has realized several advantages from this approach; smolts develop a more natural color, are acclimated under a natural temperature regime, introduced to natural foods, imprinted on water in locations targeted for adult returns, and cost has been dramatically reduced compared to the construction of dedicated acclimation facilities. The YN also recognizes that there are some negative aspects of the low-tech acclimation approach including; increased predation on juvenile coho, variability in water availability, accessibility, and potential difficulties in treating disease outbreaks (which has not occurred to date).

6.3.3 Residualization, Predation, and Competition

Despite the fact that coho, steelhead, Chinook salmon, bull trout, and sockeye salmon historically coexisted within tributaries of the mid-Columbia River, the YN was concerned that the reintroduction of coho would decrease survival of other stocks of salmon (including those listed under the Endangered Species Act) that occur in many of the locations targeted for coho reintroduction. Therefore, the YN program included a substantial M&E component aimed at characterizing predation and competition of coho juveniles and adults on ESA listed stocks of Chinook salmon and steelhead. The YN was particularly concerned with the potential for competition and predation to be increased as a result of residual coho. However, despite extensive surveys in 2001 and 2002, no residual coho were observed. Extensive predation studies determined that fish comprise only 0.18% of food consumed by juvenile coho in Nason Creek (a tributary to the Wenatchee River). In study reaches, this resulted in less than 0.14% to 1%[2] of the total juvenile spring Chinook salmon population falling prey to coho predation. Further, YN biologists found that juvenile spring Chinook salmon, steelhead, and coho salmon utilized different microhabitats. Observed differences in habitat use between treatment and control reaches (reaches with and without coho salmon) in 2001 and 2003 were present before coho introduction, and hence could not be attributed to the presence of coho salmon. Observed growth rates of Chinook salmon did not differ between reaches that were occupied by coho salmon and reaches lacking coho salmon, in fact, condition factors for Chinook salmon in reaches containing coho salmon were actually higher. These results are similar to those of Spaulding et al. (1989) who found that juvenile growth rates, densities, and emigration timing of juvenile Chinook and steelhead were unaffected by the presence of coho salmon.

Unfortunately, bull trout interactions have yet to be quantified by the YN study. However, the USFWS expressed the following views regarding coho reintroduction in the mid Columbia (USFWS 2001):

> *"It is generally felt that this supplementation program will not impact bull trout stocks and will likely benefit bull trout and other resident fish. Historically, bull trout probably benefited from the presence of anadromous salmonids. The downstream drift of eggs released from spawning salmon provided food for bull trout and other resident fishes, but more importantly the presence of decaying salmon carcasses greatly benefited juvenile salmon and resident fishes thru nutrient recycling. Generally, in drainages colonized by natural anadromous salmon and steelhead populations the bull trout have successfully co-existed."*

Nonetheless, the same document also urges a cautionary approach to the reintroduction of coho salmon in habitat occupied by bull trout:

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[2] Based on stomach content analyses, which likely overestimate predation due to a conservative estimate of residence time.

"…in many areas where bull trout currently exist, habitat conditions have deteriorated and natural predator-prey balances have been upset. Bull trout populations are at or near critically low levels in many areas of the basin. For this reason caution should be exercised in stocking large numbers of hatchery fish near bull trout spawning and rearing areas to avoid the potential for competition or predation on bull trout fry."

6.4 Guidance from Water Temperature, Habitat Preference, and Life History Data

Based on the availability and characteristics of habitat in the Clearwater River Subbasin, Witty and Cramer (1999) speculated that Clearwater coho were historically as abundant as steelhead, but less abundant than Chinook. Witty and Cramer (1999) suggest that stream gradient and late-fall water temperatures likely imposed the upper limit on coho abundance and productivity. Streams with gradients of 3% or less provide conditions favorable for coho salmon (Reeves et al. 1989). This suggests that the core spawning aggregates of coho salmon likely resided in tributaries of the mainstem Clearwater River and the South Fork Clearwater River.

Habitat availability for juvenile and adult coho salmon can also be described thermally. Adult coho migration slows at water temperatures below 38˚F and halts at temperatures below 35 ˚F (Cramer and Cramer 1994). Coho salmon prefer springs or gravel areas in streams where the flow is one to two feet per second and spawn in water temperatures ranging from 33 to 46˚F (Gribanov 1948). The optimum temperatures for coho salmon egg incubation range from 39 to 52˚F (Davidson and Hutchinson 1938). However, coho salmon sac fry can survive for short duration in water temperatures below 35 ˚F. There is an array of thermal habitats in streams that provide fish the opportunity to survive (Brett 1971, Smith and Li 1983, Ward and Stanford 1982, Berman and Quinn 1991, Hall et al. 1992). Thermal habitats that provide cool water in summer and warm water in winter, may be large or small, and subject to fluctuations related to weather conditions and discharge. Groundwater usually affects small areas, but these areas may be significant for coho spawning and overwintering in the Clearwater River Subbasin. In fact, groundwater may explain the presence of coho because relatively minor differences in temperature can be ecologically relevant (Somero and Hofmann 1997). Several authors including Li et al. (1991 and 1993), Brett (1971), Smith and Li (1983), Ward and Stanford (1982), Berman and Quinn (1991), Hall et al. (1992) Everest and Chapman (1972), Kaya et al. (1977), Gibson (1979), Keller and Talley (1983), Ozaki (1988), and Meisner (1990) describe thermal habitats. The Clearwater River has several large, warm water thermal areas (perhaps most notably Lolo hot springs), and likely hundreds of smaller groundwater thermal areas where coho could spawn allowing egg incubation during winter periods. Although formal surveys have not been completed, the presence of a strong groundwater influence is noted in the Lolo Creek watershed (Lolo National Forest 1999). In addition, a number of locations in the South Fork Clearwater River Subbasin have designated Aquatic Landtype Association (ALTA) ratings of 2, 5, or 18 suggesting that groundwater influence is common (Nez Perce National Forest 1997).

Coho salmon egg development is generally dependent on water temperature, although there is some variation in egg development between coho salmon stocks. Coho salmon eggs hatch in about 137 days when the average water temperature is 36˚F (Semko 1954), 48 days when the average water temperature is 48˚F, and 38 days when the average water temperature is 51˚F (Shapovalov and Taft 1954). Coho salmon fry emerge from the gravel 21 to 40 days after hatching when the average water temperature is 36˚F (Semko 1954; Gribanov 1948). Coho eggs require about 1,900 (˚F) temperature units3 to incubate (Sandercock 1991).

Although coho salmon fry and parr are found in both pool and riffle areas of a stream, they are best adapted to holding in pools (Hartman 1965). Coho salmon fry and parr distribute themselves throughout the stream and once territories are established remain in the same locality for relatively long periods (Hoar 1958). Coho fry and parr often form groups in pools with larger parr at the head of the pool and smaller parr at the back of the pool (Sandercock 1991). Small ponds, including those located in tributaries of the Mainstem Clearwater River and off-channel mine dredge ponds in South Fork Clearwater River tributaries may provide this habitat for coho salmon during winter months.

Coho salmon eggs incubate during winter, and free-swimming fry emerge in the spring. Fry and parr reside in the stream during summer months, and over winter prior to migrating as smolts the next spring. After 15 to 18 months at sea, adult coho salmon return to spawn. Most coho salmon spawn between November and January, but spawning may occur between September and March (Pravdin 1940; Smirnov 1960; Rounsefell and Kelez 1940; Crone and Bond 1976; Neave 1949; Chapman 1965). There is little correlation between the time that coho salmon enter a stream and the date of spawning; early-run coho salmon may spawn early, but many individuals hold for weeks or even months before spawning. However, late-run coho salmon tend to spawn soon after their arrival on spawning grounds (Sandercock 1991).

Coho salmon are the least particular of all Pacific salmon in their choice of spawning areas. Coho salmon may spawn in large rivers or in remote tributaries. Spawning may occur on gravel bars of slow flowing rivers or on white-water riffles of turbulent streams (Foerster 1935). Females generally select a site to spawn at the head of a riffle area where there is good circulation of oxygenated water through the gravel (Shapovalov and Taft 1954).

6.5 Life History Characteristics of Grande Ronde Coho Salmon

Coho salmon inhabiting the Grande Ronde River subbasin were geographically closer to the Clearwater River Subbasin than any other extant stock of coho salmon. Therefore, life history characteristics of the Grande Ronde stock might approximate attributes of the coho salmon stock that historically occupied the Clearwater River Subbasin. Grande Ronde coho salmon began maturing during summer after one winter at sea. Migration toward the Columbia River began during mid-summer, with entry into the Snake River in

[3] A temperature unit is defined as 1˚F above 32˚F for 24 hours.

September (USACE 1990). Historically, coho were sighted in the lower Grande Ronde River in mid-September (Van Dusen 1905).

Fecundity ranged from 2,700 to 3,000 eggs per female at the Grande Ronde and Wallowa River hatchery stations from 1901 to 1907 and averaged 3,671 eggs per female at the Wenaha station (Van Dusen 1905). Fecundity of Wenaha River stock coho reported by Van Dusen (1905) is unusually high and may be in error (Cramer and Witty 1998), however it is notable that fecundity estimates for Grande Ronde coho salmon are higher than reported for coho salmon in other locations.

In the 1960's, Wallowa River coho began their emigration in late-April to early-May, peak passage at Ice Harbor Dam was June 6, and they reached the Columbia River estuary in mid-May to early-June (Cramer and Witty 1998).

Coho from the Wallowa River were the latest migrants of all yearling salmonids to pass McNary and Ice Harbor dams in 1966 and 1967 (Park and Bentley 1968), a factor that may have contributed to the extinction of the Grande Ronde coho population. Johnson and Sprague (1996) report that the majority of the first coho released in the Clearwater River Subbasin migrated past Lower Granite Dam in June.

Mean length of coho salmon smolts in the Grande Ronde River basin from 1965 to 1966 was 11.7 cm. Gribanov (1948) observed that most coho are 10 cm when they smolt, although coho may migrate at sizes ranging from 3.3 to 15 cm (Shapovalov and Taft 1954; Sumner 1953; Salo and Bayliff 1958; Foerster and Ricker 1953; Andersen and Narver 1975; Armstrong and Argue 1977; Fraser *et al.* 1983; McHenry 1981).

6.6 Integration of Data Sources

Integrating data from sections 6.1 through 6.5 provided substantial guidance for Phase I of the Clearwater River Subbasin in coho reintroduction. Preliminary Clearwater River Subbasin specific data suggests that acclimation provides a substantial survival benefit. These data also suggest that smolt releases are the most effective strategy to stimulate adequate adult returns. Data from the YN program suggests that securing a localized broodstock could provide a substantial survival benefit, and increase the likelihood of program success. Data from preliminary coho releases suggests that locating adult collection facilities lower in the Clearwater River Subbasin may decrease drop out rates, allowing increased recovery of adult coho. Finally, there appears to be ample historically occupied habitat to support naturally spawning coho in tributaries currently targeted for integrated restoration activities, and available data suggest that competition and predation should not be dramatically increased over existing conditions by the presence of coho salmon.

Chapter 7: Limiting Factors

In this chapter:

- Harvest
- Hatcheries
- Hydropower
- Habitat

Salmon experience human-caused mortality throughout their life cycle. Timber harvest, grazing, irrigation, road construction, dam construction, harvest, residential development, and all other activities requiring water withdrawals, or resulting in the degradation of water quality, increase mortality of salmon at various freshwater life history stages (Mundy 1996). The dredging and filling of the estuary, and mixed stock and mixed species harvest in the ocean can increase mortality during the estuary and ocean life history stages. A synopsis of limiting factors in this chapter organizes impacts into four major categories (harvest, habitat, hydrosystem, and hatcheries).

Since coho salmon have been extirpated in the Clearwater River Subbasin, it is difficult to predict how reintroduced stocks will be affected by these factors. Some insight might be gained from using spring Chinook salmon as a surrogate for the expected rates of mortality that can be attributed to these limiting factors. The same factors that limit the sustainability of spring Chinook salmon are expected to limit the productivity of reintroduced coho salmon in the Clearwater River Subbasin.

7.1 Harvest

7.1.1 Ocean Harvest

Since coho have been extirpated from the Snake River there is no means to directly estimate the potential impacts of ocean fisheries on reintroduced Clearwater River Subbasin stocks. However, it is likely that many of the harvest management actions aimed at protecting coastal coho stocks will likewise decrease ocean harvest impacts on Clearwater River Subbasin coho salmon. Harvest restrictions have decreased fishing mortality for Oregon coastal coho stocks from upwards of 80% in the 1970's and 1980's to less than 13% after 1994 (ODFW 1998). This decrease in ocean harvest results from a number of regulations:

1. Ocean trolling has been restricted to the use of single barbless hooks to decrease hooking mortality of coho captured incidentally in targeted Chinook fisheries;

2. A limit of four lures has been implemented in troll fisheries; and

3. Certain gear types (e.g., flashers and dodgers) are prohibited.

In addition to restrictive angling regulations, a comprehensive education program has been established to aid fishers in the correct identification of Chinook and coho. The accuracy of run-size predictions has also increased due to better accounting of production releases from federal, state, tribal, and privately operated hatcheries. Finally, managers have implemented research aimed at better quantifying mortality related to incidental harvest of coho salmon in ocean fisheries targeting other species (e.g., hake).

7.1.2 Columbia River Mainstem Harvest

7.1.2.1 Hydrosystem

Although the eight mainstem hydropower dams on the Snake and Columbia rivers are not normally associated with harvesting fish, they are responsible for a large portion of the adult mortality. NMFS (2000) estimates that interdam loss accounts for 50 percent of the mortality of returning natural origin Snake River spring Chinook salmon. This “harvest” rate is used in determining the number of spring Chinook salmon that can be allocated for incidental harvest in the mainstem tribal and sport fisheries (<10 percent). Impacts associated with the hydrosystem are discussed in more detail in Section 7.3. It is expected that hyrosystem related losses of coho salmon will approximate those of spring Chinook salmon.

7.1.2.2 Fisheries

Salmon and steelhead destined for the Snake River Basin are not managed as individual stocks until they reach the mouth of the Snake River. Columbia River fisheries recognize and manage all Snake River Basin tributary runs as an aggregate. For example, under the recently completed biological assessment (CRITFC 1999) and biological opinion (NMFS 2000) discussing Columbia River fisheries, escapement objectives for Snake River Subbasin spring Chinook salmon were identified only for the aggregate of populations originating above Lower Granite Dam and not for populations of individual watersheds such as the Clearwater River Subbasin.

At this time it is difficult to predict how in-basin coho salmon harvest will be managed over the long-term. Currently, coho salmon fisheries primarily target the abundant hatchery origin coho salmon from production facilities in the lower Columbia River. It is likely that Clearwater River Subbasin coho salmon will be managed as an aggregate with a Snake River fishery quota determined by escapement estimates generated from adult counts at the mainstem hydropower facilities. The comanagers will develop a Snake River escapement goal for coho salmon as reintroduction efforts progress. In the interim, the current coho harvest plan, agreed to in the *U.S. v. Oregon* forum provides for a maximum harvest of 50% of all coho salmon destined to return to locations above Bonneville Dam. The 50% that is harvested is split equally among treaty and non-treaty (commercial and recreational fisheries). Harvest occurring above Bonneville Dam is included in the 50% harvest fraction. The remaining 50% of the coho escapement is reserved for broodstock needs, although the agreement also includes language to allow escapement for natural production, should a natural escapement goal be identified. Under those circumstances, the 50% sharing agreement would be applied to coho in excess of broodstock and natural escapement goals. In either case, these fisheries would be subject to the *U.S. v. Oregon* Fall Fisheries Agreement, which limits incidental harvest of ESA-listed stocks. In the case of Snake River coho salmon, listed fall Chinook salmon and steelhead are the two stocks most likely to be impacted by incidental take during coho harvest.

7.2 Hatcheries

Considerable concern has been expressed among the scientific community that hatchery fish can potentially impact natural spawning populations through genetic introgression, disease transmission, and competitive interactions. Most directly, the presence of hatchery fish in mixed-stock fisheries has led to harvest rates that result in overfishing of natural populations. The history of artificial propagation in the Columbia Basin and associated impacts are discussed in detail by Brannon *et al.* (1999). Scientists contributing to the Plan for Analyzing and Testing Hypotheses noted that the potential for negative interaction between naturally-produced fish and hatchery-reared fish during mainstem smolt migration is likely greater for listed Snake River stocks than for downstream stocks because of increased contact between fish during barging and dam passage (Mamorek *et al.* 1996).

In the last ten years, a considerable amount of effort has been directed at reviewing artificial production in the Columbia River Basin and developing recommendations and guidelines for technical and policy reform of hatcheries (NPPC 1999, IHOT 1995). NMFS has completed consultations covering all hatchery production in the Columbia Basin (NMFS 1999). As a result, hatchery management practices have been substantially revised (NMFS 2000). For example, many non-indigenous stocks are being transitioned to native stocks, rearing densities are being reduced, and size-at-release and release locations have been adjusted to decrease competitive interactions with natural populations.

In the 1999 Biological Opinion on Artificial Propagation in the Columbia River Basin, the Clearwater River Subbasin coho reintroduction was described and analyzed by NMFS (1999), who concluded that artificial propagation programs in the Columbia River Basin as described by the action agencies are not likely to jeopardize the continued existence of listed Snake River spring/summer Chinook salmon. In addition, PATH scientists have preliminarily concluded that, relative to the hydrosystem, artificial propagation of spring/summer Chinook salmon has not significantly contributed to declines in natural populations of spring/summer Chinook in upstream areas (Mamorek *et al.* 1996). Although uncertainties remain about the effectiveness of supplementation programs, those uncertainties have to be weighed against the risk of not taking any remedial action. NMFS (2000) determined it is reasonable to expect that the listed ESUs will benefit over time from improvements in artificial propagation and that carefully designed intervention programs will improve the future prospects for survival and recovery.

Since Clearwater River Subbasin coho salmon are a reintroduced stock, it is difficult to predict how they will interact with hatchery and natural origin salmonids with the Snake River Basin. Information from the Yakama Nation (Section 6.3) indicates that competition and predation resulting from the reintroduction of coho salmon is unlikely to negatively impact sympatric salmon stocks. Nonetheless, the coho RM&E plan will evaluate whether negative impacts are occurring.

7.3 Mainstem Snake and Columbia River Hydrosystem

Hydroelectric dams and reservoirs on the lower Snake and Columbia rivers are considered a primary factor in the decline of Snake River anadromous fish runs over the last 30 years (ACCD 2004, CBFWA 1991, CCD 2004, Ecovista 2003, Ecovista 2004a, Ecovista 2004b, Ecovista 2004c, NMFS 1995, ISG 1996). Wild spring Chinook escapement trends in northeastern Oregon streams from 1952-1996 depict relatively stable escapements from the mid-1950s to the early 1970s, then a sharp decline following the completion of four additional mainstem dams (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite). During 1952-96, the aggregate of northeastern Oregon spring Chinook habitat has not undergone any dramatic changes that account for, or coincide with, Snake River stock declines observed in the late 1970s (TAC 1997).

The system of hydropower dams on the Columbia and Snake rivers (known as the Federal Columbia River Power System or FCRPS) has greatly diminished the diversity of habitat once characteristic of this system. The dams severed the continuum of habitat, decreasing riverine habitat in the mainstem and isolating other types of habitat. Dams also altered the natural hydrograph, which further reduced available habitat types and ecosystem processes in those habitats. Slack water reservoirs increase water temperatures, pollutant levels, travel time for migrating salmonids, predator populations, and decrease habitat complexity. Two key consequences of this loss of habitat diversity have been a reduction in the biodiversity of native salmon stocks and the proliferation of non-native species (ISG 1996).

Direct mortality due to the hydroelectric system and associated operations is recognized as one of the most significant sources of mortality for anadromous fishes (Iwamoto *et al*. 1994, Mundy *et al*. 1994, ODFW *et al*. 1990, Quinn and Adams 1996, Raymond 1979). NMFS (2000) estimates that interdam loss accounts for 50 percent of the mortality of returning natural origin Snake River spring Chinook salmon and 22 percent for summer Chinook salmon.

A recent evaluation of 25 years of juvenile survival studies found that an estimated 13-14 percent of emigrating smolts are lost at each lower Snake and Columbia River dam (Bickford and Skalski 2000). Additionally, mortality may be greater for wild smolts, may accumulate as additional dams are encountered, and may vary considerably by year and river section. NMFS (2000) believes that improvements in the hydrosystem (*e.g.*, passage improvements at the dams) are increasing survival of migrating juveniles. For Snake River spring/summer Chinook smolts migrating in river (not transported), the estimated survival through the hydrosystem is now 40-60 percent, compared to 20-40 percent in the 1970s (NMFS 2000). However, delayed mortality is believed to occur in the estuary and ocean as a result of cumulative effects of the hydroelectric system (Mundy *et al*. 1994, Mamorek *et al.* 1996).

Neither the current transport system nor present in-river migration conditions will provide recovery of Snake River spring/summer or fall Chinook (BRWG 1994, NMFS 1995, STFA 1995a, STFA 1995b, ISG 1996). Improvements to the transportation system are also not likely to provide the survival rates necessary to recover Snake River spring/summer Chinook (Mundy *et al*. 1994, Mamorek *et al.* 1996). The analysis of the survival and productivity of Snake River and lower Columbia River Chinook stocks indicates Snake River spring/summer Chinook survival goals can be achieved if a portion of the mainstem migration corridor is restored to a more natural or normative condition (Mamorek *et al*. 1996).

7.4 Habitat

7.4.1 Ocean/Estuary

Many actions in the Pacific Ocean and the Columbia River estuary may be having an adverse effect on the survival of salmon. Filling and dredging, and water quality impacts from large cities, such as Portland, Oregon may have decreased the ability of the estuary to support salmon smolts as they make the transition to salt water. An estimated 65 percent of tidal swamps and marshes in the Columbia River estuary have been lost due to diking and filling (NMFS in review).

A shift in ocean conditions over the past two decades, exacerbated by El Nino events, has impacted Columbia Basin salmon returns (NMFS 2000). Oceanic climate regime shifts and their effect on Pacific Northwest salmon populations are discussed at length by Anderson (1997). Studies detailing the cyclic changes in ocean conditions have been emerging since the early 1990s. Recent studies indicate the warm and cool regimes appear to persist over about two decades, therefore, it is reasonable to expect that ocean conditions are cyclic and will eventually improve (Anderson 1997). There is increasing evidence that a regime shift to favorable ocean conditions for Columbia River salmon has now occurred although confidence in that conclusion will come only after the associated weather patterns have been observed for several years (NMFS 2000).

Another factor affecting salmon is the concentration of predators in the estuary and ocean. Seals and sea lions have been targeted for over a century for preying on Columbia River salmon (Reed 1890) and more recently bird populations in the lower Columbia River have been identified as effective predators of salmon smolts. The world's largest colony of Caspian terns and the two largest colonies of double-crested cormorants on the west coast of North America have recently become established in the Columbia estuary (NMFS 2000). Efforts are currently underway to relocate the bird populations and these may eventually reduce the bird predation (NMFS 2000).

7.4.2 Freshwater

This section on freshwater habitat contains a more extensive discussion than the other sections in this chapter for several reasons. The Nez Perce Tribe has co-management jurisdiction over the Clearwater River Subbasin and the Tribe has been actively involved in on-the-ground habitat improvements in this area. Freshwater habitat has been identified by the Cumulative Risk Initiative (CRI) project as important in recovering Snake River spring/summer Chinook and is an area that is more manageable than habitat for other life stages (*e.g.*, the ocean).

7.4.2.1 Clearwater River Subbasin

The Clearwater Subbasin Plan (Ecovista 2003; http://www.nwppc.org/fw/subbasinplanning/clearwater/default.asp) contains a detailed description of the subbasin and individual watersheds, which is summarized in the following paragraphs. The Clearwater River Subbasin is located in north central Idaho extending West to the Washington and Idaho border, East along the West slope of the Bitterroot Mountains, North 100 miles to the St. Joe River subbasin, and South 120 miles to the Salmon River subbasin (Maughan 1972 in Cichosz *et al*. 2001). The Clearwater River generally flows westward from the headwaters and enters the Snake River at Lewiston, Idaho, RM 139. The Clearwater River drains approximately 9,645 square miles (Cichosz *et al.* 2001). Major tributaries include the Lochsa River, Selway River, South Fork Clearwater River, and Lapwai Creek. Major land use in the subbasin includes forestry, agriculture, grazing, and mining (CRITFC 1995).

Land ownership in the Clearwater River Subbasin has evolved from exclusive NPT occupancy in the 1800's to more complex land ownership patterns. Currently, the Forest Service owns 59.9 %, the Bureau of Land Management owns 0.8%, 0.5% is owned by the Army Corps of Engineers, 1.6% is owned by the NPT and Bureau of Indian Affairs trust, 4.9% is owned by the State of Idaho, and 32.3% is owned by private individuals or companies. Approximately 27.7% (not including the North Fork) is classified as wilderness and another 14% is undeveloped. Areas protected under the Wild and Scenic Rivers Act include 22 miles of the Middle Fork of the Clearwater River, 62 miles of the Lochsa River, and 91 miles of the Selway River (CBSP 1990).

Land-use practices such as mining and timber harvest have altered the upland and riparian vegetation and have caused stream temperatures to rise during summer months. Mining is centered on the upper South Fork of the Clearwater River, Orofino Creek, and the Potlatch River. Smaller mining operations are located in the Lolo and Mission Creek watersheds (CBSP 1990).

Logging

Most of the federal forest land in the Clearwater River Subbasin was set aside as the Bitterroot Forest Reserve in 1897 (Cichosz et al. 2001). The Clearwater, Nez Perce, St. Joe, and Bitterroot National Forests now comprise most of the forest in the subbasin and logging has been significantly reduced because of ESA listed salmon stocks, concerns with resident salmonids, lack of resolution on the management of remaining roadless areas on the forest, and change in Forest Service management policy (Cichosz *et al.* 2001).

Roads

Road densities are greatest in the central portions of the basin where logging roads predominate, commonly exceeding 3 miles/square mile and often exceeding 5 miles/square mile (Cichosz et al. 2001). However, there is relatively little road development in the eastern portion of the Clearwater River Subbasin. Cichosz *et al.* (2001) note that the Selway-Bitterroot and Gospel-Hump Wilderness Areas contribute to the lack of road development in some areas, as does the local fire history. The distribution of logging roads in the Clearwater subbasin is notably tied to fire history, with most currently existing forest roads located in areas that did not burn during major fires of 1910 and 1917 (Cichosz *et al.* 2001).

Mining

The South Fork Clearwater drainage has a complex mining history that included periods of intense placer, dredge, and hydraulic mining (Paradis et al. 1999b in Cichosz *et al*. 2001), some of which may pose a relatively high ecological hazard. Mining claims are also aggregated in a line extending from the upper Middle Fork and lower Lochsa River northward to Orogrande Creek, then along the upper North Fork to its headwaters including Meadow, Long, Osier, and upper Kelly Creeks (Cichosz *et al*. 2001). Within the North Fork drainage, mining activity was widely dispersed and methods used varied by area and included dredging, hydraulics, draglines, drag shovels, and hand operations (Staley 1940 in Cichosz *et al.* 2001).

Farming

Farming occurs in the western third of the Clearwater River basin on lands below 2,500 feet (Cichosz *et al.* 2001). Total cropland and pasture in the subbasin exceeds 760,000 acres; small grains are the major crop, primarily wheat and barley (Cichosz *et al*. 2001). The 1985 Farm Bill has resulted in replacing farming on over 79,000 highly erodible and other environmentally sensitive acres with long-term approved cover for 10 to 15 years (Cichosz *et al.* 2001).

Ranching

Historical documentation suggests that sheep grazing in the Clearwater River Subbasin began as early as the 1890s increased through the mid 1930s, peaked in 1933, declined sharply by 1949, and remained relatively consistent until the mid 1960s (Cichosz *et al.* 2001). Permits for cattle grazing were not issued in the Clearwater National Forest until 1937, with 25 head permitted; grazing increased to over 400 head by 1943 and continued to increase, reaching 1,199 head by 1960 (Space 1964 in Cichosz *et al.* 2001).

Recreation

Wild and scenic rivers, world class big game hunting and trout fishing, and river rafting can be found in the Selway Bitterroot Wilderness Area, making the Clearwater River Subbasin a recreational resource of national significance (Cichosz *et al.* 2001). Steelhead and Chinook sport fisheries in the Clearwater River Subbasin attract anglers both from within Idaho and out-of-state, and is an important component of the local and state economy (Cichosz *et al.* 2001). Dworshak Reservoir also provides a recreational resource of regional significance.

7.4.3 Habitat Restoration Initiatives in the Clearwater River Subbasin

Habitat restoration activities occurring within the Clearwater River Subbasin are expected to benefit the coho reintroduction program. A number of BPA funded (Table 7-1) and non-BPA funded (Table 7-2) habitat improvement initiatives are occurring in areas that are expected to improve coho salmon survival.

Table 7-1. BPA funded Clearwater River Subbasin habitat improvement projects expected to benefit coho salmon.

BPA Project #	Title/Description
9706000	NPT Clearwater Focus Program
9303501	Enhance Fish, Riparian and Wildlife Habitat within the Red River Watershed
9901600	Protecting and Restoring Big Canyon Creek Watershed
9901700	Rehabilitate Lapwai Creek
9607702	Protecting and Restoring the Lolo Creek Watershed
9607703	Protecting and Restoring the Squaw and Papoose Creek Watersheds
9607704	Final Design for Fish Passage Improvements at Eldorado Falls
9607705	Restore McComas Meadows
9608600	Clearwater Subbasin Focus Watershed Program - ISCC
9901400	Restore Anadromous Fish Habitat in the Little Canyon Creek Subwatershed
9901500	Restore Anadromous Fish Habitat in the Nichols Canyon Subwatershed

7.4.4 Habitat Conditions in the Clearwater River Basin in Relation to Coho Salmon Life History Stage

This section describes limiting habitat factors and the impact to each life history stage for coho salmon. Habitat ratings of excellent, good, fair, and poor are also given for each life history stage. It should be noted that information in sections discussing the life history requirements of coho salmon (particularly regarding stream temperature and gradient preferences) suffer from a lack of knowledge specific to Clearwater River Subbasin coho salmon. It is likely that much of the information derived from peer-reviewed literature is most applicable to coastal coho stocks, and hence may be of limited value in defining habitat constraints within the Clearwater River Subbasin.

Table 7-2. Additional Clearwater River Subbasin habitat improvement initiatives expected to benefit coho salmon.

Agency	Location	Purpose
Natural Resources Conservation Service	Mainstem Clearwater River Watershed	Streambank stabilization Sediment reduction Riparian improvement
State of Idaho	Big Canyon Watershed	Cropland erosion control Riparian Improvement
Bureau of Land Management	Mainstem Clearwater River Watershed	Little Canyon Creek fish passage Stream channel restoration Road rehabilitation
Bureau of Land Management	South Fork Clearwater River Watershed	Riparian fencing Planting Rearing channel construction Stream bank stabilization Road rehabilitation
USFS	South Fork Clearwater River Watershed	Channel stabilization Opening new channels Side channel flow improvement Culvert replacement Stream bank stabilization
USFS/NPT	Lochsa River Watershed	Road obliteration
USFS	Lochsa River Watershed	Migration barrier removal Instream structure placement

7.4.4.1 General Habitat Condition

The Clearwater River Subbasin is pristine or near-pristine compared to other large Columbia River tributaries. Production potential for coho within the Clearwater River Subbasin, however, is unknown. The present capacity of some streams within the Clearwater River Subbasin to produce coho salmon has declined since settlement by white emigrants beginning in the 1850's (Parkhurst 1950, Murphy 1962, Murphy and Metsger 1962, USFWS 1962, Espinosa 1992, NPT and IDFG 1990). The extent of habitat decline has varied across the drainage.

Habitat decline affecting coho production is prevalent in mainstem tributaries. Historically, mainstem tributaries such as Lapwai Creek, the Potlatch River, and Big Canyon Creek probably supported a disproportionate population of coho because:

1. L:ower elevation stream likely had warmer winter water temperatures;

2. lower elevation streams, in general, have lower stream gradient which provided favorable conditions for side channels and beaver ponds; and

3. these streams possibly had groundwater seeps and springs providing favorable temperatures for incubation. Table 7–3 describes general stream habitat conditions within the Clearwater River basin.

Table 7–3. Stream habitat conditions within the Clearwater River basin.

Subbasin	Drainage Area (Sq. Miles)	Condition of fish habitat
Mainstem	2,783	The mainstem of the Clearwater River and its tributaries below the South Fork have been degraded to varying degrees by timber harvest, road construction, farming, livestock grazing, rural residential development, and occasional municipal pollution. Stream temperatures and sediment loading have increased and stream flows have decreased due to water withdrawals for irrigation. Mainstem flows are controlled to some degree by releases from Dworshak Dam.
South Fork	1,160	Much of the South Fork subbasin has been degraded by gold mining, timber harvest, road building, livestock grazing and farming. Many low gradient streams were mined before and after construction of the Harpster Dam in 1910.
Selway	2,029	Most of the Selway River subbasin is located within the Selway-Bitterroot Wilderness Area, and fish habitat is generally pristine. Lower portions of the subbasin outside of designated wilderness have experienced some impacts from timber harvest and road construction.
Lochsa	1,185	Much of the Lochsa River subbasin is pristine or near-pristine. Timber harvest and road construction have had some adverse impacts on fish habitat.

7.4.4.2 Stream Flows

Clearwater River Subbasin stream flows are typical for the Snake River basin. Discharge is highest in May and high flows continue into June. Low flows occur in August, September and during very cold winter periods. Figures 7–1 through 7–4 depict average monthly flow near the mouth of the Lochsa, Selway, South Fork, and at Spalding in the mainstem Clearwater River. Flows in the mainstem Clearwater River at Spalding are controlled, to a degree, by the operation of Dworshak Dam. In recent years, as shown in Figure 7–4, flows are lower during the spring run-off, and higher during the August and September periods to aid in the migration of juvenile fall Chinook salmon and adult steelhead in the lower Snake and Clearwater rivers.

Stream flows in the Clearwater River Subbasin are not typical of coastal coho streams. Coastal streams often experience high flow during winter months when eggs and sac fry are in the gravel. High flows during winter months may affect coho salmon eggs and fry in lower Clearwater River Subbasin tributaries such as Lapwai Creek, but these flows do not occur on an annual basis. High winter flows seldom affect coho eggs and sac fry in mid-to-high elevation tributaries. Coho fry are free swimming during periods of high flows in most Clearwater River Subbasin tributaries. Backwaters, side channels, ponds, and instream structures provide sanctuary areas for free swimming coho fry during high water periods.

7.4.4.3 Adult Migration

Adult coho migrate at temperatures above 38˚F (3.3˚C), and migration slows as water temperatures drop below 38˚F (3.3˚C; Cramer and Cramer 1994). For this reason, coho must reach natal streams before stream temperatures fall below 38˚F (3.3˚C). Figures 7–5 and 7–6 depict maximum and minimum stream temperature during the fall adult migration period at Spalding, and Figures 7–7 and 7-8 show stream temperature during the fall adult migration period at Orofino. Flows from Dworshak Reservoir affect stream temperatures in the mainstem Clearwater River. However, stream temperatures in the lower Clearwater River would not discourage adult coho migration. Stream temperatures above the mouth of the North Fork Clearwater River during the last half of November would discourage coho migration. However, coho migration should be completed by mid-November.

7.4.4.4 Spawning and Egg Incubation

The Nez Perce Tribe has collected fairly extensive temperature information in Newsome and Mill creeks which are tributaries of the South Fork. These streams are representative of mid and upper-watershed streams, especially streams in the South Fork subbasin. Figures 7–9 and 7–10 depict average water temperatures in Newsome and Mill creeks from 1990 through 1993. Water temperatures in Newsome and Mill creeks during the coho spawning and egg incubation period are shown on Figure 7–11. Figure 7–8 shows that water temperatures are in the “preferred” temperature range for spawning only during early October. Eggs and sac fry are in a “tolerable” temperature range during much of November, late February, March and into April. Water temperatures, at least in Newsome and Mill creeks, are questionable for the survival of coho. However, ground water seep and spring areas may provide micro-habitats that provide favorable conditions for winter survival. While formal thermal surveys have not been pursued, the presence of a strong groundwater influence is noted in the Lolo Creek watershed (Lolo National Forest 1999). In addition, a number of locations in the South Fork Clearwater River subbasin have Aquatic Landtype Association (ALTA) ratings of 2, 5, or 18 suggesting that groundwater influence is common (Nez Perce National Forest 1997).

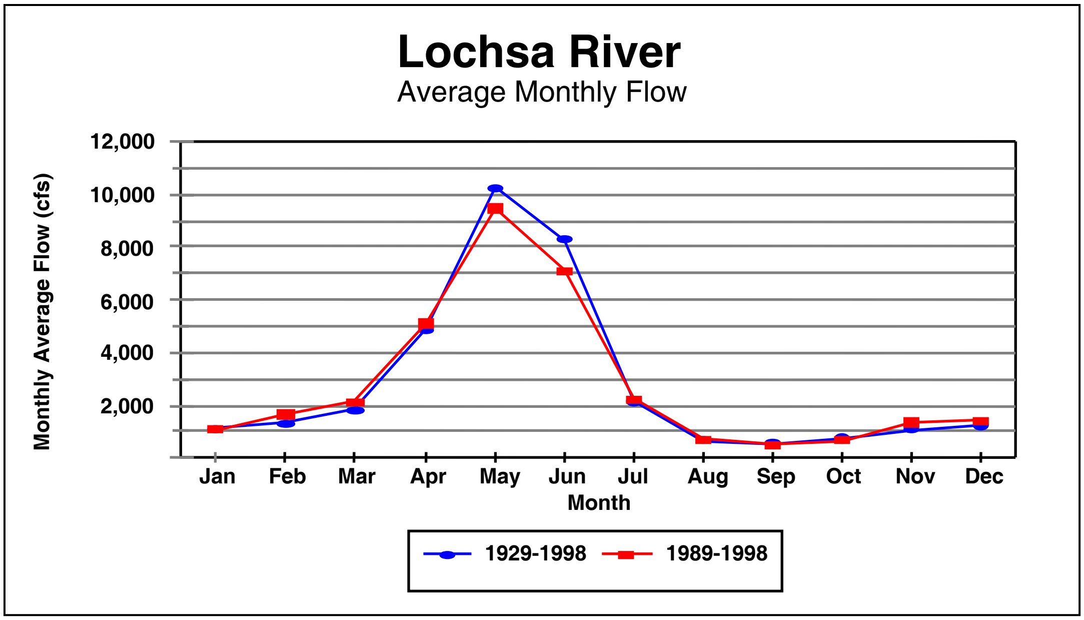

Figure 7-1. Monthly average flow of the Lochsa River at Lowell.

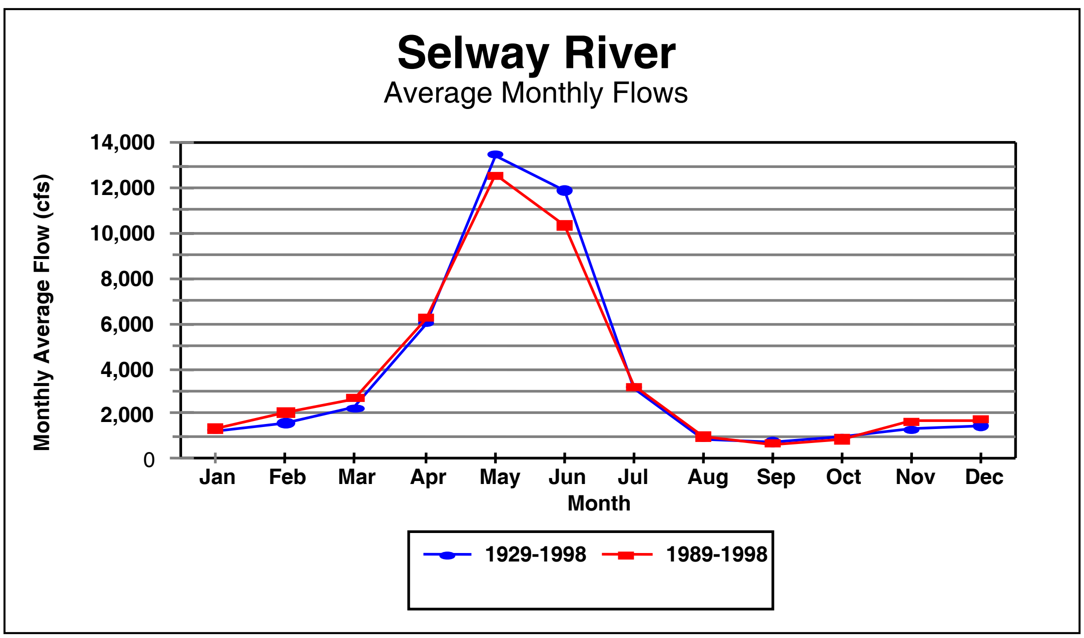

Figure 7-2. Monthly average flow of the Selway River at Lowell.

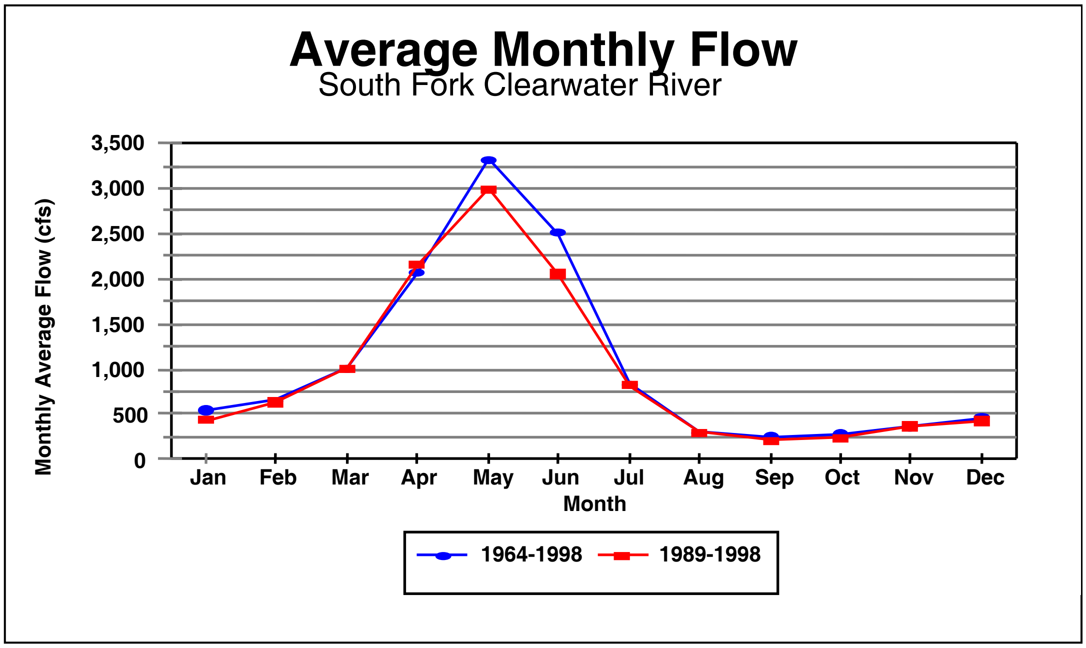

Figure 7-3. Monthly average flow of the South Fork at Stites.

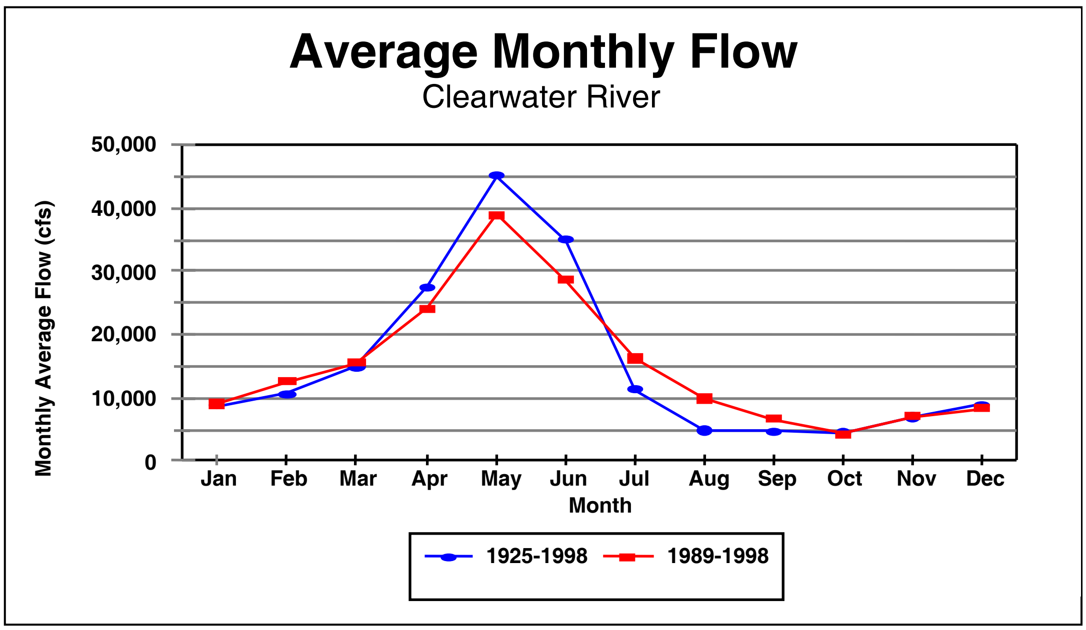

Figure 7-4. Monthly average flow of the Mainstem at Spalding.

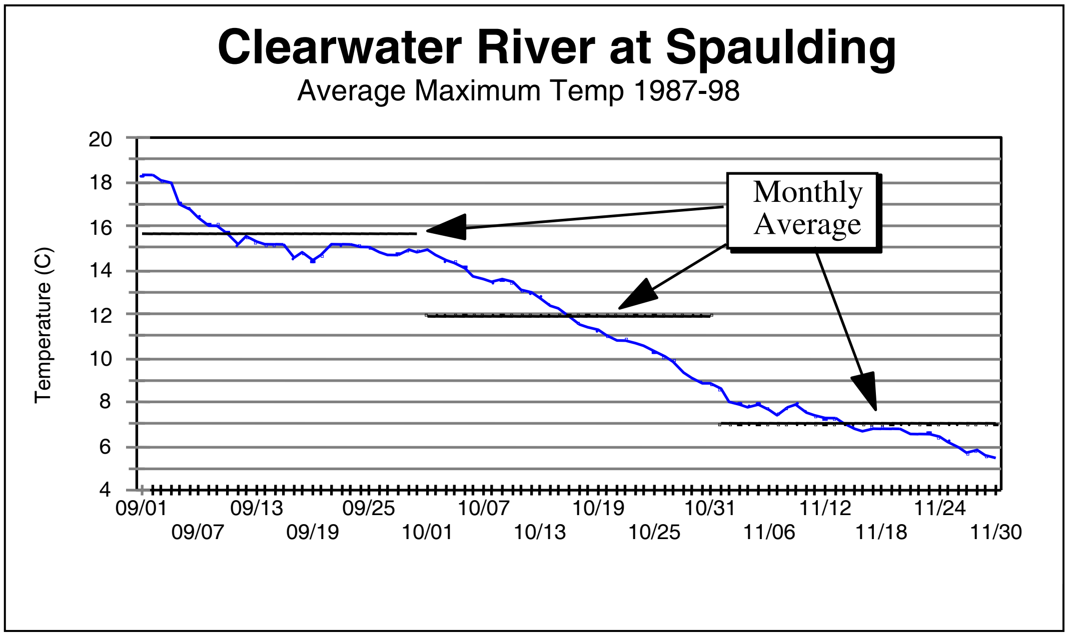

Figure 7-5. Average maximum water temperature in the Mainstem Clearwater River at Spaulding, September 1 through November 30 for an 11 year period.

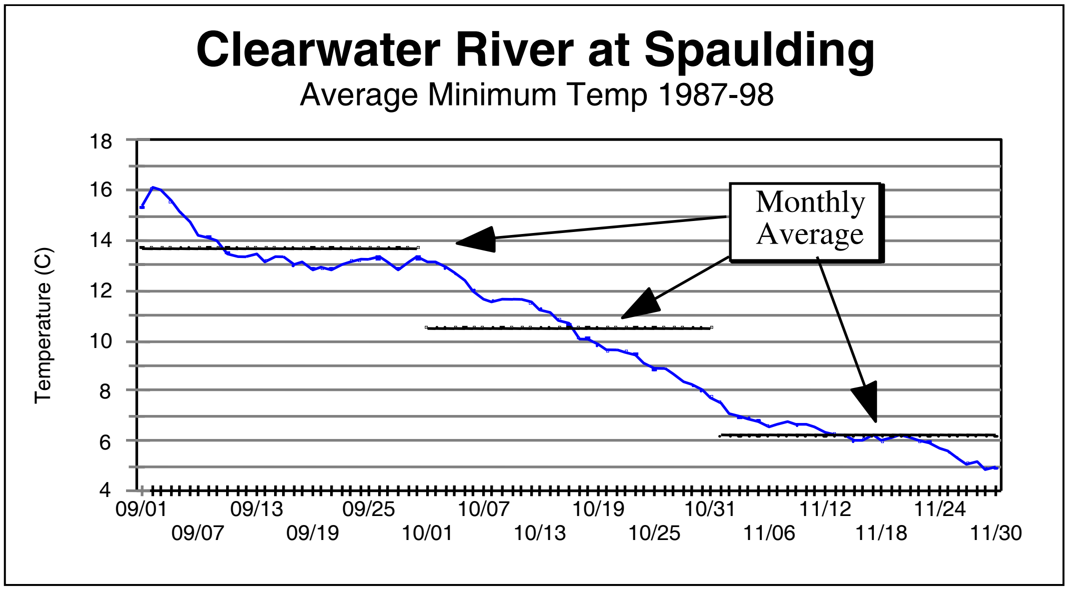

Figure 7-6. Average minimum water temperature in the Mainstem Clearwater River at Spaulding, September 1 through November 30 for an 11 year period.

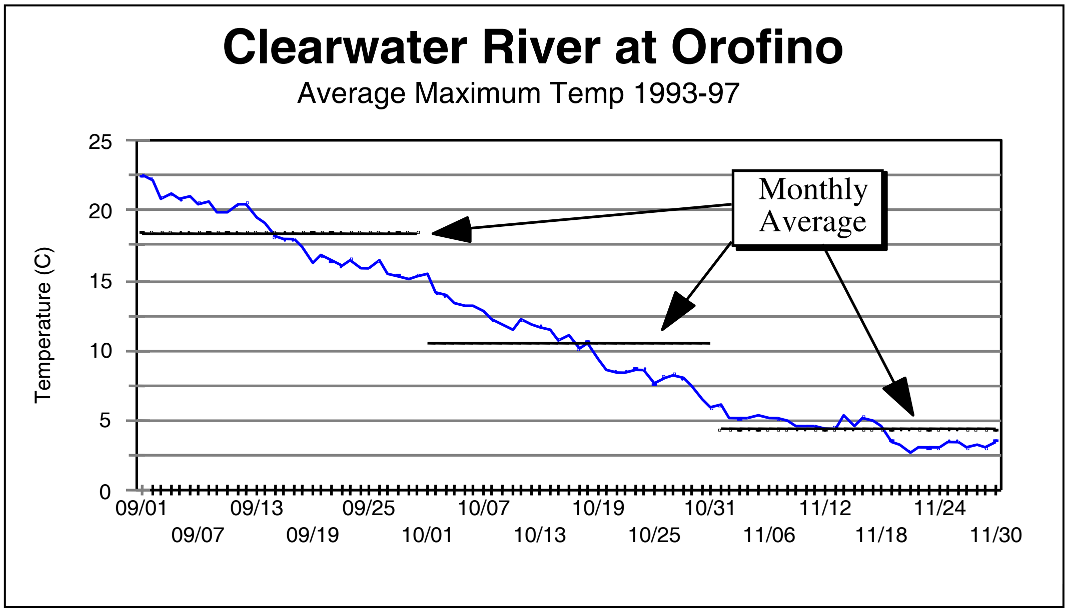

Figure 7-7. Average maximum water temperature in the Mainstem Clearwater River at Orofino, September 1 through November 30 for a 4 year period.

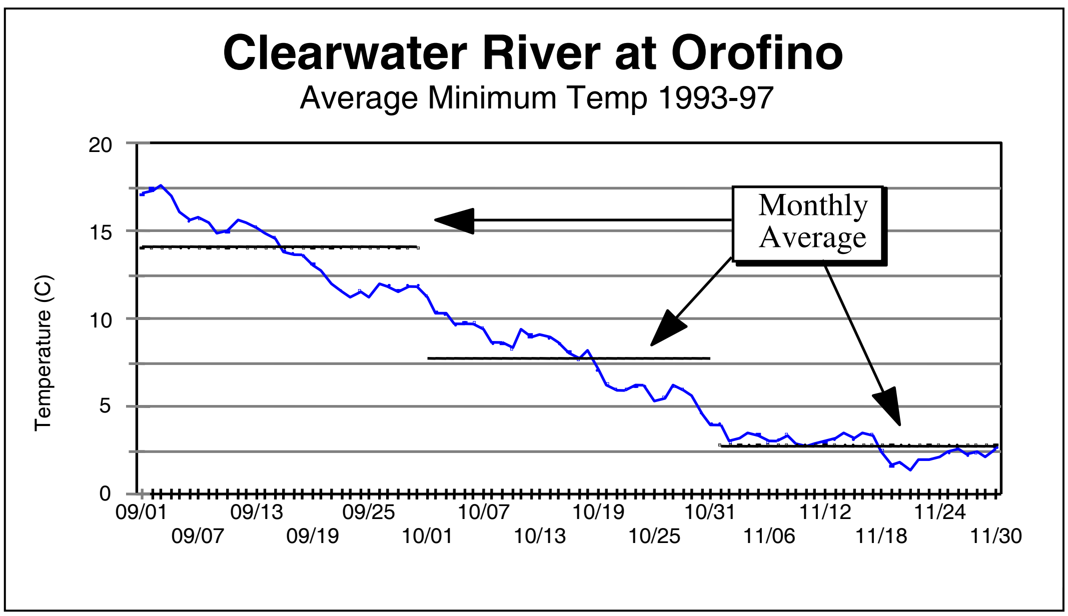

Figure 7-8. Average minimum water temperature in the Mainstem Clearwater River at Orofino, September 1 through November 30 for a 4 year period.

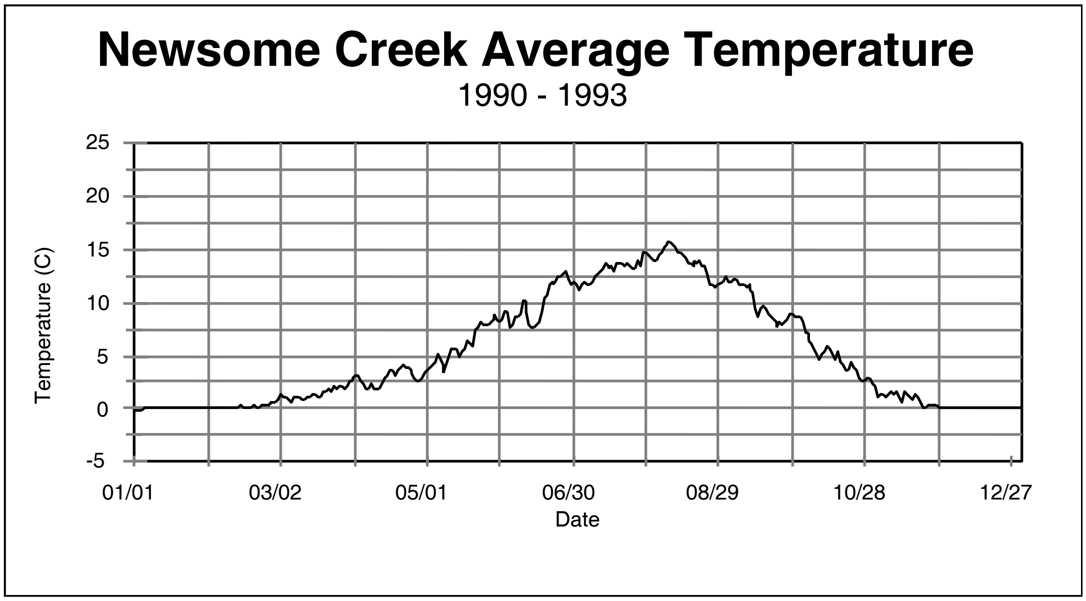

Figure 7-9. Average water temperatures in Newsome Creek during the period 1990 through 1993.

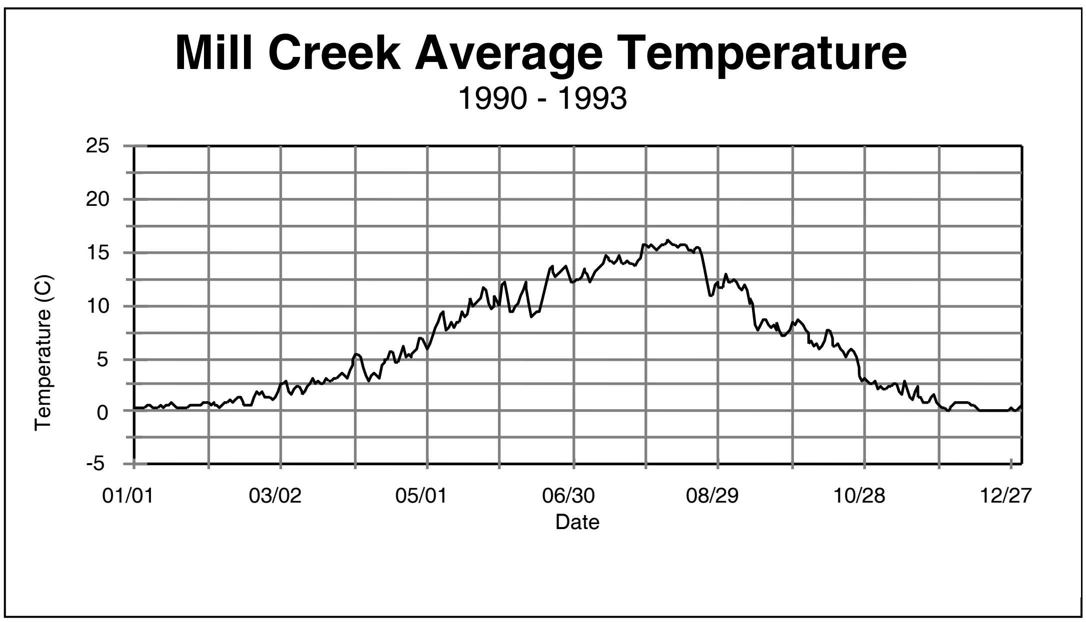

Figure 7-10. Average water temperatures in Mill Creek during the period 1990 through 1993.

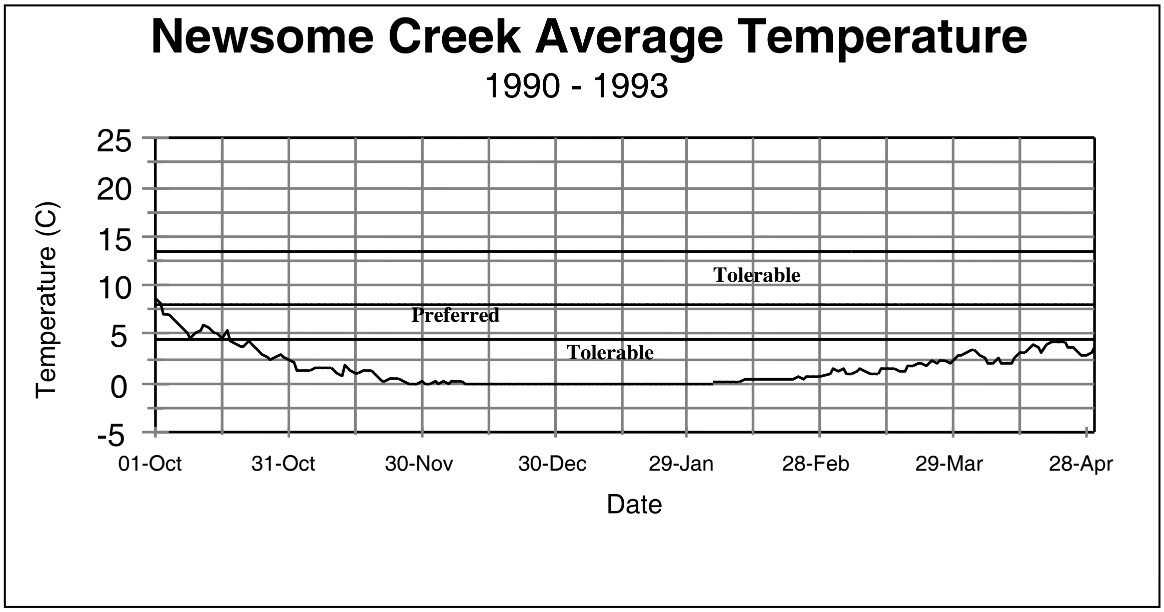

Figure 7-11. Tolerable and preferred temperature ranges for coho salmon.

7.4.4.5 Stream Gradient

Reeves et al. (1989) identifies stream gradient as a major factor controlling coho salmon populations. Streams with gradient of 3% or less are more likely to have side channels, back water areas and a higher pool-to-riffle frequency favored by coho.

Many tributaries of the Selway and Lochsa subbasins have gradients in excess of 3%, however many of these streams have low gradient meadow type habitat in upper reaches that could support coho. Meadow Creek, a tributary of the Selway River, is an example of a stream with meadow type habitat preferred by coho. In the case of Meadow Creek, however, it is questionable whether coho navigate past natural cascades in lower reaches to access the meadow habitat. General observations of stream gradients in the Clearwater River Subbasin suggest that the South Fork of the Clearwater River has more stream reaches with a gradient less than 3% than other Clearwater River Subbasin tributaries.

7.5 Aquatic Species Richness

There are 36 species of fish inhabiting the Clearwater River Subbasin, including 21 native species, three of which have required reintroduction efforts (Tables 7–4 and 7-5; Cichosz *et al.* 2001). Introduced sport or forage species are also found in the Clearwater River Subbasin and primarily include centrarchids, ictalurids, and salmonids (Table 7–6; Cichosz *et al.* 2001).

Table 7-4. Reintroduced native fishes present in the Clearwater River Subbasin.

Common Name	Scientific Name
Chinook Salmon (Spring)	*Oncorhynchus tshawytscha*
Chinook Salmon (Fall)	*Oncorhynchus tshawytscha*
Coho Salmon	*Oncorhynchus kisutch*

Table 7-5. Native fishes of the Clearwater River Subbasin.

Common Name	Scientific Name
Pacific Lamprey	*Lampetra tridentata*
Steelhead/Redband Trout	*Oncorhynchus mykiss*
Westslope Cutthroat Trout	*Oncorhynchus clarki lewisi*
Bull Trout	*Salvelinus confluentus*
Mountain Whitefish	*Prosopium williamsoni*
Northern pikeminnow	*Ptychocheilus oregonensis*
Chiselmouth	*Acrocheilus alutaceus*
Peamouth	*Mylocheilus caurinus*
Longnose Dace	*Rhinichthys cataractae*
Speckled Dace	*Rhinichthys osculus*
Redside shiner	*Richardsonius balteatus*
Largescale sucker	*Catostomus machrocheilus*
Bridgelip Sucker	*Catostomus columbianus*
Sandroller	*Percopsis transmontana*
Mottled Sculpin	*Cottus bairdi*
Shorthead sculpin	*Cottus confusus*
Paiute sculpin	*Cottus beldingi*
Torrent sculpin	*Cottus rhotheus*

Table 7-6. Exotic fishes present in the Clearwater River Subbasin.

Common Name	Scientific Name
Rainbow Trout	*Oncorhynchus mykiss*
Kokanee	*Oncorhynchus nerka*
Brook Trout	*Salvelinus fontinalis*
Golden Trout	*Salmo aguabonita*
Arctic Grayling	*Thymallus arcticus*
Tiger Muskie	*Esox lucius x E. masquinongy*
Carp	*Cyprinus carpio*
Channel catfish	*Ictalurus natalis*
Black Bullhead	*Ictalurus melas*
Brown bullhead	*Ictalurus nebulosus*
Smallmouth bass	*Micropterus dolomieu*
Largemouth bass	*Micropterus salmoides*
Bluegill	*Lepomis macrochirus*
Pumpkinseed	*Lepomis gibbosus*
Black crappie	*Pomoxis nigromaculatus*
Yellow Perch	*Perca flavescens*

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Appendix A: Project Management – Recommendations of the APRE (Council Document 99-15, NPCC 1999)

The Artificial Production Review (APR; NPCC 1999) recommends 10 guidelines for the management of artificial production facilities. The following paragraphs detail how these principles were applied in the compilation of this Master Plan.

1. "The manner of use and the value of artificial production must be considered in the context of the environment in which it will be used."

The primary goal of this program is the re-establishment of naturally spawning aggregates of coho salmon within targeted historical coho habitat. This program recognizes that the primary cause for the demise of coho salmon in the Clearwater River Subbasin was the construction of the Harpster and Lower Clearwater Dams, however overfishing and habitat degradation likely contributed to substantial reductions in abundance prior to extirpation. While the Harpster and Lower Clearwater Dams have been removed, eight mainstem hydropower facilities as well as Dworshak Dam have been constructed that will continue to impose mortality on Clearwater River Subbasin coho salmon during both juvenile emigration and adult immigration. Nonetheless, reintroduction efforts to date have indicated that hatchery production can result in a replacement rate greater than one (Section 6.2). Habitat degradation and harvest will continue to impact the survival of Clearwater River Subbasin coho, and it is unknown whether these impacts in addition to dam related mortality will allow sustainable natural production. The success of this program relies on recent and ongoing extensive habitat restoration efforts (Section 7.4). Targeted fisheries for coho do not currently exist within the Clearwater River Subbasin. However, incidental and direct ocean and in-river harvest will impact Clearwater River Subbasin coho. Estimating the effects of harvest is a key component of the RM&E plan for the coho project (Chapter 5).

This project views artificial propagation as a means to offset mortality in the egg to presmolt or smolt life history stage to compensate for mortality at later life history stages. As such, hatchery production will be unlikely, on its own, to successfully achieve restoration. The indicators of success and failure, as well as the triggers for implementation of Phase II explicitly recognize that program success relies on survival rates throughout the life cycle of the fish. Therefore these indicators and triggers focus on life cycle productivity (Section 3.6).

2. "Artificial production must be implemented within an experimental, adaptive management design that includes an aggressive program to evaluate benefits and address scientific uncertainties."

Very little is known regarding the historical abundance, distribution, and habitat requirements of Clearwater River Subbasin coho salmon. As such, this project is based on an adaptive management framework that uses limited initial releases of juvenile coho salmon in natural production areas that can be closely monitored to estimate adult escapement, juvenile production, productivity, and interspecific competitive impacts. The results of limited releases in targeted habitat will guide the number and distribution of juvenile releases in Phase II of the program, which focuses directly on supplementation.

Program benefits will be measured as nutrient enrichment (number and distribution of carcasses), adult escapement past LGD, tributary specific escapement, and eventually harvest. Risks such as disease transmission and interspecific competition and predation are specifically addressed in the RM&E program (Chapter 5).

3. "Hatcheries must be operated in a manner that recognizes that they exist within ecological systems whose behavior is constrained by larger-scale basin, regional, and global factors."

Currently, this program relies on four separate hatcheries and one satellite acclimation facility for spawning, rearing, and acclimation (Section 3.2). While reliance on facilities operated by multiple agencies introduces uncertainty to the program, it also ensures that co-managers are involved at every stage of planning.

4. "A diversity of life history types and species needs to be maintained in order to sustain a system of populations in the face of environmental variation."

The NPT Clearwater River Subbasin coho reintroduction program is based on the fact that coho salmon were a natural and important contributor to ecosystem processes within the Clearwater River Subbasin (Section 2.3). Reintroduction of coho salmon, if successful, will increase species diversity.

5. "Naturally selected populations should provide the model for successful artificially reared populations, in regard to population structure, mating protocol, behavior, growth, morphology, nutrient cycling, and other biological characteristics."

Unfortunately, there are no sources of Clearwater River Subbasin or even Snake River coho for use as broodstock. One of the greatest uncertainties associated with this effort is the reliance on hatchery origin coho salmon production from Lower Columbia River (LCR) hatcheries. However, the reintroduction is structured to take advantage of the beneficial effects of natural selection as a means to foster the emergence of a "localized" stock of coho salmon. To do so, the program will utilize adult returns from first generation LCR smolt transfers as broodstock. In turn, progeny from this broodstock will be used to supplement targeted coho habitat within the Clearwater River Subbasin. This strategy is intended to maintain genetic exchange with LCR source stocks in order to minimize the random loss of genetic variation, while at the same time employing only the progeny of adults that have successfully returned to the Clearwater River Subbasin as broodstock for supplementation activities.

6. "The entities authorizing or managing a production facility or program should explicitly identify whether the artificial propagation product is intended for the purpose of augmentation, mitigation, restoration, preservation, research, or some combination of these purposes for each population of fish addressed."

This program, if successful, will serve multiple purposes. Initially (Phase I), this program will focus on broodstock development. Once a localized broodstock is available, Phase II will be triggered, wherein the emphasis of the program will shift towards restoration. If supplementation activities are successful at establishing sustainable natural production (defined as adult to adult replacement equal to or greater than one), hatchery efforts will either cease, or be reprogrammed to serve a harvest function.

7. "Decisions on the use of the artificial production tool need to be made in the context of deciding on fish and wildlife goals, objectives and strategies at the subbasin and province levels."

Initially, Clearwater River Subbasin reintroduction efforts were possible as a result of a regional evaluation of LCR coho production through the U.S. v. Oregon forum. Mangers agreed that LCR coho production could appropriately be used in upriver areas. This agreement fits very well within the context of the recent APRE review (NPCC 2003) that suggests:
"Hatcheries could be used to enhance biodiversity by producing a wider variety of salmonid species and life histories. Greater species and life history diversity makes sense ecologically and could provide greater harvest opportunities by enhancing adult returns over a longer time period."

The APRE also points out inequities in production that are particularly apparent for coho salmon:

> *"A sizeable majority of Columbia River Basin hatchery production takes place in the lower three provinces. Unfortunately, the communities most affected by the construction of the dams do not share equally in this production."*

The Clearwater Subbasin Plan (EcoVista 2002), lists an escapement goal of 14,000 adult coho past Lower Granite Dam. This number is consistent with the Tribal Restoration Plan (CRITFC 1996)

8. "Appropriate risk management needs to be maintained in using the tool of artificial propagation."

Several risks/uncertainties have been identified in the drafting of the Master Plan. Of greatest concern is the potential for coho reintroduction activities to undermine efforts to restore spring Chinook, steelhead, and bull trout populations within the Clearwater River Subbasin. Recent experimental evidence from Yakama Nation coho reintroduction in the mid-Columbia (Section 6.3) suggests that interspecific competition and predation between coho and spring Chinook and steelhead are unlikely to be deleterious. Nonetheless, the RM&E program (Chapter 5) includes specific measures to determine whether the health of spring Chinook salmon and steelhead are negatively effected by the reintroduction of coho. Unfortunately, few data exist to predict the effect of coho reintroduction on sympatric bull trout populations. However, the USFWS expressed the following views regarding coho reintroduction in the upper Columbia (USFWS 2001):

> *"It is generally felt that this supplementation program will not impact bull trout stocks and will likely benefit bull trout and other resident fish. Historically, bull trout probably benefited from the presence of anadromous salmonids. The downstream drift of eggs released from spawning salmon provided food for bull trout and other resident fishes, but more importantly the presence of decaying salmon carcasses greatly benefited juvenile salmon and resident fishes thru nutrient recycling. Generally, in drainages colonized by natural anadromous salmon and steelhead populations the bull trout have successfully co-existed."*

Nonetheless, the same document also urges a cautionary approach to the reintroduction of coho salmon in habitat occupied by bull trout:

> *"…in many areas where bull trout currently exist, habitat conditions have deteriorated and natural predator-prey balances have been upset. Bull trout populations are at or near critically low levels in many areas of the basin. For this reason caution should be exercised in stocking large numbers of hatchery fish near bull trout spawning and rearing areas to avoid the potential for competition or predation on bull trout fry."*

9. "Production for harvest is a legitimate management objective of artificial production, but to minimize adverse impacts on natural populations, harvest rates and practices must be dictated by the requirements to sustain naturally spawning populations."

If this program is successful in establishing sustainable natural production of coho salmon within the Clearwater River Subbasin, it is likely that a harvest program will be investigated. There is no detail in his document regarding the scope of harvest, which is a deliberate omission as data are unavailable to estimate the success of natural coho production in the Clearwater River Subbasin. However, in the event that a harvest component is deemed feasible, maintenance of sustainable natural production will remain the highest program priority.

10. "Federal and other legal mandates and obligations for fish protection, mitigation, and enhancement must be fully addressed."

The relationship of the proposed program to existing legal and conservation mandates is established in Tables 1-1 and 1-2. In addition to consistency with these mandates, this program, if successful, will serve a mitigation mandate that has not been achieved to date - the reintroduction of coho salmon to historically occupied habitats of the Clearwater River Subbasin.

This mandate has a legal basis in treaties signed between the federal government and the NPT (see Section 2.4), as well as a scientific basis established under principle seven above.