Yakima Coho Master Plan

Prepared by

Yakama Nation
in cooperation with
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1. BACKGROUND

1.1 Yakima/Klickitat Fisheries Project

The Yakima Coho Project is a component of the Yakima/Klickitat Fisheries Project (YKFP). Section 1 summarizes overall YKFP goals and management philosophy, which guides projects relating to all target species in the two basins, including Yakima coho. Section 2 discusses goals and history to date of the Yakima Coho Project specifically.

The YKFP is a project designed to use artificial propagation in an attempt to re-establish, supplement, or increase natural production and harvest opportunities of anadromous salmonids while maintaining the long-term fitness of the target population, and while keeping ecological and genetic impacts on non-target species within specified limits. The planning, implementation, and evaluation of this project is guided by the framework developed by the Regional Assessment of Supplementation Project (RASP 1992). The YKFP is also an experiment to resolve uncertainties associated with supplementation. As a “laboratory,” the YKFP will help determine the role of supplementation in increasing natural production of anadromous salmonids. Both controlled experiments and basic monitoring contribute information.

Consistent with the Pacific Northwest Power Planning Council’s (NPPC) Fish and Wildlife Program (NPPC 1994), the objectives of the YKFP are to:

- Enhance existing stocks of anadromous fish in the Yakima and Klickitat river basins, while maintaining genetics and ecological resources.
- Reintroduce stocks formerly present in the basins.
- Apply the knowledge gained through supplementation throughout the Columbia River Basin.

Overall Project objectives are achieved while adhering to all relevant environmental laws and regulations, including National Environmental Policy Act (NEPA) and Endangered Species Act (ESA) requirements.

1.2 Adaptive Management and Project Planning

The YKFP endorses an adaptive management policy, which allows for Project objectives and strategies to change as new information becomes available from Project experiments, monitoring and evaluation, and literature reviews.

The Project initially established an annual process that required, for each target species, preparation and subsequent updates of an overall long-range plan (Planning Status Report [PSR]) and a second plan for resolving uncertainties (Uncertainty Resolution Plan [URP]). Progress and results of uncertainty resolution work were reported in annual project reports and/or in project completion reports, which were peer-reviewed and discussed at an annual meeting (Project Annual Review [PAR]). Following the PAR, research and monitoring plans were reviewed and revised as necessary, subject to policy review.

Annual preparation of the two plans became difficult to accomplish along with the many other plans, reports, and analyses required by funding and regulatory agencies. Early in 2002, YKFP and BPA managers agreed that master plans for each species targeted by the YKFP would replace the PSRs and URPs. Master plans will follow content guidelines from the NPPC.

The annual meeting to review study progress and results will continue, as will adaptive management in response to this peer review. The difference will be that instead of two long-range plans being expected annually, amendments to the master plan will be provided only if substantive changes are made to production, research, or monitoring goals or methods. Annual written reports on study progress and results will continue.

2. YAKIMA COHO PLANNING HISTORY

Wild stocks of coho salmon (*Oncorhynchus kisutch*) were once widely distributed within the Columbia River Basin (Fulton 1970; Chapman 1986). However, coho salmon probably became extinct in the Yakima River in the early 1980s (YN 1997). For this reason, efforts to restore coho within the Yakima basin rely largely upon releases of hatchery coho because wild stocks do not exist to supplement. Hatchery coho releases began in the Yakima basin in 1983 with the first release of 324,000 Little White Salmon hatchery smolts. At that time, the program was primarily for harvest augmentation.

The four Columbia River Treaty Tribes (Nez Perce, Umatilla, Warm Springs, and Yakama) identified coho reintroduction in the mid-Columbia region as a priority in the *Wy-Kan-Ush-Mi-Wa-Kish-Wit* document, commonly referred to as the Tribal Restoration Plan (TRP) (CRITFC 1995). It is a comprehensive plan put forward by the Tribes to restore the Columbia River fisheries (Blodgett and Dunnigan 2001a).

In 1996, Bonneville Power Administration (BPA) completed an environmental impact statement on the proposed Yakima Fisheries Project. The Project proposed to include the Yakima basin's coho program, but to expand its scope to include research into the feasibility of re-establishing a self-sustaining coho population (BPA et al. 1996). A Draft Coho PSR, prepared by the Yakama Nation in 1997 (YN 1997), described the overall long-range plan, as well as objectives, strategies, and assumptions; and it provided a full report of research results on coho to that point. Due to difficulties getting it reviewed outside YN, it was never finalized.

In spring of 1999, environmental effects of additional proposed YKFP activities, including those for coho, were reviewed in three separate documents: Biological Assessment on Bull Trout for the Yakima/Klickitat Fisheries Project 1999-2004 (BPA et al. 1999a); Biological Assessment on Mid-Columbia River Steelhead for the Yakima/Klickitat Fisheries Project 1999-2004 (BPA et al. 1999b); and Yakima/Klickitat Fisheries Project Supplement Analysis (BPA 1999). The YKFP program, including the coho component, has also been the subject of NPPC provincial reviews which include critique by the Independent Scientific Review Panel. Study results have been published in Dunnigan and Hubble 1998; Dunnigan 1999; Dunnigan 2000; Dunnigan and Lamebull 2000; and Dunnigan 2001.

The Yakima Basin Subbasin Summary was prepared in 2001 (Berg and Fast 2001). The YKFP coho program is included in that summary, which also appended a Hatchery and Genetics Management Plan (HGMP) for coho production in the basin. An updated version of the draft

1997 coho PSR was prepared in 2001 (YN 2001a), but again, the length of time taken for reviews made it out of date before it could be completed.

This master plan builds on and is consistent with all these previous documents.

There are no other coho-specific activities in the Yakima basin. However, YN and Washington Department of Fish and Wildlife (WDFW) are conducting a similar coho reintroduction feasibility study in the Wenatchee and Methow basins. Research results are shared among all participants and agency advisors for these projects, and the results inform decisions about further research needs and project directions. In addition, habitat improvements and enhancements being undertaken by various entities in the Yakima basin and on the Columbia mainstem can only improve the potential for success of the coho reintroduction effort.

3. YAKIMA COHO GOALS, OBJECTIVES, AND STRATEGIES

The Yakima Coho Project is planned in two phases. The first phase is the "feasibility phase" and the second, the "implementation phase."

The goal of Yakima Coho Project feasibility studies is to determine the feasibility of re-establishing a naturally spawning coho population and a significant fall fishery for coho within the Yakima River Basin, while keeping adverse ecological impacts within specified limits.

When warranted by the results of feasibility studies, the YKFP's Policy Group will determine whether to propose an implementation phase and, if so, whether it should consist of supplementation of naturalized populations, harvest augmentation, or some other kind of production program. This proposal would be subject to a number of review processes, including a Northwest Power Planning Council step review, as well as NEPA, ESA, and other review and approval processes, depending on the proposal's scope and funding sources. It is expected, however, that any long-term proposal would be consistent with YKFP goals. The decision in the case of *U.S. v. Oregon* and its associated Columbia River Fisheries Management Plan (CRFMP) also provide over-arching guidance to Yakima Coho Project activities.[1]

Although many project activities may be similar in both the feasibility and implementation phases, to discuss the implementation phase now would be premature. Therefore, this master plan addresses the feasibility phase exclusively.

3.1 Feasibility Phase

The feasibility of re-establishing coho in the Yakima Basin may initially rely upon the resolution of two central issues: the adaptability and survival rates of a domesticated lower Columbia River coho stock used in the reintroduction efforts, and the ecological risk to other species associated with coho reintroduction.

Initially, project managers expected that feasibility studies would run through 2003 or 2004; they defined a complex set of objectives, with strategies to meet the objectives. While study results

[1] Among other things, the CRFMP sets production and release numbers for several salmon species throughout the region, including coho. Its focus is harvest augmentation. The most recent CRFMP expired in 1999. When it is re-negotiated and adopted (currently expected by the end of December 2003), the Yakima coho plan will be adjusted, if necessary, to be consistent with the CRFMP.

show some success in meeting initial objectives, they also indicate that a number of questions remain to be answered before a clear determination can be made that a naturally reproducing population can be established. As a result, the project proposes to continue feasibility studies through at least 2007 and to revise the goals and objectives to help answer those questions. In effect, the feasibility studies will be divided into **Phase 1A** (ending in 2003) and **Phase 1B** (ending in approximately 2007).

The remainder of Section 3 is organized as follows:

- Section 3.2 describes feasibility phase activities in general terms.
- Section 3.3 summarizes project objectives as defined in the 2001 draft PSR. Each objective was refined with an extensive list of strategies, or tasks, that were designed to accomplish those objectives. They guided the feasibility phase activities for what we are now calling **Phase 1A**, which is expected to be completed in December 2003. The strategies are not repeated here (see YN 2001a); however, brief results of the studies based on those strategies are reported in Section 5.
- Section 3.4 outlines objectives and strategies proposed for what we are calling **Phase 1B,** currently proposed to begin in 2004. They refine those that guided the initial feasibility studies, based on results to date. It also contains two tables (Tables 1 and 2) which **summarize** activities proposed for this phase. **Phase 1B activities and their risks are fully described in Section 6 of this master plan.**

3.2 Feasibility Phase Activities (General Description)

In general, feasibility activities fall into five categories:

A. Define success

B. Optimize survival/performance of hatchery coho

C. Monitor ecological interactions

D. Identify suitable and critical coho habitat

E. Develop facilities for program activities

A. Define success. The definition of success for the feasibility phase depends on the balance between two major and potentially competing factors: 1) establishing naturalized coho populations while 2) minimizing risks to other species. Factor 1 will be deemed a success if analysis of empirical data indicates that naturalized populations of coho are at or above the replacement level (basin-wide productivity (P) >= 1.0) for a number of generations. Factor 2 will be considered a success if the coho program does not cause impacts on non-target species to exceed specified levels (see Table 7, Section 5).

B. Optimize survival/performance of hatchery coho. Success of the effort to re-introduce coho into the Yakima River relies on the use of hatchery fish to develop naturalized spawning populations. The hatchery coho must return in sufficient numbers as adults to either spawn naturally or to be spawned in a hatchery. Acclimation and release strategies and broodstock collection and mating protocols are key aspects to meeting this objective.

C. Monitor ecological interactions. For the coho program, biologists from YN and WDFW identified Non-Target Taxa of Concern (NTTOC) and impact containment levels for those species (see Table 7, Section 5), similar to those for the spring chinook program. These levels were changed slightly for Phase 1B activities (see Tables 9 - 12, Section 6). Risk containment levels vary with the sensitivity of each species to impact, its importance in the region, and other factors. When monitoring and evaluation suggest that NTTOC populations are declining in areas of coho concentration, studies would be implemented to determine whether coho might be the cause of the decline.

D. Identify suitable and critical coho habitat. A major objective during the feasibility phase is to identify tributaries and mainstem reaches capable of supporting self-sustaining populations of naturalized coho.

E. Develop facilities for program activities. During the feasibility phase, the project will use existing facilities as much as possible for broodstock collection, incubation/rearing, acclimation/release and juvenile and adult monitoring. However, additional acclimation, fish culturing, broodstock collection, or monitoring facilities might be needed or, in some cases, existing facilities might need to be retrofitted. Improvements to existing facilities would be based on the need to fulfill the proposed experimental protocol. Additional facilities proposed for feasibility studies emphasize limited development of sites, and temporary or portable structures wherever possible.

One aspect of determining overall program feasibility requires evaluating facility needs should a long-term program be implemented. While no formal proposals have been developed for a long-term program, staff would review existing literature on such factors as water quality, quantity and availability for more permanent production and acclimation facilities. Existing facilities, proposed improvements, and studies of long-term facility needs are described in Section 6.

3.3 Objectives of Feasibility Phase 1A

The initial PSR (YN 1997) for this project defined the following objectives for the feasibility phase.

- Determine the feasibility of re-establishing a sustainable, naturally spawning coho population in the Yakima Basin with sufficient productivity to sustain a meaningful in-basin fishery in most years.
- Optimize production of naturalized populations of coho with respect to abundance and distribution.
- Minimize adverse impacts of coho reintroduction on Non-Target Taxa of Concern (NTTOC).
- Limit losses of wild and hatchery coho smolts to native and exotic predators to levels that do not significantly limit coho production potential.
- Establish a Yakima River coho stock with heritable life history traits adapted to the Yakima River Basin.
- Expand harvest opportunities for treaty Indian and sport fisheries inside and outside of the Yakima River Basin while meeting objectives for genetics, experimentation, natural production, and ecological interactions.

As the project progressed, the scope of these objectives was refined to focus on five key questions:

1) Which geographical area is better suited for natural coho production: the upper Yakima basin or the Naches basin?
2) What acclimated smolt release timing (early or late) provides the best smolt-to-smolt and smolt-to-adult survival?
3) Which broodstock (out-of-basin vs. local) has the highest productivity?
4) To which parts of the basin do adult coho return?
5) What is the existence and biological significance of impacts to populations of NTTOC identified as being at demonstrable risk from ecological interactions with coho?

Study results related to these objectives are briefly summarized in Section 5; full results are described in the cited reports. Section 2 contains a complete list of relevant reports.

3.4 Objectives and Strategies: Feasibility Phase 1B

For this phase, we include objectives we expect to accomplish by approximately 2007 (brood years 2002-04), as well as strategies proposed to achieve the objectives. The methods for each strategy, as well as their environmental and project risks, are described in Section 6.

Objective 1. Attempt to establish naturally producing coho populations in the upper and lower Yakima River and tributaries, and in the Naches River and tributaries.

> **Strategy 1a.** Continue acclimated smolt releases in the mainstem of the upper Yakima and Naches rivers, including early-run and late-run stocks.
>
> **Strategy 1b.** Test survival of smolts released in upper Yakima tributaries.
>
> **Strategy 1c**. Test over-winter survival (parr-smolt survival) by releasing coho parr in selected tributaries to the Yakima and Naches rivers.
>
> **Strategy 1d.** Test egg-fry survival, adult productivity, and interactions with NTTOC by releasing adult coho in selected tributaries to the Yakima and Naches rivers.
>
> **Strategy 1e.** Transition from use of hatchery/Lower Columbia origin coho to natural/ Yakima origin coho broodstock as quickly as possible.
>
> **Strategy 1f.** Monitor and evaluate factors that will determine when a self-sustaining and naturally producing population of coho is re-established in each subbasin, including adult productivity, egg-fry survival, over-winter (parr-smolt) survival, smolt-smolt survival, and smolt-adult survival.

Objective 2. Continue to investigate the coho life history in the Yakima basin.

> **Strategy 2a.** Conduct spawner surveys throughout the Yakima basin.
>
> **Strategy 2b.** Determine, in general terms, where coho currently are found in the basin and their abundance.
>
> **Strategy 2c.** Determine life history timing (i.e., summer and fall parr and smolt out-migrants).

Objective 3. Assess ecological interactions.

Strategy 3a. Study coho residualism in release locations where steelhead also are found.

Strategy 3b. Study interactions between natural-origin coho or surrogates and other salmonids.

Objective 4. Develop and test use of additional culturing, acclimation and monitoring sites.

Strategy 4a. Develop additional acclimation sites in the upper Yakima River subbasin (Holmes, Boone Pond, and Taneum Creek).

Strategy 4b. Establish additional monitoring sites in the Yakima and Naches subbasins.

Strategy 4c. Test use of a small-scale fish culturing facility (La Salle High School on Ahtanum Creek).

Objective 5. Determine long-term facility needs.

Strategy 5a. Investigate potential permanent spawning and incubation/rearing sites more suitable than Prosser for coho.

Strategy 5b. Investigate the feasibility/desirability of establishing permanent, fixed acclimation sites in the upper Yakima, Naches, or other subbasins.

Table 1 summarizes the activities proposed to accomplish the objectives and strategies. Further detail on the releases is provided in Table 2. Appendix A provides detail on broodstock collection protocols and projections of numbers to be collected.

Table 1. Activities Proposed for Yakima Coho Project (YKFP), Phase 1B

Activity	Location, Numbers, Timing
Hatchery broodstock development - existing	- Prosser Hatchery: 0 - 500,000 smolts - Lower Columbia River hatcheries: 500,000 – 1 million fry/smolts
Small-scale culturing (eyed-summer parr) - new	- Ahtanum: LaSalle High School (RM 2); 30,000; to summer parr
Acclimated volitional smolt releases from mainstem sites (smolt-smolt survival studies)	1,200,000 annually • Early run 450,000 Upper Yakima • Early run 450,000 Naches • Late run 100,000 Upper Yakima • Late run 100,000 Naches
Acclimated volitional smolt releases from new tributary sites (smolt-smolt survival, late-run/early-run survival studies)	42,000 annually • 40,000 Taneum Cr. • 1,250 Keechelus-Easton Reach Beginning late March
Parr releases – scatter plant (over-winter survival studies)	3,000 each site, 24,000 total annually, in July[2] - Upper and lower Yakima • Crystal Springs/Easton-Keechelus Reach • Big Cr. • Wilson Cr. • Toppenish Cr. • Ahtanum Cr. - Naches • N. Fork Little Naches • Salmon Falls-S. Fork • Nile Cr. • Little Rattlesnake Cr.
Adult releases (egg-fry survival, adult productivity, and NTTOC studies)	20 pairs each site, except Taneum Cr. (see Table 2), in fall - Upper and lower Yakima • Taneum Cr. • Wilson Cr. • Reecer Cr. • Ahtanum Cr. • Toppenish Cr. - Naches • Pileup Cr. • Nile Cr.
Acclimation sites – existing	- Upper Yakima: Easton Ponds (RM 201); Clark Flat (RM 164) (use only as alternatives to new upper Yakima mainstem sites) - Naches: Lost Creek Pond (RM 39) and Stiles Pond (RM 9)
Acclimation sites - new mainstem	- Upper Yakima: Holmes site (RM 160) and Boone Pond (RM 180.5) Roza Dam (RM 128) (use as alternate only)
Broodstock collection – existing sites	Prosser, Roza, and Cowiche dams. Collect no more than 50% natural origin, 75% hatchery origin returns. See Appendix A. Oct 1–Dec 15

[2] All parr releases would be PIT tagged. If numbers prove too small for reliable estimates of survival, releases would be increased, probably to no larger than 5,000 per group.

Table 1 (continued)

Activity	Location, Numbers, Timing
Radio-telemetry	Tag up to 100 adults and track from jet boats and autos and at fixed dam sites (Prosser 50, Cowiche 25, Roza 25). Mid-Sep through Nov
Spawning surveys (foot/boat)	- Mainstem Yakima (Keechelus Dam to Granger) - Mainstem Naches (Little Naches to confluence) - Release tributaries Sep 15–Nov 30
Juvenile collection/rotary trapping - existing traps	- Roza Dam juvenile trap: Up to 3,000 Yakima River naturally produced winter migrants will be PIT tagged (Nov-Mar) - CJMF: Count, measure, PIT tag up to 3,000 coho (Nov 15–Jul 15) - Ahtanum Cr. rotary trap (RM 0.75) Nov 1–Jun 30 - Toppenish Cr. rotary trap (RM 26.5) Nov 1–Jun 30
Juvenile collection/rotary trapping - new traps	- Naches R. (Selah-Naches Diversion Canal, RM 18.4) - Wilson Cr. irrigation dam (RM 2) - Taneum Cr. (RM 4)
Snorkeling – coho distribution, habitat use	Preferred habitat (side channel areas and mainstem pools) in the following streams: - Upper Yakima: systematic sampling (10%) of preferred habitat from Easton to Ellensburg - Naches mainstem: systematic sampling (10%) of preferred habitat from Little Naches R. to confluence - Release tributaries (Taneum, Ahtanum, Toppenish, Pileup, Nile) - systematic sampling of preferred habitat. Specific reach generally will coincide with release reaches. Summer, 3 days for each major subbasin, 1-2 days each for tributaries
Juvenile electro-fishing surveys (boat)	Yakima mainstem: systematic sampling of preferred habitat, 10 half-mile reaches between Roza Dam (RM 128) and Granger (RM 83). One in summer, one in fall/winter
Juvenile electro-fishing surveys (backpack)	**Distribution surveys** Backwater channel areas in the following rivers: - Upper Yakima mainstem (Easton Dam to Wilson Cr.) - Naches mainstem: confluence to the Little Naches R. - Little Naches R.: confluence to North Fork and lower half mile of tributaries (based on presence of redds) - Tributaries near adult and parr release areas Nov-Feb, 5-10 days/month, not every area annually **NTTOC surveys** - Upper Yakima: Taneum Cr. (treatment), Swauk Cr. (control) - Naches: Pileup Cr. (treatment), Quartz Cr. (control)
Snorkeling - residualism	Spot checks downstream of new release site in Taneum Creek. 1 survey in early summer.

Table 2. Coho Release Plan, Phase 1B

Location	Release #	Life Stage	PIT Tag #	Stock	Purpose	Study Method
Mainstem Sites						
Yakima River						
Easton	Alternate site[1]	Smolt	1,250	Yakima origin	Smolt-smolt survival	PIT detector at release location, CJMF, McNary
Roza Dam	Alternate site[1]	Smolt	1,250	L. Columbia origin	Smolt-smolt survival	PIT detector at release location, CJMF, McNary
Clark Flat	Alternate site[1]	Smolt	1,250	L. Columbia origin	Smolt-smolt survival	PIT detector at release location. CJMF, McNary
Holmes	250,000 early[2] 100,000 late[3]	Smolt	1,250	L. Columbia origin[4]	Smolt-smolt survival	PIT detector at release location, CJMF, McNary
Boone Pond	250,000[2]	Smolt	1,250	Yakima origin	Smolt-smolt survival	PIT detector at release location, CJMF, McNary
Naches River						
Stiles Pond	250,000 early[2] 100,000 late[3]	Smolt	1,250	L. Columbia origin[4]	Smolt-smolt survival	PIT detector at release location, CJMF, McNary
Lost Creek	250,000[2]	Smolt	1,250	Yakima origin	Smolt-smolt survival	PIT detector at release location, Selah-Naches diversion, CJMF, McNary
Tributary Sites						
Upper Yakima						
Crystal Springs/Easton-Keechelus Reach	3,000	Parr	3,000	L. Columbia origin	Over-winter survival (parr-smolt)	PIT detector at Roza, CJMF, McNary
Keechelus-Easton Reach	1,250	Smolt	1,250	Yakima origin	Smolt-smolt survival	PIT detector at Roza, CJMF, McNary
Big Creek	3,000	Parr	3,000	L. Columbia origin	Over-winter survival (parr-smolt)	PIT detector at Roza, CJMF, McNary
Taneum Creek	20,000 early run, 20,000 late run	Smolt	1,250	Yakima/L. Columbia origin	Smolt-smolt survival	PIT detector at Taneum trap, CJMF, McNary,
Taneum Creek	120 females 160 males	Adult	na	L. Columbia origin	Egg-fry survival, adult productivity, NOTTOC study	Electro-fishing surveys, redd capping, new Taneum trap
Swauk Creek	Control for Taneum Cr.	na	na	na	NTTOC study	Electro-fishing surveys
Wilson Creek	20 pairs (40 fish)	Adult	na	L. Columbia origin	Egg-fry survival, adult productivity	Electro-fishing surveys, new trap at RM 2
Wilson Creek	3,000	Parr	3,000	L. Columbia origin	Over-winter survival (parr-smolt)	Electro-fishing surveys; new trap at RM 4; PIT detectors at diversion trap, CJMF, McNary
Reecer Creek	20 pairs (40 fish)	Adult	na	L. Columbia origin	Egg-fry survival, adult productivity	Electro-fishing surveys

1. Might be used if bird predation is too high at preferred sites (Holmes and Boone Pond).
2. These numbers are not fixed. If the project succeeds in producing more than 500,000 Yakima-origin smolts, numbers at ponds designated for in-basin fish could be increased to accommodate them. The balance between the two types of smolts in the four ponds will be managed on an annual basis by the WDFW and YN co-managers as the need arises.
3. Late-run fish could be released from upstream ponds if space becomes limited at downstream sites.
4. Eventually, if the project begins to approach the goal of producing up to 1 million smolts from Yakima-origin adults (see Appendix A), Lower Columbia fish could be replaced by Yakima-origin smolts in all ponds.

Table 2 (continued)

Location	Release #	Life Stage	PIT Tag #	Stock	Purpose	Study Method
Middle Yakima						
Ahtanum Creek	20 pairs (40 fish)	Adult	na	Yakima origin	Egg-fry survival, adult productivity	Electro-fishing surveys, existing rotary trap
Ahtanum Creek	3,000	Parr	3,000	Yakima origin	Over-winter survival (parr-smolt)	Snorkel, electro-fishing surveys; existing rotary trap; PIT detection at Ahtanum trap, CJMF, McNary
Toppenish Creek	20 pairs (40 fish)	Adult	na	L. Columbia origin	Egg-fry survival, adult productivity	Electro-fishing surveys, redd capping
Toppenish Creek	3,000	Parr	3,000	L. Columbia origin	Over-winter survival (parr-smolt)	Snorkel, electro-fishing surveys; existing rotary trap; PIT detection at Toppenish, CJMF, McNary
Naches						
N. Fork Little Naches River	3,000	Parr	3,000	L. Columbia origin	Over-winter survival (parr-smolt)	Snorkel, electro-fishing surveys; PIT detection at Selah-Naches diversion, CJMF, McNary
Pileup Creek	20 pairs (40 fish)	Adult	na	L. Columbia origin	Egg-fry survival, adult productivity, NTTOC studies	Electro-fishing surveys, redd capping
Little Naches (Salmon Falls-South Fork)	3,000	Parr	3,000	Hatchery origin	Over-winter survival (parr-smolt)	Snorkel, electro-fishing surveys; PIT detection at Selah-Naches diversion, CJMF, McNary
Quartz Creek	Control for Pileup Cr.	na	na	na	NTTOC studies	Electro-fishing surveys
Nile Creek	3,000	Parr	3,000	L. Columbia origin	Over-winter survival (parr-smolt)	Snorkel, electro-fishing surveys; PIT detection at Selah-Naches diversion, CJMF, McNary
Nile Creek	20 pairs (40 fish)	Adults	na	L. Columbia origin	Egg-fry survival, adult productivity	Electro-fishing surveys, redd capping
Little Rattlesnake Creek	3,000	Parr	3,000	L. Columbia origin	Over-winter survival (parr-smolt)	Snorkel, electro-fishing surveys; PIT detection at Selah-Naches diversion, CJMF, McNary

4. EXISTING ENVIRONMENT

4.1 The Historical and Current Status of Anadromous and Resident Fish in the Subbasin

4.1.1 Target Species: Coho Salmon (Oncorhynchus kisutch)

Kreeger and McNeil (1993) and the Yakima Subbasin Plan (YIN et al. 1990) estimate the historical coho run at 44,000 and 150,000 respectively (Berg and Fast 2001). The historical distribution of coho salmon in the Yakima subbasin is shown in Figure 1 (Berg and Fast 2001).

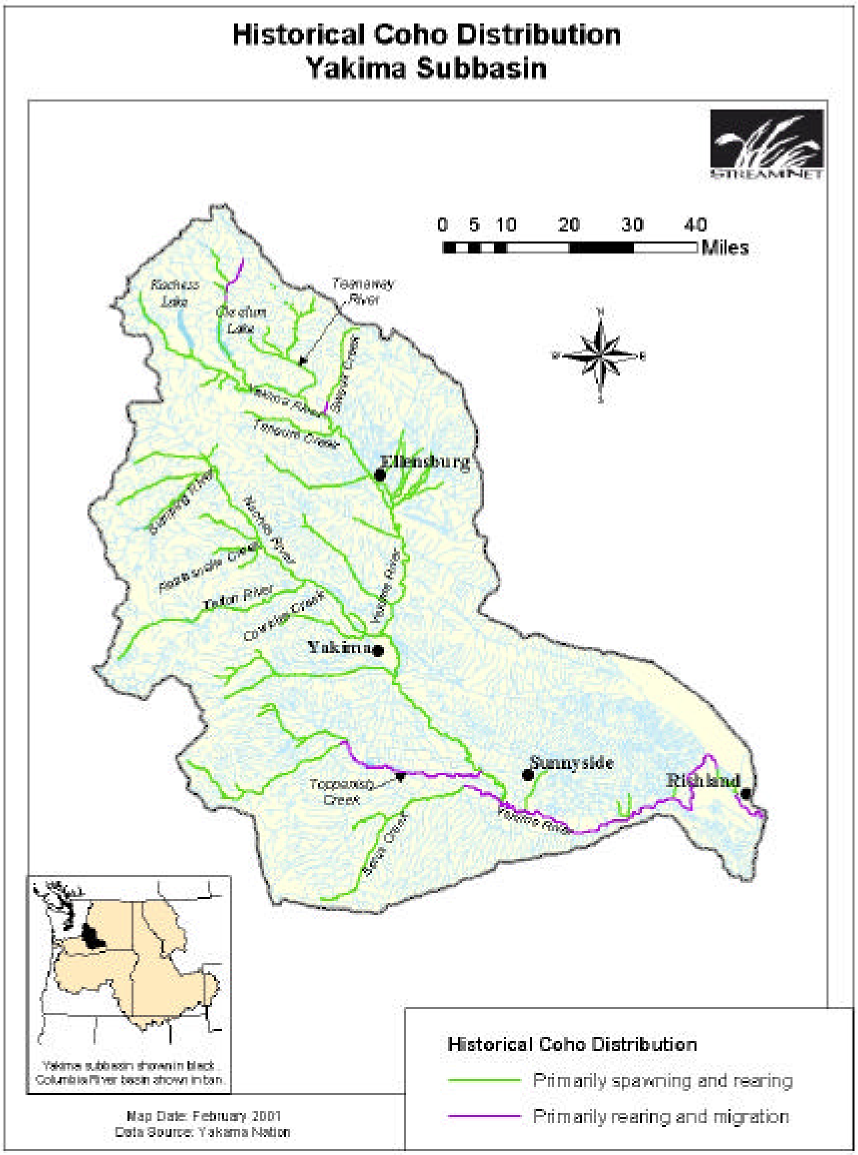


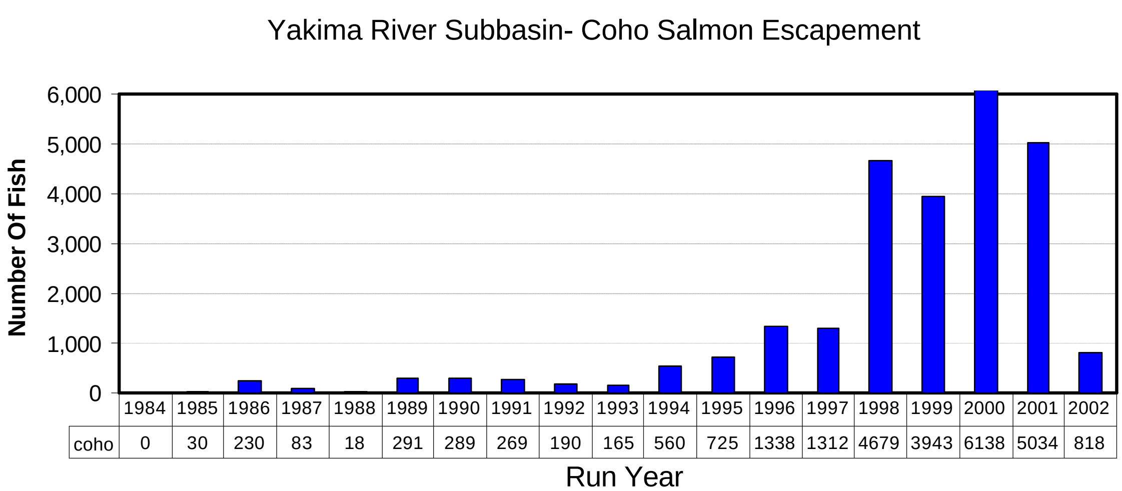
Figure 1. Historical Coho Distribution in the Yakima Subbasin

Fragmentary WDFW records of spawner surveys indicate that the endemic stock spawned in the upper Yakima above the Cle Elum confluence. Bryant and Parkhurst (1950) reported that coho spawned in smaller tributaries of the upper Yakima in the early 20th century, and it is now assumed that coho used virtually every low-gradient, perennial stream in the basin prior to extensive habitat alteration in the late 1800s (Berg and Fast 2001).

Wild coho now are considered extirpated in mid-Columbia basins and are not listed under the Endangered Species Act. However, the State of Washington Species Criteria lists them as Vulnerable, and Species of Importance. Their decline occurred in two major phases. First, between 1850 and 1900, water diversions for irrigation reduced runs of coho and all other anadromous salmonids by 90% (Davidson 1953; Tuck 1995; Lichatowich 1996). In the second phase, from 1900 to 1980, a remnant coho population slowly dwindled to extinction (Tuck 1995; Lichatowich 1996).

Efforts to restore coho within the Yakima basin rely largely upon releases of hatchery coho derived from Lower Columbia River stocks. The Yakama Nation has released between 85,000 and 1.4 million coho smolts in the Yakima basin annually since 1985. However, before 1995, the primary purpose of these releases was harvest augmentation; after 1995, the primary purpose became a test of the feasibility of re-establishing natural production (Berg and Fast 2001). Adult passage data at Roza Dam from 1941 to 1968 indicate that the endemic stock was early-run. The vast majority of the hatchery coho smolts out-planted since 1985 also have been early-run.

Figure 2 shows the estimated coho run size for the years 1984-2002. Coho returns since regular out-planting began in 1985 have increased steadily, climbing from 0 in 1984 to a peak of 6,138 in 2000 (Figure 2). The poor 2002 returns reflect low juvenile survival in their release year—the drought year of 2001. Because few of the out-planted coho smolts were marked until 2000, the proportion of natural-origin recruits in returns before 2001 is unknown (Berg and Fast 2001). Natural-origin adults comprised 30.8% of the 2001 adult return (YN 2001b).



	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
coho	0	30	230	83	18	291	289	269	190	165	560	725	1338	1312	4679	3943	6138	5034	818

Figure 2. Annual Adult Coho Run Size Over Prosser Dam, 1984-2002 [3]

Hatchery-reared coho, out-planted as smolts, are now reproducing in both the Yakima and Naches Rivers (Figure 3). Natural reproduction is evident from the increasing number of zero-

[3] The coho program changed from harvest augmentation to feasibility studies in 1995.

aged coho parr in samples taken at numerous points in the basin (YN, unpublished data, 2000 [in] Berg and Fast 2001). The naturalized run spawns in reaches downstream of the historical areas because, until 1999, the vast majority of hatchery smolts were acclimated and/or released well downstream of historical spawning areas. As was evident from the monitoring of radio-tagged adult coho in the fall of 1999, most coho spawned near their acclimation and release points, primarily in the middle Yakima below Sunnyside Dam (from RM 95 - RM 104) (Dunnigan 2000).

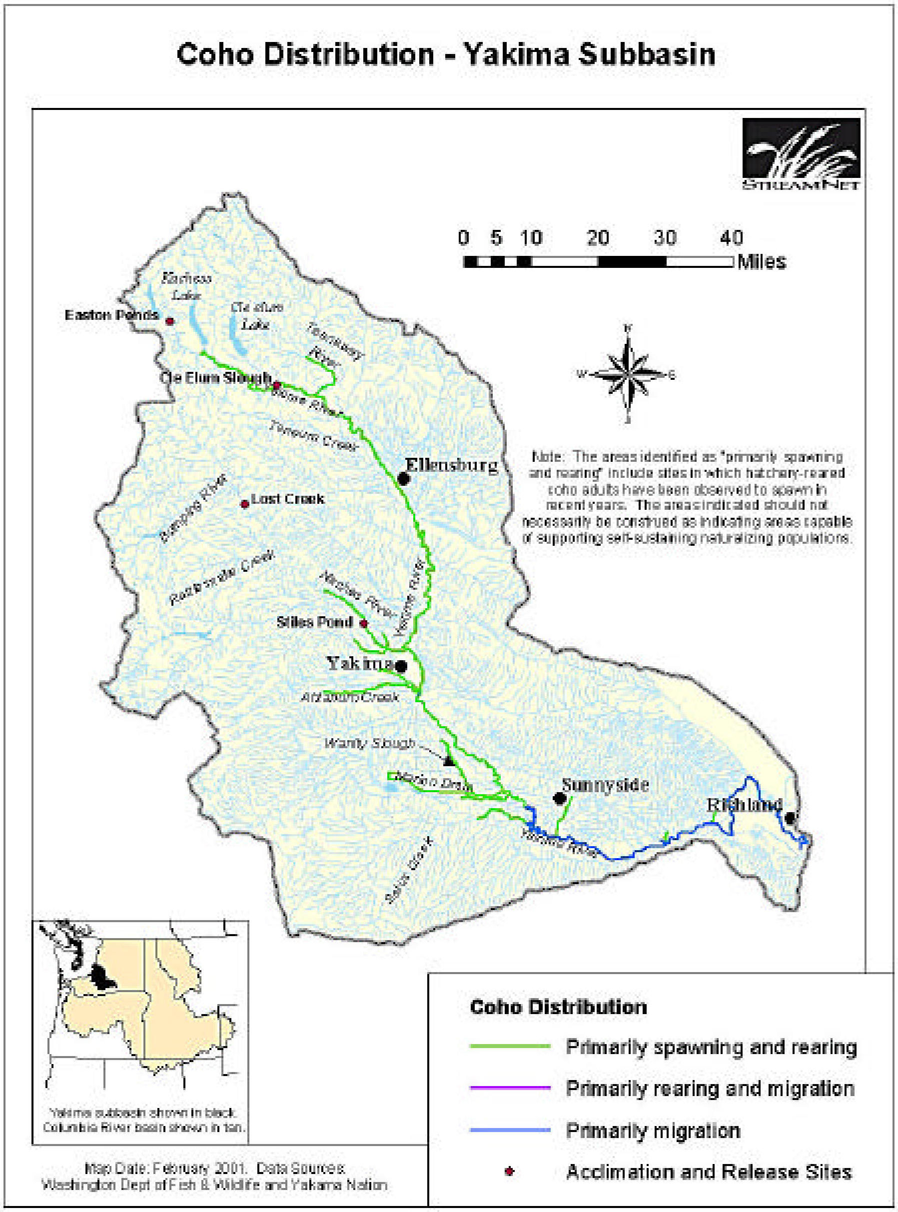


Figure 3. Current Coho Distribution in the Yakima Subbasin

Since 1999, all smolts have been released in the Naches and the upper Yakima rivers, although a portion of the releases began from Lost Creek in the upper Naches River in 1997. Despite this, the majority of spawning appears to occur in the Yakima River downstream of the Naches River confluence. Three factors could be contributing to this:

- lack of stamina (primarily of females) to reach their areas of release located further upstream,
- straying and delay due to false attraction from irrigation return flow, and
- natural production occurring in the Yakima River above Granger.

Nevertheless, the percentage of spawners returning to the Naches River has steadily increased from 8.2% in 1999 to 17.1% in 2001 (Table 3). Correspondingly, the percentage of fish spawning in the Granger to Sunnyside Dam reach has decreased from 61.6% in 1999 to 37.1% in 2001 (Dunnigan et al. 2002).

Table 3. Results of 1999-2001 Radio Telemetry Studies for Yakima Basin Coho

	1999	2000	2001
Number radio tagged	86	102	105
Never seen	3.5%	5.9%	5.7%
Mortality/regurgitated tag	3.5%	2.0%	7.6%
Fell back at Prosser	4.7%	7.8%	5.7%
Prosser Dam to Granger	4.7%	1.0%	6.7%
Granger to Sunnyside Dam	61.6%	41.1%	37.1%
Sunnyside Dam to Naches confluence	12.8%	16.6%	5.7%
Mid-Yakima tributaries	1.2%	14.6%	4.8%
Lower Naches	4.7%	2.0%	3.8%
Naches above Cowiche Dam	3.5%	1.0%	13.3%
Naches confluence to above Roza Dam		7.9%	9.5%

Total harvest rates for all upriver, early coho (marked and unmarked) average about 20% in ocean fisheries and 15% in mainstem Columbia River fisheries, for a total of about 35%. Harvest rates on marked coho (hatchery released) are estimated to average 30% in ocean fisheries and 20% in river fisheries, for a total harvest rate of 50%. Harvest rates on unmarked coho (natural-origin or unmarked hatchery smolts) are estimated to average 12% in ocean fisheries and 11% in river fisheries for a total harvest rate of 23%. Currently non-Indian fisheries are managed to assure that at least 50% of the total upriver coho return escapes above Bonneville Dam. (These are combined early and late stocks—late stocks return to the Klickitat River) (Blodgett and Dunnigan 2001a). Harvest in the Yakima basin is minimal. In 2001, no coho were caught in the Tribal fishery, 50 coho in the sport fishery (YN 2001b).

4.1.2 Other Anadromous and Resident Fish in the Basin

Summer Steelhead *(Oncorhynchus mykiss)* ESA-listed as Threatened [4]

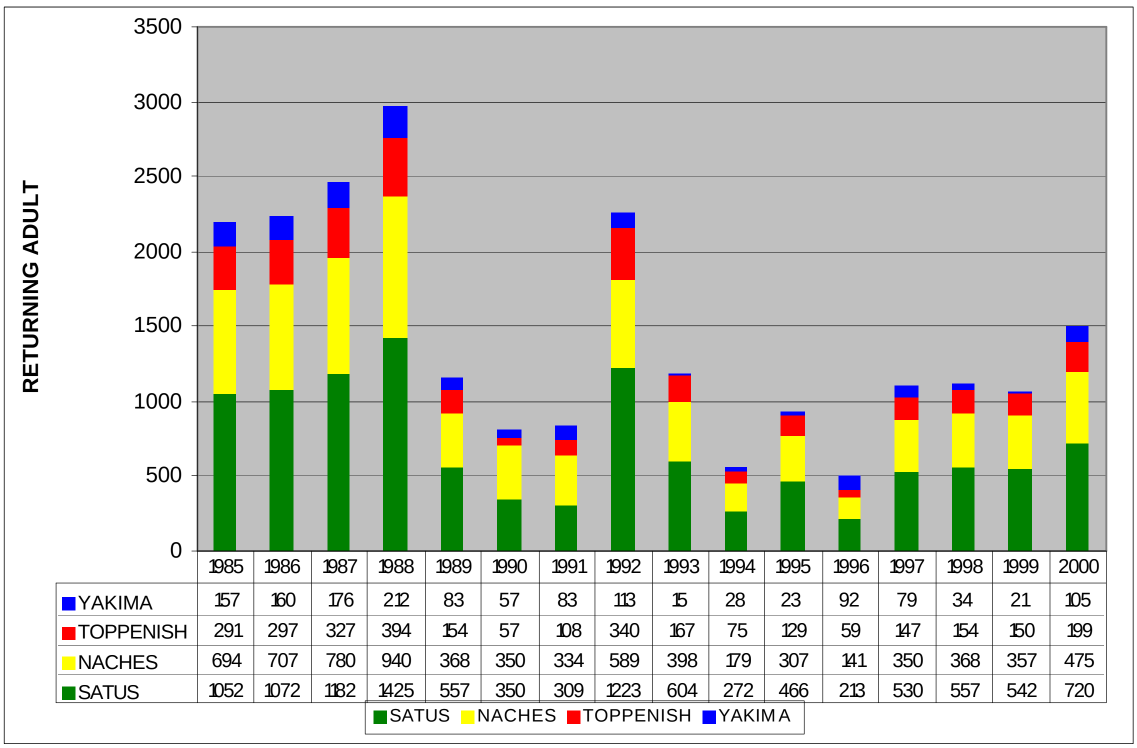
Historically, steelhead were probably found wherever spring chinook were found, and in many other tributaries and reaches as well. Yakima steelhead spawn in intermittent streams (Hubble 1992), side channels of larger rivers (Pearsons et al. [date not cited in original source] [in] Berg and Fast 2001), and in smaller streams and streams with steeper gradients than are suitable for spring chinook or coho. Therefore it is probable that the historical spawning distribution of summer steelhead included nearly all accessible portions of the Yakima basin, with highest spawning densities occurring in complex, multi-channel reaches of the mainstem Yakima and

[4] Information in this section came from Berg and Fast 2001.

Naches rivers, and in third- and fourth-order tributaries with moderate (1-4%) gradients. Estimates of the size of the historical steelhead run range from 20,800[5] (Kreeger and McNeil 1993) to 100,000 (Smoker 1956) [in] Berg and Fast 2001).

Yakima Basin summer steelhead are included in the Middle Columbia River (MCR) Evolutionarily Significant Unit (ESU) (Busby et al. 1996), which was listed under the Endangered Species Act (ESA) as "threatened" on March 25, 1999 (64 FR 14517). The MCR ESU includes all wild populations of summer steelhead in the Columbia River and its tributaries from the Wind River to the Yakima River (Berg and Fast 2001).

The current distribution of Yakima Basin steelhead is much more restricted and spatially variable than it was historically. Well over half of the spawning occurs in Satus and Toppenish Creeks, with a smaller proportion in the Naches drainage and a much smaller proportion in the upper Yakima (the Yakima mainstem and tributaries upstream of the Naches confluence) (Hockersmith et al. 1995). See Figures 4 and 5 (Berg and Fast 2001). Current steelhead abundance is only about 1.3% to 6% of historical estimates, averaging 1,256 fish (range = 505 in 1996 to 2,840 in 1988) over brood years 1985[6] - 2000 ([in] Berg and Fast 2001), with hatchery fish contributing about 10 to 20 percent of the total run, as monitored at Prosser Dam.



	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
YAKIMA	157	160	176	212	83	57	83	113	15	28	23	92	79	34	21	105
TOPPENISH	291	297	327	394	154	57	108	340	167	75	129	59	147	154	150	199
NACHES	694	707	780	940	368	350	334	589	398	179	307	141	350	368	357	475
SATUS	1052	1072	1182	1425	557	350	309	1223	604	272	466	213	530	557	542	720

Figure 4. Steelhead Return Numbers in Four Yakima Subbasins, 1985-2000

5 Mean of range estimated – 18,200 to 23,400.

6 Prior to the run of 1984-85, it was impossible to use the ladders at Prosser Dam to count adult steelhead, and estimates of run sizes before the 1985 brood are based on estimated catch and an assumed exploitation rate.

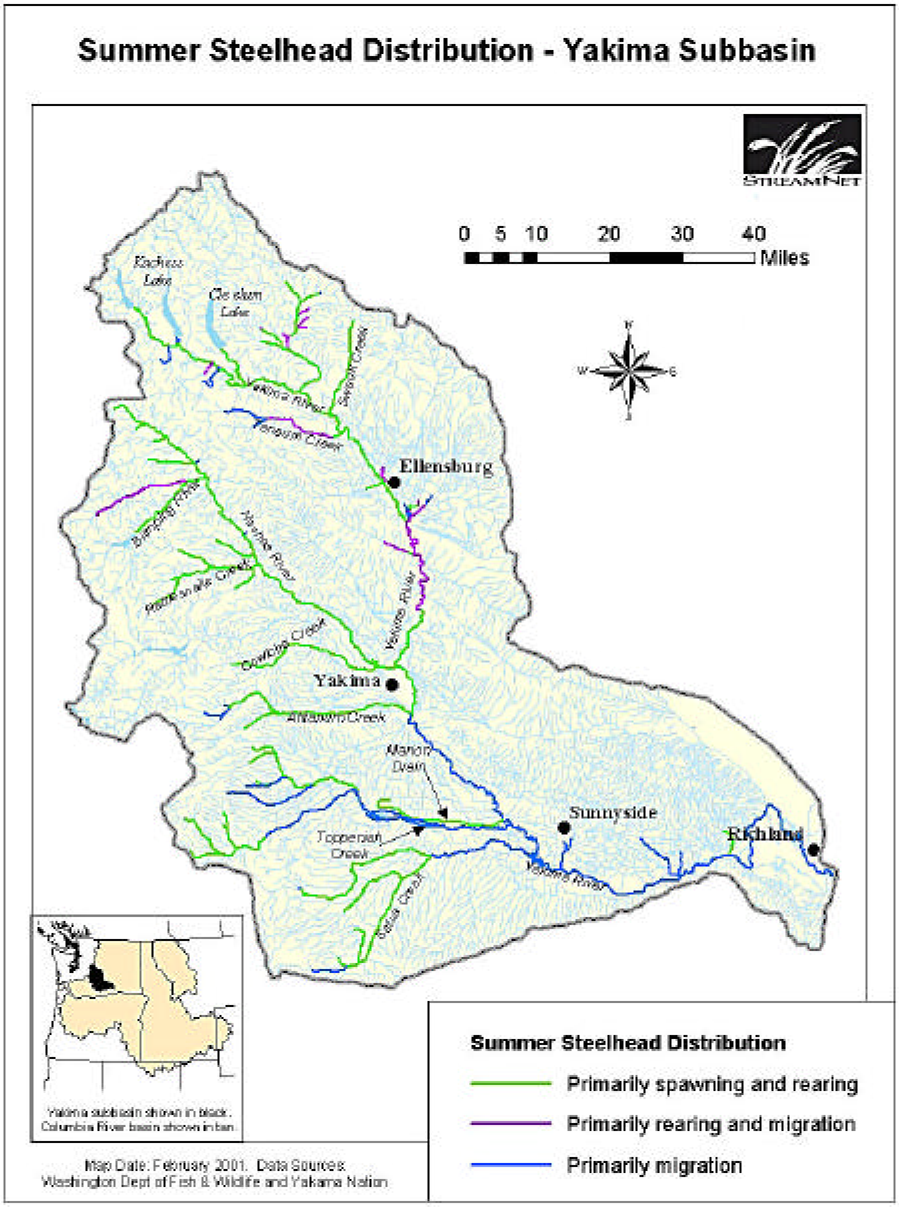


Figure 5. Summer Steelhead Distribution in the Yakima Subbasin

Busack and Phelps (1996) performed a number of electrophoretic analyses on rainbow trout and steelhead of both wild and hatchery origin collected at 14 sites over six years. On the basis of a large number of paired comparisons of allozyme frequencies, they identified four genetically distinct populations of wild steelhead in the basin: an upper Yakima stock, a Naches stock, a Satus Creek stock and a Toppenish Creek stock. They also determined from admixture analyses that wild rainbow and steelhead from a number of locations in the upper Yakima interbreed. Although a comparable analysis of wild Naches trout and steelhead was not performed, it was determined that hatchery trout and Naches steelhead have interbred, as have hatchery trout and wild steelhead in the upper Yakima. Wild Satus and Toppenish Creek steelhead, on the other hand, showed no evidence of interbreeding with hatchery trout or steelhead.

Steelhead adults begin passing Prosser Dam in September, cease movement during the colder parts of December and January, and resume migration from February through June. They hold in the Yakima mainstem and generally are not seen in tributaries until April, May, and June. The run has two peaks, one in late October, and one in late February or early March. The relative numbers of wild fish returning during the fall and winter-spring migration periods varies from year to year, perhaps depending on the duration of a "thermal window" in the fall.

Spring Chinook Salmon (*Oncorhynchus tshawytscha*) [7]

Spring chinook salmon are prized as sport fish and for commercial, ceremonial, and subsistence fishing. Historically, they comprised one of the largest anadromous fish runs in the Yakima River Basin. A substantial portion of the YKFP program is devoted to study and management of spring chinook.

Based on two years of extensive genetic analysis by WDFW (Busack et al. 1991), there appear to be three genetically distinct substocks of spring chinook salmon in the Yakima River Basin: the American River, Naches River, and upper Yakima stocks.

Adult spring chinook salmon begin migrating upstream past Prosser Dam in late April and have completed passage by late July. Figure 6 shows their current distribution in the basin. They currently spawn in the Yakima River upstream from the city of Ellensburg and immediately downstream to Roza Dam; in the Cle Elum River downstream from Lake Cle Elum; in the mainstem Naches, Bumping, Little Naches, and American rivers; and in Rattlesnake Creek. All populations have completed spawning by mid-October.

[7] Unless otherwise noted, all material in this section came from BPA et al. 1996.

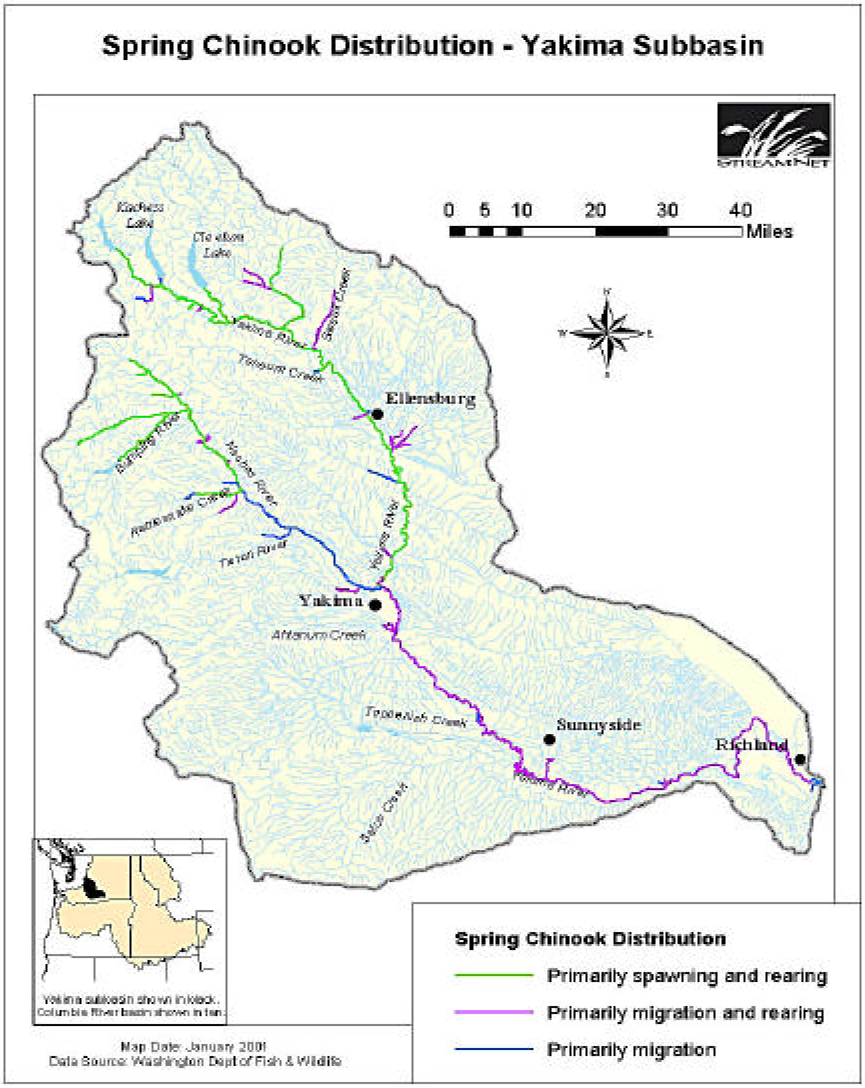
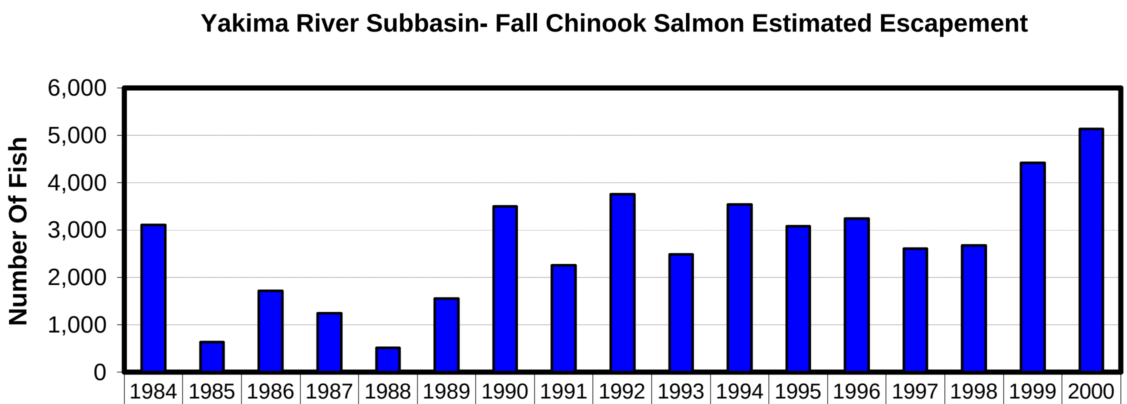


Figure 6. Spring Chinook Distribution in the Yakima Subbasin

Fall Chinook Salmon (*Oncorhynchus tshawytscha*) [8]

Fall chinook salmon once were abundant in the Yakima River Basin. Historical production may have been as high as 250,000 adult fish (YIN et al. 1990). Little is known about their historical distribution within the Yakima River, although their production is believed to have been confined to the area between the Sunnyside Dam and the Columbia River confluence (Fast et al. 1990 [in] BPA et al. 1996). Figure 7 shows recent estimates of adult returns to the Yakima Basin (Blodgett and Dunnigan 2001b).

[8] Unless otherwise noted, all material in this section came from BPA et al. 1996.



	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
fall chinook	3106	637	1715	1251	523	1563	3509	2266	3761	2485	3547	3085	3248	2613	2679	4424	5133

Run Year

Figure 7. The Estimated Fall Chinook Run to the Yakima Basin (Includes Below Prosser Dam), 1984-2000

There are no data describing the historical run timing, age composition, sex ratio, size-at-age, fecundity, or population structure of Yakima fall chinook salmon. Figure 8 shows their current distribution.

Under the expired Columbia River Fish Management Plan (CRFMP) of *U.S. v. Oregon* (currently being re-negotiated), the YN's fall chinook program in the Yakima River Basin includes the production and release into the Yakima of 1.7 million smolts from the Little White Salmon National Fish Hatchery. Between 1983 and 1994, the smolts were transported and directly released into the Yakima River. With funds provided under the Mitchell Act program, the YN has developed acclimation facilities in the vicinity of Prosser Dam for final rearing and release of these fall chinook smolts; they began operation in 1994.

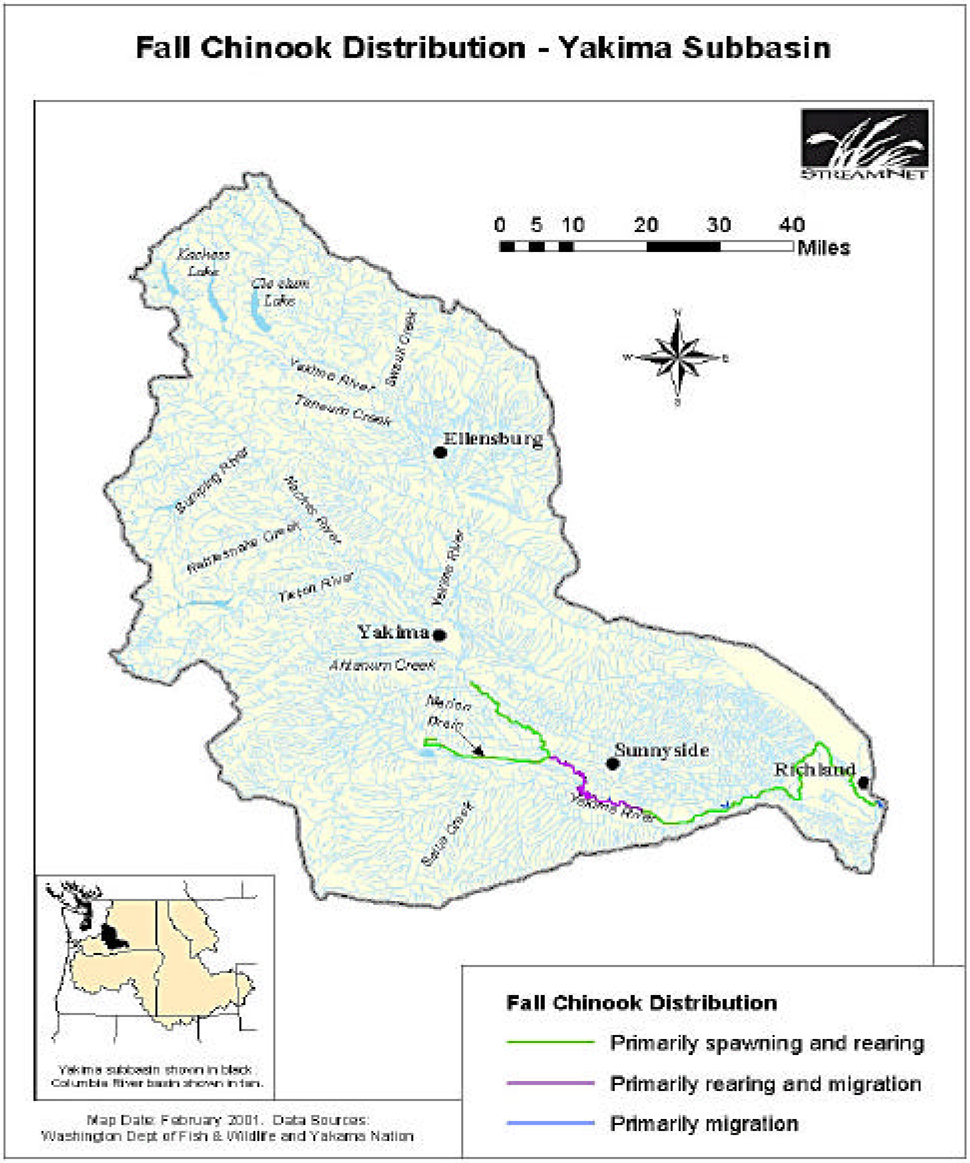


Figure 8. Fall Chinook Distribution in the Yakima Subbasin

Rainbow Trout (*Oncorhynchus mykiss*)

Rainbow trout that inhabit the mainstem of the upper Yakima basin provide the best naturally produced stream trout fishery in the state of Washington (Krause 1991; Probasco 1994 [in] Berg and Fast 2001).

Preliminary genetic analyses of resident rainbow trout in the upper Yakima River have discerned five genetic groups (Pearsons et al. 1993 [in] BPA et al. 1996). Using electrophoretic methods, the analysis found that rainbow trout and steelhead were genetically similar where they occurred together. Genetic as well as ecological evidence indicates that rainbow trout and steelhead interbreed. Rainbow trout were genetically indistinguishable from sympatric steelhead collected in the North Fork of the Teanaway River (Pearsons et al. 1998 [in] Berg and Fast 2001).

Rainbow trout spawn throughout the entire upper Yakima basin, with the possible exception of some high-elevation portions of a few tributaries (Pearsons et al. 1993; Pearsons et al. 1994 [in] BPA et al. 1996).

Bull Trout *(Salvelinus confluentus)* ESA-listed as Threatened [9]

In the past, bull trout were found throughout the Yakima River subbasin. In all streams where bull trout are noted in the historical catch records, relatively few fish were recorded compared to other game fish. Whether this is a reflection of historically low population abundance is difficult to tell.

In June 1998, the U.S. Fish and Wildlife Service (USFWS) listed bull trout in the Columbia River basin as threatened under the Endangered Species Act.

Currently, nine bull trout stocks have been identified in the Yakima basin that are native fish sustained by wild production (Table 4). There are no hatchery bull trout stocks in Washington State. According to WDFW, there is no information to indicate that these are genetically distinct stocks; they are treated separately because of the geographical, physical and thermal isolation of the spawning populations.

According to WDFW, of the nine stocks identified, only Rimrock Lake is healthy; Bumping Lake is depressed; Yakima River, Ahtanum Creek, North Fork Teanaway, Kachess Lake and Keechelus Lake are critical and Naches and Cle Elum/Waptus Lakes are unknown (WDFW 1998).

Bull trout are strongly influenced by temperature and are seldom found in streams exceeding summer temperatures of 18º Celsius. Cool water temperatures during early life history results in higher egg survival rates, and faster growth rates in fry and possibly juveniles as well (Pratt 1992). Depending on the life history form, rearing and over-wintering habitat vary, but all require cool clean water with insects, macro-zooplankton, and small fish for larger adults.

Pacific Lamprey (*Lampetra tridentatus*)

Pacific lamprey are known to be in the Yakima Basin (BPA et al. 1996), but their historic and present distribution and status are relatively unknown. Occasionally a few adults were counted at Prosser Dam in the spring through the 1990s. In 2001 and 2002, 22 and 82 adults were counted, respectively (M. Davis, YN, 2003, personal communication).

[9] Unless otherwise noted, all information in this section is from Berg and Fast 2001.

Table 4. Historical and Present Distribution of Bull Trout in the Yakima Subbasin

R=Resident, F=Fluvial, F/R=Fluvial/Resident, AD=Adfluvial

Lake or Stream	Last Year Present	Last Year Checked
Yakima River (Benton Co) (F)	1997 (1)	2002
Yakima River (Yakima Co) (F)	2002	2002
Satus Cr.	1953 (2)	1991
Ahtanum Creek (R)	2002	2002
N.F. Ahtanum Cr.	2002	2002
Shellneck Cr.	2002	2002
M.F. Ahtanum Cr.	2002	2002
S.F. Ahtanum Cr.	2002	2002
Naches River (F)	2002	2002
Cowiche Cr.	2002	2002
Tieton R.	2002	2002
Oak Cr.	1999	1999
Rattlesnake Cr.	2002	2002
N.F. Rattlesnake Cr.	1996	1996
Hindoo Cr.	1995	1996
Dog Cr.	1996	1996
Little Wildcat Cr.	2002	2002
Milk Cr.	1996	1996
Bumping R. (Lower)	2002	2002
American R.	2002	2002
Kettle Cr.	2002	2002
Timber Cr.	1993	1993
Union Cr.	2002	2002
Little Naches R.	2002	2002
Crow Cr.	2002	2002
Quartz Cr.	1998	1998
Pileup Cr.	1998	1998
Rimrock Lake (AD)	2002	2002
S.F. Tieton R.	2002	2002
Short and Dirty Cr.	1994	1994
Spruce Cr.	1996	1996
Grey Cr.	1994	1994
Bear Cr.	2002	2002
Indian Cr.	2002	2002
N.F. Tieton R. (Lower)	1997	1994
Clear Lk.	1993	1996
N.F. Tieton R.(Up.)	1996	1990
Dog Lk.	1950 (2)	
Bumping Lake (AD)	2002	2002
Deep Cr.	2002	2002
Bumping River (Upper)	1994	1994

(1) A single fish captured near Benton City by WDFW biologists (extreme rare occurrence).
(2) This record possibly species mis-identification (brook trout).
Source: Updated and modified from Goetz 1989 by WDFW (personal communication, Eric Anderson, 2003).

Table 4 (continued)

Lake or Stream	Last Year Present	Last Year Checked
Yakima River (Kittitas Co.) (F)	2002	2002
Coleman Cr.	1970	1984
Swauk Cr.	1993	1999
Easton Lake	2000	2000
N.F. Teanaway R. (F/R)	2002	2002
Jack Cr.	1997	1997
Jungle Cr.	1997	1997
DeRoux Cr.	2002	2002
Cle Elum Lake (AD)	1993	1993
Cle Elum R. (Upper)	2002	2002
Waptus Lake	1997	1998
Kachess Lake (AD)	2002	2002
Box Canyon Cr.	2002	2002
Kachess R. (Upper)	2002	2002
Mineral Cr.	2002	2002
Keechelus Lake (AD)	2002	2002
Rocky Run Cr.	1983	1983
Gold Cr.	2002	2002

4.2 Current and Planned Management of Anadromous and Resident Fish in the Subbasin

The Yakima Subbasin Summary (Berg and Fast 2001) outlines a detailed summary of goals, objectives, and strategies for fish and wildlife in the Yakima subbasin. They represent management goals of a number of federal, tribal, state, and local governments and agencies that have jurisdiction over subbasin resources. The following section further summarizes the goals and objectives relevant to anadromous and resident fish. Many objectives and strategies are similar for several goals, so not all objectives and strategies are listed under each goal. As can be seen from this summary, the YKFP's Yakima Coho Project objectives are consistent with the subbasin-wide goals. As well, if accomplished, the subbasin goals would enhance the potential for success of the Yakima Coho Project.

Overall goal: Protect, restore and enhance fish and wildlife and their habitats in the Yakima subbasin to provide ecological, cultural, economic and recreational benefits.

- **Goal 1: Maintain and protect existing high quality habitat areas and the native populations inhabiting those areas.** Objectives and strategies address habitat purchases for such key habitat components as floodplain and side channel habitat; use of incentives like conservation easements to encourage habitat protection; maintaining and restoring stock distribution of bull trout and their habitat; continued mapping of resource areas; and enforcement of existing laws designed to protect habitat from further damage and encroachment.

- **Goal 2: Restore degraded areas, and return natural ecosystem functions to the subbasin.** Objectives and strategies call for increased flows and reduced water temperatures in specific sections of the basin, especially when anadromous fish are present; restoration of habitat necessary for critical life history stages including spawning, rearing and migration; and restoration of degraded wetland and riparian habitats.
- **Goal 3: Restore, maintain, and enhance fish and wildlife populations to sustainable levels and also, when applicable, harvestable levels.** Objectives and strategies call for supplementation of wild stocks that are declining and in danger of extinction, and reintroduction of salmon and steelhead to areas they once occupied. Objectives list specific strategies related to spring chinook and the existing program at the YKFP Cle Elum Supplementation and Research Facility (CESRF), coho reintroduction as described in this master plan, mainstem and Marion Drain populations of fall chinook, use of reconditioned steelhead kelts to rebuild ESA-listed steelhead in the basin, monitoring and evaluation of existing steelhead stocks/runs and habitat, and recovery of bull trout stocks. Other objectives address fisheries. While one calls for rearing hatchery salmon, steelhead, and trout to provide recreational and tribal fishing opportunities, another emphasizes limiting harvest of bull trout to healthy stocks with surplus production. Maintenance of genetic diversity is also emphasized.
- **Goal 4: Increase the information and knowledge needed to restore and manage fish, wildlife and their habitats.** Objectives and strategies address research and monitoring as well as public information and education programs.

5. PHASE 1A STUDY RESULTS SUMMARY

The following brief summaries are included in this master plan only to provide a rationale and context for the Phase 1B studies now proposed. They should not be considered a complete report of study results, which are detailed in the reports cited.

Phase 1A of the coho feasibility study, due to be completed at the end of 2003, addressed five basic questions:

1. Which geographical area is better suited for natural coho production: the upper Yakima basin or the Naches basin?
2. What acclimated smolt release timing (early or late) provides the best smolt-to-smolt and smolt-to-adult survival?
3. Which broodstock (out-of-basin vs. local) has the highest productivity?
4. To which parts of the basin do adult coho return?
5. What is the existence and biological significance of impacts to populations of NTTOC identified as being at demonstrable risk from ecological interactions with coho?

The experiments designed to answer the first three questions were conducted between 1999-2002. Results through 2001 were published in detail in project annual reports (Dunnigan 2000; Dunnigan 2001). The release plan is summarized in Table 5.

Table 5. Coho Release Strategies

Upper Yakima 1				Upper Yakima 2				Naches 1				Naches 2			
Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late	Early	Late
Out-of-basin	Local	Local	Out-of-basin	Out-of-basin	Local	Local	Out-of-basin	Out-of-basin	Local	Local	Out-of-basin	Out-of-basin	Local	Local	Out-of-basin

Each of the 16 groups was uniquely coded wire tagged and PIT tagged. Smolt-to-smolt survival indices were statistically analyzed by Douglas Neeley, the YKFP statistician. A summary of his results is presented in Table 6 for years 1999-2001.

Table 6. Coho Survival-Index Rates to McNary Dam

Time of release			Release location		Stock type	
Release Year	Early	Late	Upper Yakima	Naches	Local	Out-of-basin
1999	0.53*	0.44*	0.46	0.52**	0.54***	0.43***
2000	0.24	0.18	0.15	0.26	NA	NA
2001	0.13	0.12	0.04	0.22	0.19****	0.07****

* statistical difference ($P = 0.05$)
** Stiles Pond only
*** statistical difference ($P = 0.02$)
****statistical difference ($P < 0.001$)

The early release smolt group out-performed the late-released group all three years and was significantly different in 1999. This is attributed to progressively poorer out-migration conditions in the lower Yakima River from April through June. Smolts released from the Naches basin had greater survival to McNary Dam than those released from the upper Yakima subbasin. Better out-migration survival for smolts originating from the Naches basin is attributed to a shorter out-migration distance to McNary Dam and probably less avian predation at the acclimation sites prior to release. Smolts produced from the local broodstock had better survival than those from out-of-basin in 1999 and 2001.

Results were slightly different in 2002, though the general trends observed in past years remain. The major conclusions were summarized by Neeley (2003), and were as follows:

Early Release versus Late Release

- For the Yakima stock, the late-release survival index significantly exceeded that of the early-release, but the time-of-release difference for the Willard stock was not significant.
- For the Stiles release site, the survival index for the late release significantly exceeded that for the early release. The time-of-release difference was not significant for the other two sites (Easton and Lost Creek).

Yakima Stock versus Willard Stock

- The Yakima stock survival index to McNary significantly exceeded that of the Willard stock for late releases. There was no significant difference between the two stocks for early releases; however, this conclusion was less certain due to logistical issues (Neeley 2003).

Smolt-adult survival rates for the 2001 and 2002 adult returns (brood years 1998 and 1999) were:

- 2001: hatchery 1.8%, wild 3.8%
- 2002: hatchery .04%, wild 0.87% (reduced survival for both groups during out-migration in the 2001 drought year)

Researchers suggest that the lower adult return rate of the out-of-basin fish might be attributable to lack of stamina in progeny of lower Columbia broodstock, which migrate a much shorter distance when returning from the ocean than Yakima basin-bound fish (Dunnigan et al. 2002).

Results of Phase 1A studies addressing question #4 (location of adult returns) are shown in Table 3, Section 4.1.1.

As a way to begin to address the issue of ecological interactions (question #5), during Phase 1A, the coho project adopted the risk containment objectives for Non-Target Taxa of Concern (NTTOC) as identified by the YKFP spring chinook project (Table 7).

Table 7. Risk Containment Objectives for NTTOC in the Yakima Basin

NTTOC	Containment Objective
Rare – rare species or stock, or regionally rare Bull trout (upper Yakima R. and Naches R.) Westslope cutthroat trout (upper Yakima R. and Naches R.) Pacific lamprey Naches steelhead Status steelhead Toppenish steelhead Upper Yakima steelhead	No impact
Rare – in basin Marion Drain fall chinook salmon Mountain sucker Leopard dace Sand roller	Very low impact ($\leq$ 5%)
Native game or food fish – very important Resident rainbow trout in the mainstem Yakima R. and mainstem Naches R. Upper Yakima R. spring chinook salmon Naches spring chinook salmon American River spring chinook salmon	Low impact ($\leq$ 10%)
Native game or food fish – important Mountain whitefish Resident rainbow trout in tributaries	Moderate impact ($\leq$ 40%)
Common Other native species	$\leq$ maximum impact that maintains all native species at sustainable levels

These objectives are target levels of impact; they are **not** rigid limits, which if exceeded, would cause managers to immediately modify, suspend or cancel the project. The objectives define which species to monitor for changes to populations in areas of coho releases. If changes to NTTOC populations are found, the next step is to design studies to determine if the change is caused by the coho program or by other factors. **Note that these objectives were changed slightly for Phase 1B, and subbasin-specific risk assessments were performed based on proposed releases in specific subbasins.**

In Phase 1A, the project studied the risks of hatchery coho residualism, and of hatchery coho smolt predation on and competition with other fish species. Specifically, the project examined coho smolt predation on spring and fall chinook, and coho fry competition with rainbow/ steelhead and cutthroat trout. The following describes the project's conclusions to date about each of those risks.

Residualism. The following results were reported in more detail in Dunnigan 1999, Dunnigan 2001, and YN 2001b.

An investigation was initiated in 1999 to determine baseline levels of hatchery coho residuals in the upper Yakima subbasin. Prior to this investigation, no estimates of relative abundance of residual fish existed. On May 17, 1999, approximately 24,850 and 125,000 yearling coho smolts were volitionally released after a period of approximately 5 weeks of acclimation at the Easton and Jack Creek spring chinook acclimation facilities respectively. Identical volitional releases were made from each location on May 27, for a season total release of 49,700 Easton and 250,000 Jack Creek smolts. Snorkel surveys were conducted in the Yakima and Teanaway rivers downstream of the acclimation sites from July 8-20, 1999 to detect the presence of hatchery coho smolts that did not migrate during the May smolt releases.

Analysis suggests that there may have been up to 8,580 (1.7%) hatchery coho residuals between the Cle Elum River confluence and Roza Dam from the 500,000 coho released in the upper Yakima subbasin in 1999. These estimates likely represent the worst case scenario, based on two factors. First, the estimates were calculated using early July snorkel observations, which were higher than late July estimates. Many of the coho present in the early July sample might have migrated downstream and therefore were not detected during the late July surveys. Second, the Easton reach contains probably the highest quality rearing habitat within the entire Yakima basin, which likely maximized the potential for coho to inhabit this area and to be observed in the surveys. Furthermore, hatchery coho residual rates observed in the Teanaway River were much lower than the Easton reach, even though it is likely that Teanaway surveys had higher snorkel efficiency due the narrower stream width. Therefore, expansions based on observations within the Easton reach are likely over-estimates of hatchery coho residual rates for areas of lower quality rearing habitat located downstream. WDFW snorkel and electro-fishing surveys in the upper Yakima subbasin in the summer and fall of 1999 corroborate YN's findings that hatchery coho smolt residual rates were low (T. Pearsons, personal communication).

Residualism surveys near release sites in the Yakima and Naches subbasins were conducted again in 2000 and 2001. Estimates of the average number of residual coho in the upper Yakima and Naches subbasins were relatively low in 2000 (Dunnigan 2001). YN estimated that more coho were present in the Naches subbasin than in the upper Yakima in 2000 (67.8 and 14.7 coho per kilometer respectively). The higher estimated number in the Naches is attributed to natural coho production in that reach. (Hatchery coho had no external mark to distinguish them from naturally produced coho.) Estimates of the number of coho residuals per kilometer in 1999 and 2000 were similar when expressed as a per capita of coho released (Dunnigan 2001). Again, WDFW snorkel and electro-fishing surveys in the upper Yakima subbasin in summer and fall of 2000 corroborate YN's findings that hatchery coho smolt residual rates were low (T. Pearsons, personal communication [in] Dunnigan 2001).

In 2001, surveys for residual coho smolts on the upper Yakima River (Easton reach) were conducted from the Easton acclimation site (Rkm 325.4) to the confluence of Cle Elum River

(Rkm 294.6). The Naches River (Lost Creek reach) surveys were done from the Lost Creek acclimation site (Rkm 61.8) to the confluence with Rock Creek (Rkm 53.9). In 2001, residual coho were generally absent from all snorkel surveys. Two residual coho were seen in the Lost Creek reach, which equated to 0.25 fish per river kilometer. No residuals were observed in the upper Yakima River reach. Sub-yearling coho were observed in low numbers (upper Yakima: 55 fish or 1.8 fish per km; Naches: 33 fish or 4.2 fish per km), an indication of natural production. Results in 2001 are consistent with those in 1999 and 2000, where relatively low densities of residuals and sub-yearlings were observed in both subbasins.

A high degree of residualism could negatively impact the coho program strictly from the aspect of production. Based on the low estimated number of residual hatchery coho observed in the Yakima subbasin, it is unlikely that residualism significantly affected smolt survival estimates or future smolt-to-adult survival estimates (Dunnigan 2001).

High numbers of residual coho also could increase the potential for negative ecological interactions with other species. Based on the low estimated number of residual coho found during the study years, the potential probably was minimal for such negative ecological interactions (Dunnigan 2001).

Due to the low numbers of residual coho found at smolt release sites, **Phase 1B residualism studies** will be limited to areas near a new release site (see Section 6.3, Strategy 3a).

Coho Predation on Fall Chinook. As reported in Dunnigan and Hubble 1998, hatchery coho smolt predation on fall chinook was studied in 1992, 1997, and 1998. Because results from 1992 are considered inconclusive, only results from 1997 and 1998 are summarized here. For detail on data collection and analysis methods, please see the original report.

<u>1997</u>

A total of 6,523 coho samples were collected from the Yakima Basin during 1997 for stomach analysis. YN collected 5,234 coho from CJMF and 1,126 coho from Sunnyside Dam. Five coho (0.4% of the sample) had consumed fish at Sunnyside Dam. Two of the five fish were identified as *Oncorhynchus* spp. Although 837 coho salmon (16% of the sample) collected at CJMF contained fish, only 11 of these prey fish were identified as *Oncorhynchus* spp. The two most abundant fish species found in coho stomachs in 1997 were carp (*Cyprinus carpio*) and sucker (*Catastomus* spp) (92% and 5% respectively, of all fish-containing samples). Coho at CJMF consumed virtually no fish until June 1st, which also coincided with an increase in the abundance of non-salmonid species moving through the facility.

Flows during the 1997 coho out-migration were unusually high and protracted, which greatly reduced coho catchability in the open river, and resulted in the collection of only 173 coho. High flow conditions in the Yakima River began on March 20, and peaked at 19,024 cubic feet per second on May 15th, which coincided with the release date of coho. None of the coho captured in the open river had consumed fish, although most coho (55%) had consumed insects. The small sample size of coho collected in the Yakima River contributed to low precision in the 95% confidence interval for estimates of the incidence of predation.

<u>1998</u>

YN collected a total of 1,693 coho salmon for stomach analysis, of which 1,231 (72.7%) were collected at CJMF and 462 (27.3%) were collected by electro-fishing in the Yakima River. Coho salmon rarely consumed fish in 1998. Researchers found fish remains in 5 (0.29%) coho collected at all locations in 1998, and none of these prey items were identified as chinook. Invertebrates were the most common item found in coho stomachs in 1998. The downstream movement of high numbers of non-salmonid species at CJMF observed during 1997 was not observed in 1998.

Although no fall chinook remains were found in any of the sampled fish in 1998, the results were statistically analyzed to help assess the level of confidence in the observations. Coho predation rates on the estimated total number of fall chinook smolts above and below Prosser were calculated. They ranged between 0.63% of fall chinook smolts above Prosser and 2.17% of fall chinook smolts below Prosser.

Based on the sampling conducted in 1997 and 1998 associated with CJMF, researchers estimated that the impact of coho predation on fall chinook smolts produced above Prosser was no higher than 0.1% and was likely much lower. These levels equate to approximately 3.7 adults, based on a 1% smolt-to-adult survival rate for Yakima River fall chinook (Bruce Watson, YN, personal communication). In addition, predation associated with CJMF is probably the worst-case scenario for coho predation on fall chinook. Fish in the CJMF are at unnaturally high densities in unnatural habitat with no escape cover from predators, and fish are potentially held several hours in the livebox before they are examined and released.

Sample sizes in 1998 provided precise estimates of the total number of fall chinook consumed in the open river. Researchers estimate that coho consumed a maximum of 349 fall chinook smolts in the entire Yakima River, which equates to approximately 3.5 adult fall chinook (Bruce Watson, personal communication). This level of potential impact seems small when compared to predation by smallmouth bass, which consumed an estimated 1 million fall chinook juveniles in the lower Yakima River in 1998 (McMichael et al. 1998), or the equivalent of 10,000 adult fall chinook.

Coho Predation on Spring Chinook. YN released 26,809 non-acclimated coho smolts in the upper Yakima River near Easton, Washington (RM 203) on May 26 and 27, 1998. In 1999, YN released approximately 49,700 acclimated coho smolts, half on May 17 and the other half on May 27. Each year YN operated two 5-foot diameter rotary traps continuously over a period of 10 days from the release date; the traps were approximately 6 miles downstream of the release point. The trap usually was checked continuously, but time between fish removal from the trap never exceeded 60 minutes, in order to minimize coho predation on chinook fry in the trap.

YN collected 1,097 coho salmon at the rotary trap in 1998. Most coho were captured during the night. Five coho within the sample (0.45%) had consumed fish. Researchers identified two coho prey items as *Oncorhynchus* spp., both of which were consumed by a single coho.

During the 1999 field season, YN collected 993 coho during the early release (May 17 – 22), and 764 coho during the late release (May 27 – June 9). Mean coho and spring chinook fry fork lengths were lower in 1999 than in 1998. However, coho movement was generally similar between years, with most coho moving during the night and passing the trap within a few days after release. The fish weighted mean residence time within the Easton study reach was 2.5 and 3.2 days respectively for the early and late release in 1999, compared to approximately 4 days in 1998. Coho predation on juvenile fish was less common in the 1999 samples than in the 1998 samples. Two coho in the sample had consumed fish (0.11%): a single fish each from the early and late sample periods in 1999 consumed fish. Neither of these prey items was identified as *Oncorhynchus* spp.

It is likely that the smaller chinook fry in 1999 were potentially more vulnerable to predation than the larger fry in 1998; however, several factors offset the higher prey vulnerability in 1999 and resulted in a lower overall predation rate. These factors included lower abundance of fry in 1999, lower water temperatures which resulted in lower coho metabolic rate, and an extended acclimation period which resulted in reduced coho residence time within the study area.

Similar studies of predation by hatchery coho smolts on summer chinook and spring chinook were conducted in the Wenatchee basin in 2000 and 2001, with similar results, indicating that predation by hatchery smolts on these species is low (Murdoch and Dunnigan 2001; Murdoch and LaRue 2002).

Coho Competition with Rainbow/Steelhead and Cutthroat Trout. As reported in Dunnigan 1999, YN scatter-planted a total of 404,340 non-acclimated coho fry into the Naches River basin between June 17 and June 24, 1998. YN estimated stocking densities by estimating available habitat within each stream/reach from existing habitat information (U.S. Forest Service [USFS]), unpublished data; YN, unpublished data); and then estimated coho carrying capacity for the amount of each habitat type (i.e., riffle, pool, glide, side channel, etc.) (Reeves et al. 1989). Coho were released in four broad geographical areas within the basin:

- lower mainstem Naches River (RM 2–16: 121,600 fish),
- mainstem Bumping River (RM 0–17: 132,000 fish),
- upper Naches tributaries (RM 28–42: 67,400 fish), and
- the Little Naches River mainstem and tributaries (RM 45 [RM 3.2-13.2]: 83,431 fish).

The primary focus of the study was to estimate post-release survival of hatchery coho fry; thus, the competition data collected was ancillary to the research.

YN installed traps near the confluence of the Little Naches River and in Quartz and Pileup creeks to monitor fish movement, and conducted electro-fishing surveys in Quartz and Pileup creeks to assess the distribution and abundance of hatchery coho and resident fish.

Cutthroat trout abundance increased with elevation, and rainbow trout density decreased with elevation. Although rainbow trout were more abundant than cutthroat trout in the lower sections of Pileup and Quartz creeks, cutthroat trout were overall more abundant in each stream. Coho salmon abundance was largely an artifact of stocking location, and was not correlated with elevation. Researchers found no evidence that coho salmon influenced the abundance of cutthroat or rainbow trout when they compared the abundance of each species in allopatry and sympatry with coho salmon. They repeated each test after removing the effects of elevation on cutthroat and rainbow trout abundance, and found no difference between allopatric and sympatric mean densities of resident trout. Similarly, they found no evidence that coho salmon affected the growth of cutthroat or rainbow trout when they compared the condition factor of each species in allopatry and sympatry with coho salmon.

YN found no evidence to suggest coho were having a negative impact on these native fish species in the two streams examined. Researchers attribute these low levels of observed impacts in part to low stocking densities of coho fry. In addition, they believe that spatial segregation (Hartman 1965; Allee 1974), resource partitioning (Ross 1986) and differences in diet (Johnson and Ringler 1980) minimize the potential for competition between coho and steelhead.

The ability to detect small differences (statistical power) in either abundance or condition factor was likely limited by relatively small sample sizes. The report acknowledges this limitation, while noting that competitive interactions were not the primary focus of these field activities.

Due to the consistency of study results that show low rates of predation by hatchery coho smolts on other species, additional **predation studies** are not planned for Phase 1B. However, due to the small sample sizes, the **competition studies** conducted in Phase 1A were limited in their ability to detect small differences in coho effect on other species. Additional studies are proposed for Phase 1B to aid in assessing ecological interactions between naturalized coho or their surrogates and NTTOC (see Section 6.3, Strategy 3b).

6. PHASE 1B STUDY METHODS AND ASSOCIATED RISKS

This section outlines the methods for accomplishing each objective and strategy proposed for Phase 1B, and the environmental risks associated with those methods.

Risks associated with this phase of the feasibility program fall into three categories:

- Physical effects on environmental resources caused by facility development
- Effects on target fish (coho) and non-target taxa (NTT) caused by monitoring and broodstock collection activities (e.g., trapping, marking, handling, etc.)
- Interaction risks to non-target fish from the presence of reintroduced coho.

Site-specific development and monitoring risks are discussed as appropriate for each strategy. However, the kinds of interaction risks, their intensity, and the likelihood of their occurrence are more difficult to predict and are the subject of debate among scientists. As a result, biologists from YN and WDFW prepared a risk assessment for each of four subbasins where coho releases were proposed, using an assessment method as described in Pearsons and Hopley 1999. Table 8 shows the template they used to perform the risk assessment. It includes definitions of the kinds of potential interactions considered, as well as definitions of each factor considered in the assessment.

The biologists identified species of concern for each subbasin (upper Yakima, Naches, Ahtanum and Toppenish) and defined target impact levels which, with one exception (cutthroat trout), correspond to the impact levels defined for spring chinook several years ago as shown in Table 7. Then the amount of overlap between coho and non-target species life stages was identified, as well as the type of interaction that might be expected. The level of risk for each species in each subbasin represents the average of all the participants' estimates; the "Uncertainty" column represents the standard deviation of the group's values. For example, at 9.7, the highest "Uncertainty" number is that for the risk to steelhead from coho releases in the upper Yakima subbasin. This number indicates the large variation in the assessment of risk among the participants, whose risk levels ranged from 9 to 35. However, all the risk levels as shown in Tables 9 - 12 are relatively low and do not warrant additional monitoring beyond what is currently proposed.

Table 8. Template for Assessing Ecological Risks to NTT of Fish Stocking Programs [10]

Proposed Stocking Program: Target taxon________________________ Size at release _________________
Date of release_________________ Number and location ____

		Overlap[a]		Interaction Strength[b]			
NTT[c]	Status[d]/Impact	Type 1 Life Stage	Type 2 Life Stage	Type 1 Interaction	Type 2 Interaction	Risk[e]	Uncertainty[f]
Example of species or stock	D/10%	Fry	All	C, P, B, D, N	C, P, B, D, N, S	74%	16%

a *Type 1*: spatial and temporal overlap between NTT and released hatchery salmonids, residuals, and returning adults.
Type 2: spatial and temporal overlap between NTT and all life history stages of naturally produced offspring of returning hatchery adults.
Life stage—fry, parr, smolt, adult (salmonids); age 0, juvenile, adults (other species) or all if overlap occurs for all life stages or none if no overlap occurs.

b Ecological interactions that could occur between stocked anadromous salmonids and NTT.

Negative interactions

C (competition)—the presence of hatchery salmonids limiting the availability of resources that NTT would use in the absence of hatchery salmonids. This occurs when stocked salmonids and NTT use common resources, the supply of which is short (i.e., exploitative or indirect competition); or if the resources are not in short supply, competition occurs when hatchery salmonids limit access of NTT that are seeking a desired resource (i.e., interference or direct competition; Birch 1957).

P (predation)—the direct consumption of NTT by hatchery salmonids (direct predation; *Pd*) or the increase in predation by other predator species resulting from the presence of hatchery salmonids (indirect predation; *Pi*). Indirect predation can occur through the following mechanisms: (1) Hatchery salmonids displace NTT from preferred habitat, making NTT more vulnerable to predators; or (2) the increased abundance of hatchery salmonids attracts predators, causes predators to switch prey, or increases population densities of predators, which can increase consumption of NTT, particularly if NTT are preferred.

B (behavioral anomalies)—the presence and behavior of hatchery salmonids alter the natural behavior of NTT. For example, migrating hatchery salmonids may cause premature migration of NTT (e.g., pied-piper effect; Hillman and Mullan 1989) or may cause NTT to become less active (McMichael et al., in press).

D (pathogenic interactions)—the transfer of a pathogen from hatchery salmonids to NTT (direct pathogenic interaction) or the increased susceptibility of NTT to pathogens (indirect pathogenic interaction).

M (nutrient mining)—the carcasses of fish that would normally reproduce naturally are collected for hatchery broodstock and are not distributed back into the natural environment or are distributed inappropriately. This results in a loss of nutrients/food that would ordinarily be available to NTT.

Beneficial interactions

N (nutrient enrichment)—increase in nutrients available to NTT because of an increase in marine-derived nutrients from greater salmonid returns (e.g., salmon carcasses).

F (prey)—increased availability of prey for piscivorous NTT.

S (predator swamping)—the survival of NTT is enhanced due to swamping of predators by hatchery fish.

c *NTT*—highly valued non-target taxa.

d *Status*: H=healthy, D=depressed, T=Threatened (ESA), C=critical (or other status descriptors). Impact—acceptable impact level to the NTT (e.g., 10% impact to abundance, distribution, and size structure).

e *Risk*: probability (0%–100%) of failing to meet an objective for NTT; 0% corresponds to impossibility of failing, and 100% corresponds to surety that an objective will be exceeded.

f *Uncertainty*: scientific uncertainty of risk assessment due to lack of information or variability of ecological interaction outcomes; calculated as the standard deviation of the risks.

[10] Source: Pearsons and Hopley 1999. The template is slightly edited from the published version to make definitions easier to find and to reflect terms used by participants in this project's risk assessment. The authors provided an example of one NTT relative to a hypothetical stocking program.

Table 9. Risk Assessment for Coho Releases in Upper Yakima Subbasin

		Overlap		Interaction Strength			
NTT	Status/ Impact	Type 1 Life Stage	Type 2 Life Stage	Type 1 Interaction	Type 2 Interaction	Risk	Uncertainty
Spring chinook	D/10%	egg fry parr smolts adults	egg fry parr smolts adults	C[1] Pi, Pd[2], D, N, S C, Pi, Pd[3], D, B, N, S C, Pi, D, B, N, S No interactions	C[1] C, Pi, Pd, B, D, N, F, S C, Pi, B, D, N, S C, Pi, D, N, F, S No interactions	5.27	4.93
Steelhead	T/0%	egg fry parr smolts adults	egg fry parr smolts adults	No interactions C, Pd, Pi, B, D, N, S, F C, Pi, B, D, N, S, F C, Pi, B, D, N, S, F C	No interactions C, Pi, Pd, S, D, N ,F C, Pi, S, D, N, F C, Pi, S, D, N, F C	17.83	9.68
Rainbow (main)	H/10%	egg fry parr adults	egg fry parr adults	No interactions Pd, Pi, B, D, N, S, F C, Pi, B, D, N, S, F C	No interactions Pd, Pi, D, N, S, F C, Pi, D, N, S, F C	10.33	6.59
Rainbow (trib.)	H/40%	egg fry parr adults	egg fry parr adults	No interactions C, Pd, Pi, D, N, S, F C, Pi, B, D, N, S, F C	No interactions C, Pd, Pi, D, N, S, F C, Pi, D, N, S, F C	4.25	3.13
Bull trout	T/0%	egg fry parr adults	egg fry parr adults	C C, Pd, Pi, D, N, F C, Pi, D, N, F N, F	C C, Pd, Pi, B, D, N, F C, Pi, D, N, F N, F	2.83	2.16
Cutthroat trout	D/5%	egg fry parr adults	egg fry parr adults	No interactions Pd, Pi, D, N, S, F C, Pi, B, D, N, S, F C	No interactions Pd, Pi, D, N, S, F C, Pi, B, D, N, S, F C	5.33	3.78
Fall chinook	D/5%	egg fry parr adults	egg fry parr adults	C C, Pd, Pi, B, D, N, S, F C, Pd, Pi, B, D, N, S, F C	C C, Pd, Pi, B, D, N, S, F C, Pd, Pi, B, D, N, S, F C	6.50	4.55
Pacific lamprey	D/0%	egg fry amocetes adults	egg fry amocetes adults	C C, Pd, Pi, B, D, N, S, F C, Pd, N, F C, N, F	C C, Pd, Pi, B, D, N, S, F C, Pd, N, F C, N, F	3.50	5.96

Assumptions

Assume 100 coho returning above Roza

1 Redd superimposition is expected to be low because of low coho spawner densities (.5-1%)

2 Predation estimates from hatchery smolts in Nason Cr. (Wenatchee basin) and Yakima are less than 1%

3 Residualized coho predation

Table 10. Risk Assessment for Coho Releases in Naches Subbasin

NTT	Status/ Impact	Overlap: Type 1 Life Stage	Type 2 Life Stage	Interaction Strength: Type 1 Interaction	Type 2 Interaction	Risk	Uncertainty
Spring chinook	D/10%	egg fry parr smolts adults	egg fry parr smolts adults	C[1] Pi, Pd[2], D, N, S C, Pi, Pd[3], D, B, N, S C, Pi, D, B, N, S No interactions	C[1] C, Pi, Pd, B, D, N, F, S C, Pi, B, D, N, S C, Pi, D, N, F, S No interactions	2.3	1.1
Steelhead	T/0%	egg fry parr smolts adults	egg fry parr smolts adults	No interactions C, Pd, Pi, B, D, N, S, F C, Pi, B, D, N, S, F C, Pi, D, N, S, F C	No interactions C, Pi, Pd, S, D, N, F C, Pi, S, D, N, F C, Pi, S, D, N, F C	12.0	4.2
Rainbow (main)	H/10%	egg fry parr adults	egg fry parr adults	No interactions Pd, Pi, B, D, N, S, F C, Pi, B, D, N, S, F C	No interactions Pd, Pi, D, N, S, F C, Pi, D, N, S, F C	2.0	1.4
Rainbow (trib.)	H/40%	egg fry parr adults	egg fry parr adults	No interactions C, Pd, Pi, D, N, S, F C, Pi, B, D, N, S, F C	No interactions C, Pd, Pi, D, N, S, F C, Pi, D, N, S, F C	4.5	6.4
Bull trout	T/0%	egg fry parr adults	egg fry parr adults	C C, Pd, Pi, D, N, F C, Pi, D, N, F N, F	C C, Pd, Pi, B, D, N, F C, Pi, D, N, F N, F	5.5	6.4
Cutthroat trout	D/5%	egg fry parr adults	egg fry parr adults	No interactions Pd, Pi, D, N, S, F C, Pi, B, D, N, S, F C	No interactions Pd, Pi, D, N, S, F C, Pi, B, D, N, S, F C	2.5	0.7
Fall chinook	D/5%	egg fry parr adults	egg fry parr adults	C C, Pd, Pi, B, D, N, S, F C, Pd, Pi, B, D, N, S, F C	C C, Pd, Pi, B, D, N, S, F C, Pd, Pi, B, D, N, S, F C	4.0	1.4
Pacific lamprey	D/0%	egg fry amocetes adults	egg fry amocetes adults	C C, Pd, Pi, B, D, N, S, F C, Pd, N, F C, N, F	C C, Pd, Pi, B, D, N, S, F C, Pd, N, F C, N, F	0.5	0.7

<u>Assumptions</u>

Assume 100 coho returning above Roza

1 Redd superimposition is expected to be low because of low coho spawner densities (.5-1%)

2 Predation estimates from hatchery smolts in Nason Cr. (Wenatchee basin) and Yakima are less than 1%

3 Residualized coho predation

Table 11. Risk Assessment for Coho Releases in Ahtanum Subbasin

NTT	Impact	Overlap: Type 1 Life Stage	Overlap: Type 2 Life Stage	Interaction Strength: Type 1 Interaction	Interaction Strength: Type 2 Interaction	Risk	Uncertainty
Spring chinook	10%		fry parr smolts		Pd, C, Pi, N, S C, Pi, N, S C, Pi, N, S	2	2.8
Steelhead	0%		fry parr smolt		Pd, Pi, C, S, N C, Pi, S, N C, Pi, N, S	18	4.2
Bull trout	0%		parr smolts adults		C, Pi, S, N Pi, S, N N	5.5	0.7
Cutthroat trout	5%		fry parr smolt		Pd[3], C, Pi, S C, Pi, S, N C, Pd, Pi, N, S	8.9	1.6

Table 12. Risk Assessment for Coho Releases in Toppenish Subbasin

NTT	Impact	Overlap: Type 1 Life Stage	Overlap: Type 2 Life Stage	Interaction Strength: Type 1 Interaction	Interaction Strength: Type 2 Interaction	Risk	Uncertainty
Spring chinook	10%		fry parr smolts		Pd, C, Pi, N, S C, Pi, N, S C, Pi, N, S	0	0.0
Steelhead	0%		fry parr smolt		Pd, Pi, C, S, N C, Pi, S, N C, Pi, N, S	20.5	6.4
Bull trout	0%		parr smolts adults		C, Pi, S, N Pi, S, N N	0	0.0
Cutthroat trout	5%		fry parr smolt		Pd[3], C, Pi, S C, Pi, S, N C, Pd, Pi, N, S	2	1.4

3 Residualized coho predation

6.1 Objective 1 Methods and Risks

Objective 1. Attempt to establish naturally producing coho populations in the upper and lower Yakima River and tributaries, and in the Naches River and tributaries.

Strategy 1a. Continue acclimated smolt releases in the mainstem of the upper Yakima and Naches rivers, including early-run and late-run stocks.

Method: Two acclimation/release sites on the mainstem of each river were developed and used in Phase 1A. In the Naches, the project proposes to continue using the existing sites: Lost Creek (RM 39) and Stiles Pond (~RM 8) (Figure 9). However, in the upper Yakima, the coho smolts at the existing sites have been subject to high bird predation. The Cle Elum Slough site (RM 184) was not used in 2002 for that reason—all coho were acclimated at the Easton site. In addition, the acclimation period conflicts with a popular put-and-take fishery at the Easton Ponds site. Phase 1B proposes to use two new sites in the upper Yakima: the “Holmes site” (RM 160) and the Boone Pond site (RM 180.5) (Figure 10). As alternatives, in case bird predation at the new sites is unacceptably high, the project could use the existing Easton Ponds site (RM 201) or a portable acclimation raceway at Clark Flat (RM 164). Minor improvements at Roza Dam (RM 128) could also be made if necessary. Figure 9 shows existing facilities in the basin. The proposed new upper Yakima sites and alternates are shown in Figure 10.

Approximately 500,000 Yakima and 500,000 Cascade stock (Lower Columbia) hatchery smolts from early-run stocks would be released into the Yakima basin each year (Table 13). Each of four sites (two in the Yakima and two in the Naches) would contain approximately 250,000 early-run fish. Yakima-origin fish would be acclimated in the upstream site in each subbasin; the downstream sites would be used for Lower Columbia-origin fish.

Table 13. Mainstem Coho Smolt Release Sites, Phase 1B

Location	Release #	Life Stage	PIT Tag #	Stock	Purpose	Study Method
Yakima River						
Easton	Alternate site	Smolt	1,250	Yakima origin	Smolt-smolt survival	PIT detector at release location, CJMF, McNary
Roza Dam	Alternate site	Smolt	1,250	L. Columbia origin	Smolt-smolt survival	PIT detector at release location, CJMF, McNary
Clark Flat	Alternate site	Smolt	1,250	L. Columbia origin	Smolt-smolt survival	PIT detector at release location. CJMF, McNary
Holmes	250,000 early 100,000 late	Smolt	1,250	L. Columbia origin	Smolt-smolt survival	PIT detector at release location, CJMF, McNary
Boone Pond	250,000	Smolt	1,250	Yakima origin	Smolt-smolt survival	PIT detector at release location, CJMF, McNary
Naches River						
Lost Cr.	250,000	Smolt	1,250	Yakima origin	Smolt-smolt survival	PIT detector at release location, Selah-Naches diversion, CJMF, McNary
Stiles Pond	250,000 early 100,000 late	Smolt	1,250	L. Columbia origin	Smolt-smolt survival	PIT detector at release location, CJMF, McNary

Researchers also propose to test the possibility of establishing late-run stocks of coho. Because low water in the fall due to irrigation withdrawals may reduce adult returns, late-run fish, which could be returning in December, might have better rates of return. YN proposes to release

100,000 late-run smolts, which would be out-of-basin fish, from the downstream acclimation site in each subbasin. However, if space proves too limited in the downstream sites, late-run fish might also be acclimated and released from the upstream sites.

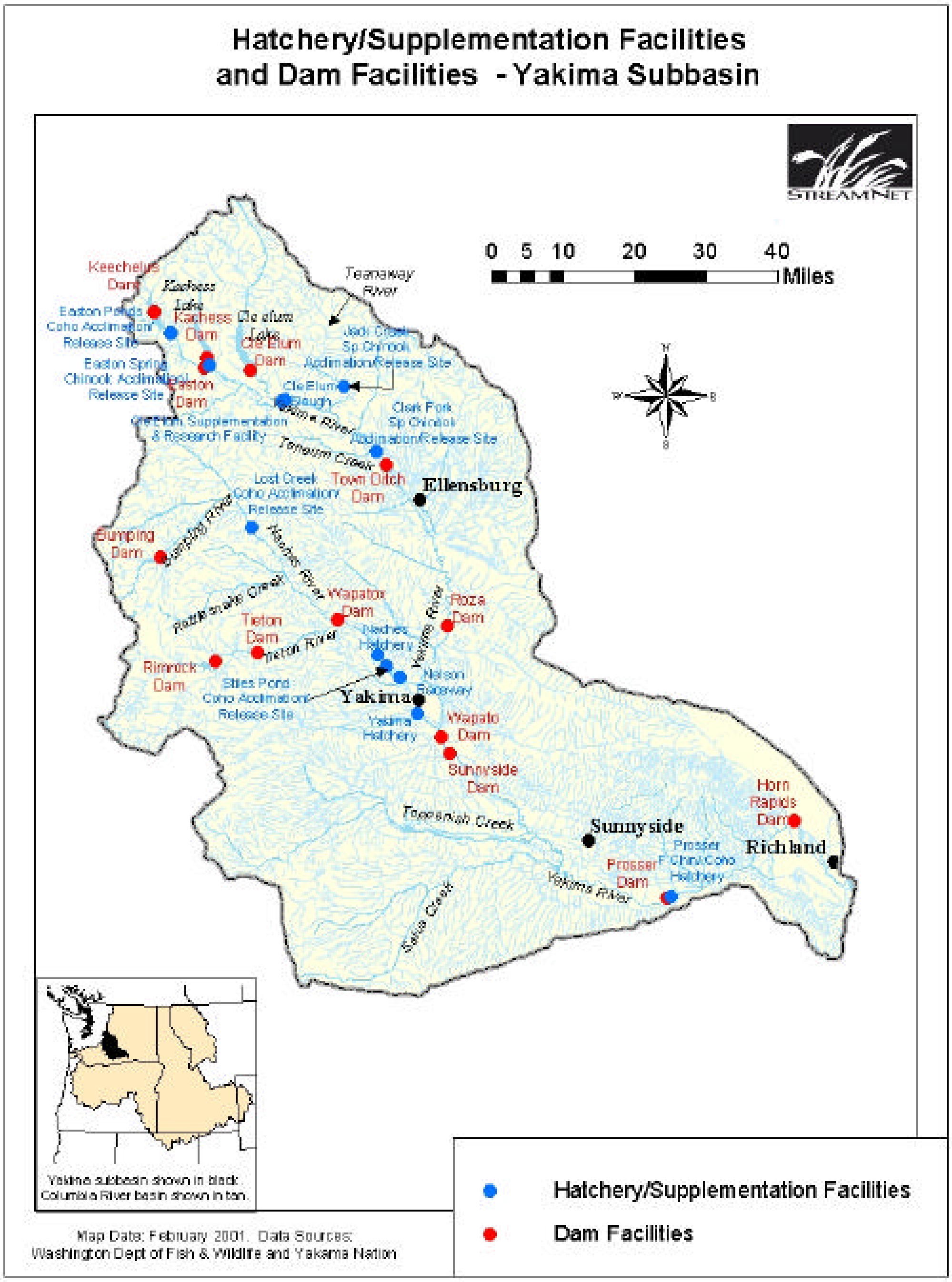


Figure 9. Existing YKFP Facilities

Prosser Hatchery can culture a maximum of 500,000 smolts based on its current water and rearing space constraints. However, should enough local returns be collected to produce more than 500,000 Yakima-origin smolts (see Strategy 1e and Appendix A), some could be reared at lower Columbia River hatcheries. In that case, depending on how many Yakima-origin smolts were produced at hatcheries both in-basin and out-of-basin, more than 250,000 Yakima-origin smolts might be acclimated at the upstream ponds designated for in-basin fish. If the project began to approach its goal of producing all one million smolts from Yakima-origin stock, the Lower Columbia smolts could be replaced in both acclimation ponds in each subbasin.

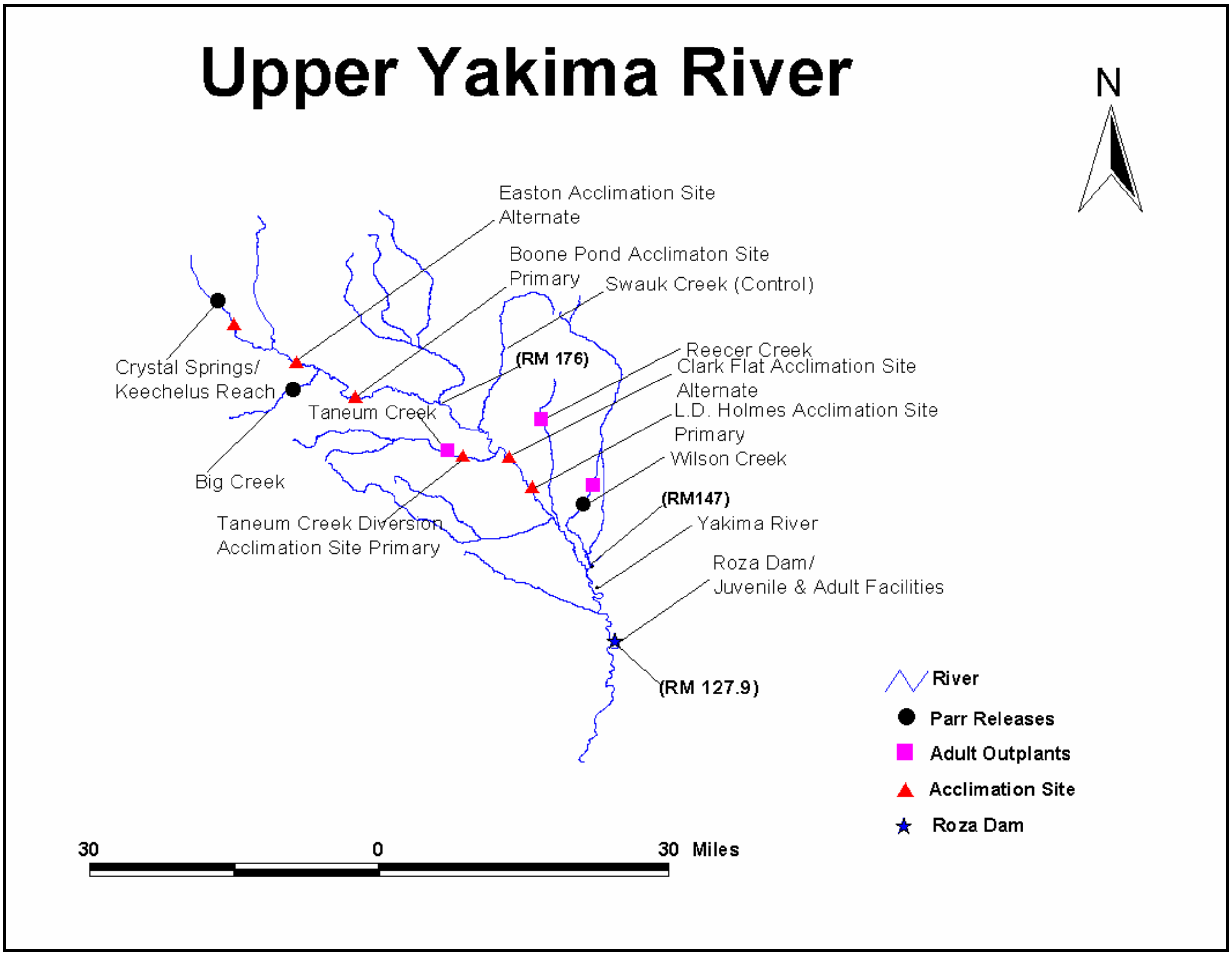


Figure 10. Coho Program Sites in the Upper Yakima Subbasin

Risks: Physical effects caused by development of the proposed new sites are discussed in Section 6.4, Strategy 4a.

The YFP EIS acknowledged potential ecological interactions (competition and predation) between coho and other species in the lower Yakima basin, where coho were expected to be acclimated and released (BPA et al. 1996, section 4.1.2). A Supplement Analysis was prepared in 1999 that assessed environmental effects that might be caused by proposed changes in the YKFP program since the EIS was prepared, including changes to the coho program (BPA 1999).

The Supplement Analysis found that volitional releases of up to one million smolts in May each year from two existing sites in the Naches and upper Yakima basins would pose a low risk of predation on or competition with other fish species, including listed steelhead and bull trout. Steelhead fry emerge from the gravel after the coho have migrated through the Yakima system, and yearling rainbow/steelhead are too large to be readily consumed by coho smolts (BPA 1999). The risk to bull trout is especially low due to the limited spatial overlap between coho smolt emigration corridors and bull trout spawning areas (WDFW 1998). Subsequent studies, including residualism studies and a study of predation on spring chinook in Easton Reach, generally support these conclusions (Dunnigan 1999). See Section 5 of this master plan for a summary of that research.

Despite these studies and previous findings, concerns and questions remain. For that reason, WDFW and YN undertook the interactions risk assessment shown in Tables 9 and 10. As shown in the tables, coho interactions with steelhead are not expected to pose a high risk. For example, the highest risk level projected for coho/steelhead interactions is under 18 (when 100 represents maximum risk) in the upper Yakima basin, and 12 in the Naches. Interaction risks with other non-target species are expected to be even lower.

Of particular concern are the effects of interactions between natural-origin coho and other species. These interactions are expected to be low for at least a few years due to the low number of natural-origin spawners (an estimated 1,530 adults in 2001). As stated in Section 4.1.1, adult returns still are concentrated in the lower reaches of the mainstem Yakima River (downstream of Union Gap) (Dunnigan et al. 2002), most of which is not spawning or rearing habitat for listed species or those in the "no impact" section of the NTTOC list (Table 7). Although some life cycle activities of late-run stocks would take place a few weeks later than those of early-run fish (i.e., primarily spawning and fry emergence), the effects on other fish of releasing late-run coho would not be noticeably different from those of early-run coho.

However, the number of coho adult returns has been increasing steadily. The hatchery smolt-to-all adult return rates increased beginning with the 1998 return (0.448%) and averaged 0.456% for 1998-2001. Prior to this period, rates didn't exceed 0.142%. Thus, numbers of possible natural-origin returns (NORs) comprising the adult run probably began to increase beginning with the 2001 return. Because all smolts released in 2000 were coded wire tagged, 2001 was the first year NORs could be distinguished from hatchery-origin returns (HORs). In 2001, 2,209 coho (44%) of the 5,034 coho enumerated at Prosser Dam passed via the denil trap and were sampled. Of the sampled fish, 1,517 coho were enumerated as hatchery (68.7%) and 692 were enumerated as wild (31.3%). Using these proportions and adjusting for coded wire tag (CWT) retention, estimates of total hatchery and wild coho passage at Prosser Dam in 2001 were 3,464 hatchery and 1,502 wild adults and 47 hatchery and 21 wild jacks (Dunnigan et al. 2002). The preliminary 2002 return composition was 88.9% NORs and 11.1% HORs.

If the trend continues, and if coho begin to populate the upper reaches of the basin, density-dependent competition effects might become a concern. To study the potential for such effects in advance of large numbers of naturally produced coho occupying parts of the basin, the project proposes controlled studies in paired streams in the Naches and upper Yakima subbasins (see Section 6.3, Strategy 3b). Habitat use and residualism surveys will help identify general species associations, habitat overlaps with steelhead and other species of concern, and whether coho appear to be displacing these species in areas where they overlap.

Juvenile trapping to monitor out-migration would be done partly at existing facilities, partly at potential new smolt traps (see Strategy 1f in this section).

Strategy 1b. Test survival of smolts released in upper Yakima tributaries.

Method: Smolts would be acclimated and released in two upper Yakima tributaries.

Approximately 1,250 Yakima-origin smolts would be PIT tagged and placed in the Keechelus-Easton Reach at the head of Lake Easton. Their survival would be monitored at Roza, CJMF, and McNary.

A more multi-faceted study would be conducted for smolts acclimated and released at a new site in Taneum Creek. All coho used for the project in Phase 1A were primarily early-run fish. In Phase 1B, the project would compare survival of 20,000 early run Yakima-origin smolts and 20,000 Lower Columbia-origin late-run smolts, all acclimated together in the new Taneum acclimation pond (see Section 6.4, Strategy 4a, for a description of the site). The project would PIT tag 1,250 smolts from each group and monitor their survival to Roza, CJMF, and McNary.

Risks: As shown in Table 9 and discussed under Strategy 1a, the risks of smolt releases in the upper Yakima would be low.

Strategy 1c. Test over-winter survival (smolt-parr survival) by releasing coho parr in selected tributaries to the Yakima and Naches rivers.

Method: In July each year, 24,000 parr would be scatter-planted in designated tributaries, 3,000 parr in each of the following streams (see Figures 10 - 12):

- Upper and lower Yakima subbasins
  - Crystal Springs/Easton-Keechelus Reach: From Kachess River confluence (RM 202.5) to Keechelus Dam (RM 214.5)
  - Big Creek: From Main Canal crossing (RM 1.5) to Jim Creek (RM 6.5)
  - Wilson Creek: From Cherry Creek (RM 1.1) to Bull Ditch (RM 7.8)
  - Toppenish Creek: From Toppenish Lateral Canal (RM 44.2) to North Fork (RM 55.4)
  - Ahtanum Creek: From Goodman Road (RM 2.8) to North Fork/South Fork confluence (RM 23.1)
- Naches subbasin
  - North Fork Little Naches River: From confluence (RM 0) to RM 2
  - Little Naches River: From Salmon Falls (RM 4.5) to South Fork (RM 9.9)
  - Nile Creek: From USFS boundary (RM 3) to Glass Creek confluence (RM 7.5)
  - Little Rattlesnake Creek: From RM 0 to Soda Spring Meadow (RM 6)

All parr would be coded wire tagged and PIT tagged. The tags allow researchers to monitor their survival as smolts to various PIT detectors on the Yakima mainstem and tributaries or the Naches River, and to CJMF and McNary, as well as to monitor out-migration timing. If 3,000 proves to be too small a number for reliable estimates of survival, releases would be increased, probably to no more than 5,000 per group. Habitat use and distribution surveys would also be conducted (see Section 6.2, Strategy 2b).

Rationale for Release Locations: In general, parr release creeks were chosen because they once were coho habitat; because the existing habitat looks better than that in other streams (e.g., other streams have passage problems); and because they have facilities or characteristics that allow monitoring to be done. In addition, the streams chosen in each subbasin reflect a broad enough geographic range within the subbasin to test over-winter survival differences; and, in most cases (unless the purpose is to study ecological interactions with listed species), the release numbers and the locations in each stream minimize overlap with habitat of listed species. The following paragraphs are examples of the rationale for choosing some of the release streams. Similar rationale applies to the other release streams.

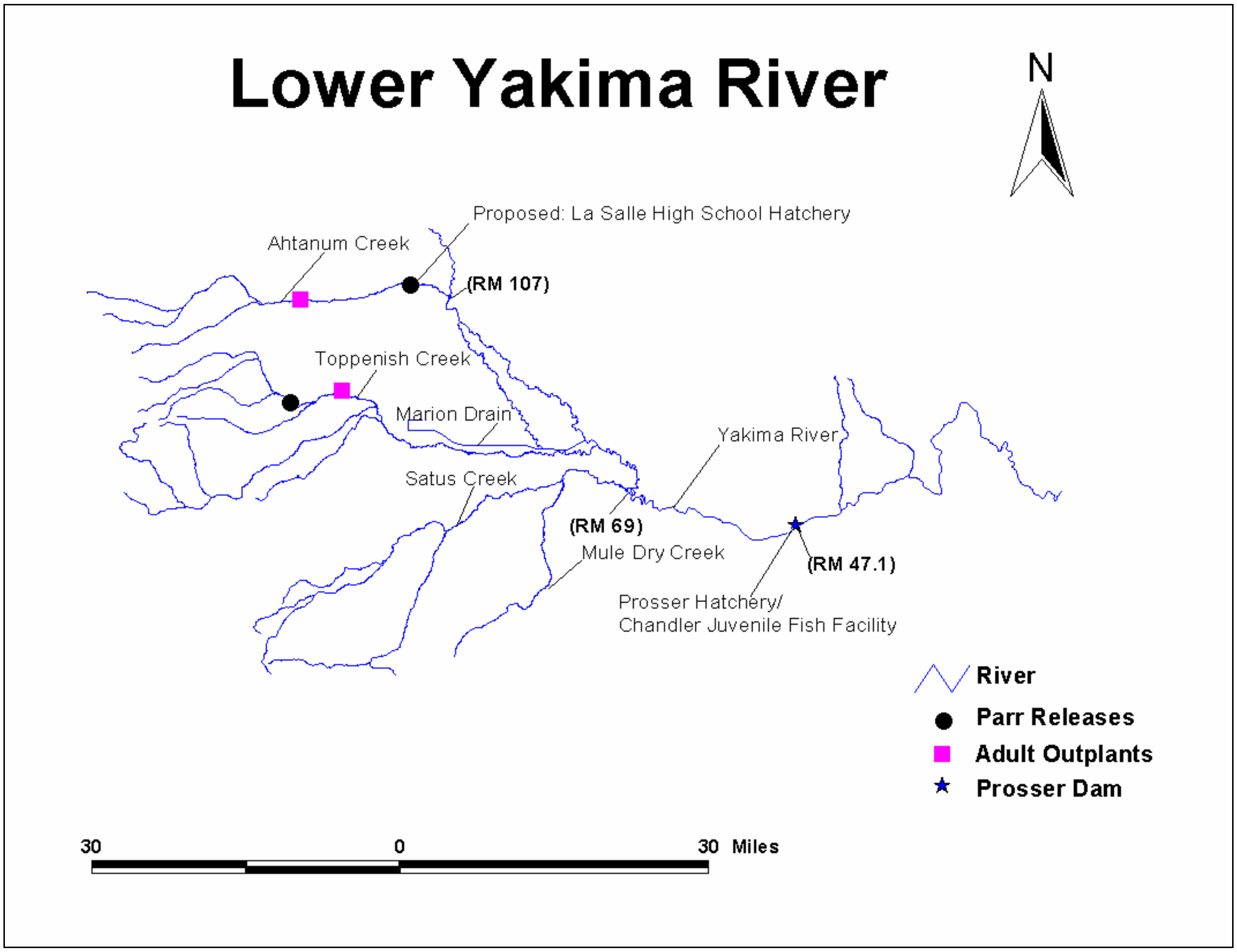


Figure 11. Coho Program Sites in the Lower Yakima River Subbasin

Ahtanum: This watershed historically produced coho salmon. Coho are naturally producing in this reach of the creek, and with recent passage and instream flow improvements, the potential exists to colonize the middle and upper mainstem to the Forks. Juvenile monitoring capabilities exist with the current rotary trap located at RM 0.75.

Toppenish: It is thought that coho salmon historically resided in the Toppenish watershed (see Section 4.1.1). Toppenish Creek upstream of the WIP Dam (RM 44.2) affords good to excellent spawning and rearing habitat. An established juvenile monitoring site (rotary trap) exists on Toppenish Creek that would allow in-basin monitoring of production and migration timing. Generally good flow conditions during spawning would allow for accurate redd counts to estimate adult escapement. Counts may also be possible at the WIP diversion dam located at RM 3.4 (Satus Unit pump station).

Wilson Creek: Wilson Creek in the upper Yakima basin was historically a significant coho salmon tributary. Significant habitat improvements have been made and more are planned (personal communication, Scott Nicolai, YN, 2003). To this point, improvements to upstream access and screening of diversions are the primary items, with riparian restoration projects among others being planned. Currently the creek is thought to be under-utilized by anadromous fish, given the recent habitat improvements. The presence of coho salmon in the creek could provide a way to educate local citizens and spur an interest to further protect and enhance the creek for all salmonids. Monitoring and evaluation opportunities exist on the creek both for juveniles (either using a rotary trap or an existing diversion dam) and adults (using one of the existing diversion dams and fish ladders).

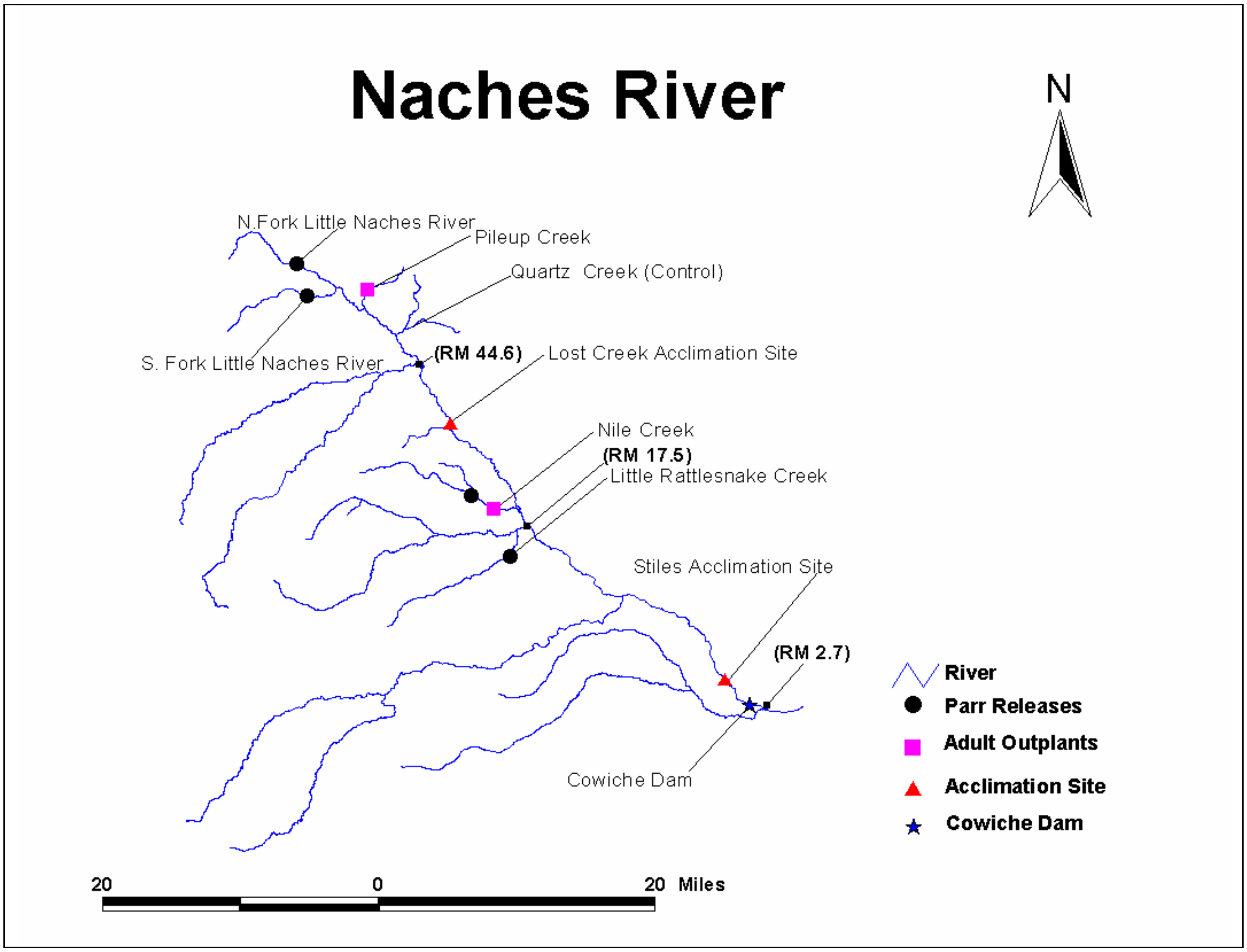


Figure 12. Coho Program Sites in the Naches River Subbasin

Risks: The primary NTTOC species identified by the YKFP as meriting special attention by the coho project are steelhead and bull trout (both ESA-listed species) and spring chinook.

There is steelhead spawning/rearing or rearing/migration habitat in several of the streams where coho parr would be released, including Toppenish and Ahtanum creeks, and the upper Yakima, Naches, and Little Naches rivers (see Figure 5, Section 4.1.2). In the Ahtanum, most steelhead redds are found several miles above the upper limit of where coho would be released (RM 23) (Brandon Rogers, YN, personal communication, March 2003). In Toppenish Creek, steelhead spawning areas begin above the WIP diversion dam (RM 44.2), in the zone where the agricultural valley transitions into shrub-steppe and ponderosa pine habitat. As a result, coho smolt releases would overlap steelhead spawning and rearing habitat in the Toppenish, as coho could be released between RM 44 and 55. However, most steelhead spawning takes place above the Forks area at RM 55 (Brandon Rogers YN, personal communication, March 2003).

Bull trout are also found in Ahtanum Creek (see Section 4.1.2), but not below the North and South forks (RM 23.1) (Eric Anderson, WDFW, personal communication, December 2002). A very low level of interaction risk was identified (Table 11). Bull trout are not known to occupy the other release creeks. Although spring chinook spawn and rear in the middle and upper reaches of Rattlesnake Creek and rear to some degree in the lower section, they use Little Rattlesnake Creek rarely, if at all.

Overall, Tables 9 – 12 show a low risk of interactions between coho and several other fish species. The highest level of interaction risk identified (20.5) was in Toppenish Creek, between coho and steelhead (Table 12).

Effects of smolt trapping are discussed in this section, Strategy 1f. **Effects of habitat use and distribution surveys** are discussed in Section 6.2, Strategy 2b.

Strategy 1d. Test egg-fry survival, adult productivity, and interactions with NTTOC by releasing adult coho in selected tributaries to the Yakima and Naches rivers.

Method: Adult coho would be trapped as part of the broodstock collection process (see Strategy 1e for locations and methods), and transported to selected streams for release. The streams and reaches that would be used are listed below and shown in Figures 10 – 12. Twenty pairs of fish would be released at each site, except in Taneum Creek, where 120 females and 160 males would be released. Taneum Creek will also be an NTTOC study stream, and has been the subject of extensive surveys by WDFW (see Section 6.3, Strategy 3b). Not all streams would be planted every year. The rationale for using these streams is similar to that for the selection of the parr release streams.

- Upper and lower Yakima

- Taneum Creek: From Taneum diversion (mainstem RM 2.25) to North Fork/South Fork confluence (RM 12.7)
- Wilson Creek: From Cherry Creek (RM 1.1) to Bull Ditch (RM 7.8)
- Reecer Creek: RM 0 – 2.
- Ahtanum Creek: From Goodman Road (RM 2.8) to North Fork/South Fork confluence (RM 23.1)
- Toppenish Creek: From Toppenish Lateral Canal (RM 44.2) to North Fork (RM 55.4)

- Naches

- Pileup Creek: From USFS Road #19 crossing (RM 0.25) to end of spur road (RM 2)
- Nile Creek: From USFS boundary (RM 3) to Glass Creek confluence (RM 7.5)

Egg-fry survival/adult productivity study methods are described under Strategy 1f. NTTOC studies are described in Section 6.3, Strategy 3b.

Risks: Tables 9 – 12 show a low risk of adverse ecological interactions between adult coho and their progeny and other fish species. As is the case for parr releases in some streams, adult releases are not risk-free, but due to the nature of some of the studies (interaction studies), some risk must be imposed in order to accomplish the research.

Strategy 1e. Transition from use of Lower Columbia/hatchery origin coho to Yakima/natural origin coho broodstock as quickly as possible.

Method: For Phase 1A, in-basin broodstock were collected at Prosser Dam on the Yakima River (RM 47) between mid-September through mid-November. Phase 1A results suggest that returning fish lack stamina, because they are spawning well below their acclimation sites much higher in the basin, although return numbers higher in the basin are slowly increasing (see Section 4.1.1).

In Phase IB, the goal is to produce one million coho smolts that are released each year from in-basin fish. Appendix A projects how many fish would be collected depending on the run size, and the conditions under which the goal of having all broodstock from in-basin fish might be met. The program proposes the following protocols:

- Collect broodstock at Cowiche and Roza dams, when possible, because they are closer to current acclimation sites and preferred spawning and rearing habitat.
- Collect natural-origin returns (NORs) as a first priority, and hatchery-origin returns (HORs) as a second priority.
- Collect only 50% of the NORs each year and 75% of HORs.

These protocols would address the stamina issue in two ways:

1) by collecting at Roza and Cowiche, the program would be taking fish for broodstock that have demonstrated the ability to return much further upstream than Prosser;

2) by using natural-origin fish for broodstock while at the same time allowing for natural production, the program would encourage the development of a population adapted to local conditions, including migration distance.

Broodstock would be collected at Prosser Dam, at the Roza Adult Monitoring Facility on the upper Yakima (RM 128), and at Cowiche Dam on the Naches (RM 3.6). Broodstock would be collected randomly and in proportion to the projected run size past each collection site. Based on the pre-season run forecast and the number of experimental and broodstock fish required, the total number of fish to be collected is proportioned in weekly increments throughout the run. This results in a pre-season, weekly collection target number (low in the tails of the run, higher in the peak). All fish would be scanned with a coded wire tag detector (wand) to determine origin (hatchery or natural). Annual fluctuation in run size and the run composition of wild to hatchery adults will dictate how quickly and consistently in-basin and natural-origin broodstock numbers increase.

All adults collected in the Yakima basin for broodstock are trucked to the holding ponds at Prosser Hatchery. They are treated with formalin and checked weekly for ripeness. When ripe, they are spawned at Prosser Hatchery. Spawned-out carcasses would be returned primarily to tributary sites and possibly to mainstem areas near the acclimation sites.

Risks: Adult steelhead return to spawn at the same time as coho, so could be trapped during coho broodstock collection. The primary effect would be migration delay and stress from handling; a small amount of mortality is possible, but rare. Bull trout are rarely seen in these areas, and are seen primarily in the spring, so are unlikely to be affected by coho broodstock collection in the fall.

The trap for broodstock collection at Cowiche Dam would be run for coho purposes only (Roza is being operated to mark steelhead). Because it has not been operated in the fall to date, the number of steelhead the project would handle is unknown. Based on NMFS steelhead radio-telemetry study (Hockersmith et al. 1995), Toppenish, Satus, Marion Drain, lower Naches and upper Yakima combined accounted for only 10% of the steelhead over-winter areas. Because steelhead tend to hold primarily in the lower mainstem over winter, it is unlikely that many steelhead would be encountered at the Cowiche trap during the coho broodstock collection period.

Dates and times of operation at each facility, as well as its permitting status, are as follows:

<u>Roza</u>: Oct 1–Dec 7, 7 days/week, 24 hours. It is operated under a Section 10 permit (currently being processed), to radio tag and PIT tag adult steelhead. For the past 10 years, the mean steelhead count at Roza has been 79 steelhead, with numbers ranging from 15 to 216. Counts were in excess of 100 between return years 2000 and 2002: specifically, 108, 141, and 238 for 2000, 2001 and 2002 respectively. The coho program would operate within the limits of the existing permit, so would cause no additional adverse effects on steelhead. According to Mark Johnston, trap operator, bull trout have been captured at Roza Dam—20 fish in 1999, less than 5 other years. All were encountered in the spring, so the likelihood of encountering them during coho broodstock collection is low, and coho trapping would not exceed current trap operations.

<u>Cowiche</u>: Oct 1–Dec 7, 7 days/week, 24 hours. Bull trout could be in the area, but no data exist on their use of the area (Eric Anderson, WDFW, personal communication). The probability is low of encountering them because, based on their life history characteristics, they would be unlikely to be migrating during this period. As stated previously, the project expects to encounter low numbers of steelhead during the broodstock collection period (Hockersmith et al. 1995, BPA et al. 1999b).

<u>Prosser:</u> Oct 1–Dec 7, 5 days/week, 24 hours. The trap would operate under existing permits. As stated in BPA et al. 1999b, the project would encounter adult steelhead during broodstock collection at Prosser Dam. However, because less than 20% of the returning steelhead use the right bank ladder during the coho broodstock collection period, the impact would not be adverse. Mortality at this facility would be low because any non-target fish entering the collection facility are immediately netted from the livebox and passed through a window back into the ladder exit area (BPA et al. 1999b). The primary effect would be a slight delay in migration.

Strategy 1f. Monitor and evaluate factors that will determine when a self-sustaining and naturally producing population of coho is re-established in each subbasin, including adult productivity, egg-fry survival, over-winter survival (parr-smolt), smolt-smolt survival, and smolt-adult survival.

Methods:

Adult-to-adult productivity. This represents one of the four criteria defining Factor 1 of project success (P>= 1.0). Adult productivity will be measured at each subbasin broodstock collection facility for both natural and hatchery components. Adult-to-adult survival for each subbasin is calculated as follows:

$P_{adult} = S_1/S_2$;

where P_{adult} is the estimated adult-to-adult survival; S_1 is the number of returning adults past Roza or Cowiche dam; and S_2 is the number of adults from the parent brood year producing the S_1 returning adults. A "P" value that averages greater than 1.0 over several generations indicates that the population is sustainable and increasing.

The Roza facility provides for 100% interrogation. The adult fish passage efficiency for the Cowiche Dam fishway is unknown, but based on video monitoring and visual observation for the last three years, it is thought to be 80% or better. All returning adults at each facility will be wanded with a portable detector for the presence of a CWT to distinguish wild and hatchery origin fish. Any fish that spawns or drops out below Roza or Cowiche dams obviously will be excluded from the adult-adult productivity calculation. An estimated percentage of the returning adult population that displays this behavior can be determined by subtracting the Roza and Cowiche fish counts from the Prosser Dam video fish counts. However, it is not possible in this group of fish to determine their origin, whether natural or hatchery.

Because it is anticipated that a high component of the run will spawn downstream of Cowiche and Roza dams, and that there will be a need (at least in part) to collect broodstock at Prosser Dam, an estimate of adult-to-adult survival will be made at Prosser. This will be calculated using the video counts and the wild-to-hatchery ratio determined from fish handled at the Prosser denil ladder.

Egg-to-fry survival/adult productivity. Egg-to-fry survival will be estimated for selected redds in the Yakima and Naches subbasins, with corresponding gravel samples taken to determine gravel quality. Target streams would be those where adults are released.

A minimum of five redds from each creek will be capped. Redds determined to have the best chance of being successfully capped will be selected. The spawned-out female will be captured and measured for fork length; the Prosser Hatchery egg fecundity-to-fork length relationship will be used to estimate the number of eggs each female deposited. The redd cap—a nylon-mesh cloth bag with an attached live box at the cod end—will be placed on the redd 1-2 weeks before the expected emergence date, calculated based on Temperature Units (TUs). To estimate date of fry emergence, a HOBO thermograph located near each redd will be used to determine cumulative TUs. Emergent fry will be enumerated daily from each respective livebox.

Over-winter (parr-smolt) survival. All parr will be PIT tagged and monitored at various traps and detectors. New traps on a few tributaries will allow researchers to determine if parr have remained in the release stream over the winter or if they left before the normal smolt migration period in the spring. PIT detectors at those traps, as well as at mainstem points (Roza, CJMF, McNary) will help researchers calculate over-winter survival.

Smolt-to-smolt survival. Smolt-to-smolt survival can be estimated only for *hatchery* smolts released from each subbasin. The absence of effective juvenile monitoring sites in appropriate places in either the upper Yakima or Naches subbasins precludes estimating the number of *naturally produced* coho smolts from each subbasin.

To monitor out-migration, smolts would be trapped at existing and new rotary traps:

Ahtanum Creek: RM 0.75 (Fullbright Park) (existing trap)

Toppenish Creek: RM 26.5 (existing trap)

Yakima River: RM 128 (Roza Dam) (existing trap)

Taneum Creek: RM 4 (diversion dam) (new trap)

Wilson Creek: RM 2 (irrigation dam) (new trap)

Naches River: RM 18.4 (Selah-Naches diversion) (new trap)

Hatchery smolt-to-smolt survival for each subbasin is calculated as follows:

$S_H = S_{H\text{ at CJMF}} / S_{H\text{ released}}$

Where S_H is the estimated hatchery smolt-to-smolt survival rate; $S_{H\text{ at CJMF}}$ is the estimated number of hatchery smolts past CJMF; and $S_{H\text{ released}}$ is the total number of hatchery fish released from both subbasins.

Prior to acclimation (usually in fall or late winter), all hatchery fish will be coded wire tagged in the snout, but not adipose clipped. Each group and acclimation/release site will have its unique CWT code. In addition, 1,250 fish from each group and acclimation/release site will be PIT tagged at the Prosser Hatchery by YN personnel. Coded wire tagging will be subcontracted to USFWS and conducted at Prosser Hatchery for the Yakima stock fish and at Cascade Hatchery for the Cascade stock fish.

The total number of fish placed into each of the four ponds will be determined from the total number of CWT fish minus any mortalities between the time of marking and transfer to the ponds. The estimated number of smolts passing CJMF is determined using the spring chinook smolt entrainment rate vs. percent flow-diverted relationship.

A relative smolt-to-smolt survival comparison from CJMF to McNary Dam for natural and hatchery smolts will be made using the PIT tag data. The McNary Dam relative smolt survival index value as calculated by YN statistician D. Neeley will be used to compare relative smolt-to-smolt survival between these two groups of fish.

Smolt-to-adult survival. Smolt-to-adult survival can be estimated for both naturally and hatchery produced coho. Naturally and hatchery produced smolts are counted at CJMF, and returning adults are counted at Prosser Dam. This represents our best method to compare relative smolt-to-adult survival rates between naturally and hatchery produced fish. In addition, smolt-to-adult survival for hatchery fish released as smolts from the acclimation sites to returning adults at Prosser, Cowiche and Roza dams can be estimated. However there is no similar method to estimate smolt-to-adult survival for naturally produced smolts originating from the upper Yakima and Naches subbasins. Though the majority of naturally produced smolts in the upper

Yakima occur upstream of Roza Dam, this facility has not proven reliable for estimation of juvenile out-migrants. Currently in the Naches subbasin, the majority of spawning appears to occur downstream of the Selah-Naches diversion, which potentially could be developed into a suitable juvenile monitoring site (see Section 6.4, Strategy 4b).

Estimates of smolt-to-adult survival for naturally produced and hatchery fish is a continuation of the smolt-to-smolt survival discussed above. The fraction of naturally produced or hatchery adults will be multiplied by the total number of adults passing each dam to estimate the total number of naturally produced and hatchery fish returning to that facility. The estimated number of naturally produced smolts at CJMF will be used for the natural to hatchery smolt-to-adult comparison, and the estimated number of hatchery smolts that out-migrated from each acclimation site will be used to determine the hatchery smolt at release-to-adult survival.

Risks: With the exception of a few smolt traps and PIT detectors, facilities already exist to do much of this monitoring. Handling as described rarely leads to mortality and would be within existing limits and protocols at Prosser, and as already described at Roza and Cowiche. The most significant risk is to the coho when they are tagged, as some mortality can occur (by some estimates, up to 20% of PIT-tagged fish, due to the stress caused by handling) (Prentice et al. 1994). PIT tagging survival at Cle Elum for spring chinook tagged in the fall/winter by YN personnel has averaged 96-97% (Mark Johnston, personal communication, 2003). The coho, though valuable, are considered research fish, so the risks normally associated with PIT tagging fish are considered acceptable. Mortality is also associated with coded wire tagging, but again, the risk and loss of fish are considered acceptable in order to collect data for the research.

<u>Effects of new PIT detectors</u>. Although new PIT detectors would be needed at the Selah-Naches diversion, at diversions on Wilson and Taneum creeks, and the rotary traps in the Ahtanum and Toppenish subbasins, they would be placed at existing facilities, so no environmental disturbance would occur.

<u>Effects of redd capping.</u> Placing the redd caps requires digging a 6-inch-deep trench around the perimeter of the redd just before the coho are expected to emerge, then backfilling with gravel. The amount of sediment raised would be no more than the fish itself raises. No other effects on other species or the stream environment would occur.

<u>Effects of smolt traps.</u> To monitor migration numbers and timing, coho smolts would be trapped at existing or new traps in selected subbasin streams. Existing traps include those at Roza Dam and Chandler Juvenile Monitoring Facility (CJMF) on the Yakima mainstem, and rotary traps on Ahtanum Creek at RM 0.75 and on Toppenish Creek at RM 26.5.

The CJMF facility is the primary juvenile monitoring facility in the Yakima basin and is operated year-round. The Roza trap is operated for spring chinook PIT tagging 24 hours a day from November 1 through March 31. Coho will be trapped and PIT tagged as part of the spring chinook operation. The trap is checked in the morning, and captured fish are PIT tagged and released later the same day. Because the coho program would use the trap within existing parameters, it would cause no additional adverse effect on listed species.

The Ahtanum and Toppenish traps are operated to evaluate steelhead smolt production and migration timing (BPA-funded projects #199901300, 199705300 and 199603500) under existing NEPA documentation and ESA permits. Both traps operate between November 1 and June 30, 7 days a week, 24 hours a day.

At the Ahtanum and Toppenish facilities, the coho project would trap juveniles within the limits of existing permits. The primary effect on the steelhead is migration delay and stress from handling. During the period coho would be migrating and thus subject to trapping, steelhead would not be of a size to be prey for coho. The trap is checked daily; staff measure and weigh 50 steelhead smolts (and presumably coho) per day at each trap. Fish are anesthetized with a eugenol mixture of 1:9 clove oil to denatured ethanol per liter of water. Once sampled and fully recovered, fish are released below the trap.

The allowable incidental non-lethal take of steelhead is 5,000 annually for the Toppenish trap and 200 annually for the Ahtanum. Staff calculate a lethal take of 100 steelhead at the Toppenish trap and 4 at the Ahtanum trap. Bull trout are not found in these lower elevation waters. Because the coho smolt trapping program would operate within the limits of the existing steelhead ESA permits, it would cause no additional adverse effect on listed species.

New traps are proposed on Taneum and Wilson creeks in the upper Yakima subbasin; and at the Selah-Naches diversion canal on the Naches River. See Section 6.4, Strategy 4b for a discussion of the effects of the new traps.

6.2 Objective 2 Methods and Risks

Objective 2. Continue to investigate the coho life history in the Yakima basin.

Strategy 2a. Conduct spawner surveys throughout the Yakima basin.

Method: Conduct foot/boat surveys, with locations determined by past and current telemetry distributions. Currently these include the Yakima mainstem (Keechelus Dam to Granger); the mainstem Naches (Little Naches to confluence); and tributaries where coho have been released.

Conduct peak and end-of-season surveys between September 15 and November 30. Flag redds with ribbon and record locations using Global Positioning System (GPS).

Risks: These surveys pose little or no risk to other species or to the environment. The primary risk is to the 100 coho that would be radio-tagged. As these are research fish, the potential mortality is considered a necessary risk in order to accomplish research objectives.

Strategy 2b. Determine, in general terms, where coho currently are found in the basin and their abundance.

Method: Conduct snorkel and electro-fishing (both boat and backpack) surveys to determine the geographic and seasonal distribution and relative abundance of juveniles. Parameters measured will be presence/absence and relative abundance (i.e., catch per unit effort (CPUE) or fish per linear meter). Specific locations and times proposed are:

Snorkeling: Systematic sampling (10%) of preferred habitat (side channel areas and mainstem pools) in the following streams:

- Upper Yakima: Easton to Ellensburg
- Naches mainstem: Little Naches River to confluence
- Release tributaries (Taneum, Ahtanum, Toppenish, Pileup, and Nile creeks), to coincide with release reaches

Summer, 3 days for each major subbasin, 1-2 days for each tributary

Juvenile electro-fishing surveys (boat): Systematic sampling of preferred habitat in Yakima mainstem: 10 half-mile reaches between Roza Dam (RM 128) and Granger (RM 83).

One in summer, one in fall/winter

Juvenile electro-fishing surveys (backpack): Backwater channel areas in the following rivers:

- Upper Yakima mainstem: Easton Dam to Wilson Creek
- Naches mainstem: confluence to the Little Naches River
- Little Naches River: confluence to North Fork and lower half mile of tributaries (based on presence of redds)

November-February, 5-10 days/month, not every area annually

Risks:

Electro-fishing. Electro-fishing has the potential to injure fish. Although most if not all stunned adult and juvenile fish appear to recover sufficiently to swim away, long-term effects or effects that do not result in immediate mortality are not well understood (USDI FWS 2001). During research in the Columbia River basin, an electro-shocking injury level for incidentally shocked juvenile salmon has been estimated at 10 percent (M. Schuck, fishery biologist, Washington Department of Fisheries, pers. comm. [in] Scholz 1992). Barton and Dwyer (1997) found that, for juvenile bull trout, electro-shock resulted in increased plasma glucose and plasma cortisol levels indicative of acute stress (in USDI FWS 2001).

We estimate that a maximum of 45 steelhead juveniles and 0 bull trout juveniles could be captured and released during the boat electro-fishing surveys in the Yakima mainstem, with the potential for an unintended lethal take of 10 steelhead annually. This assumes 60 hours of actual electro-fishing time annually and is based on springtime boat electro-fishing surveys conducted in 2002 between Zillah and Sunnyside Dam by YN personnel (Linda Lamebull, YN, personal communication, 2003). In these 2002 surveys, 35 *O. mykiss* were captured as an incidental species over the course of 3 months of electro-fishing. Total time spent electro-fishing was 46.9 hours, averaging an encounter rate of 0.75 steelhead per hour. To reduce the potential for fish mortality, YN will use trained personnel, will apply the NMFS electro-fishing guidelines (NMFS 1998) and guidelines found in Fredenburg (1992), and will meet all requirements of the ESA Section 10 permit required by NMFS for electro-fishing in areas with listed steelhead.

Assuming a similar rate of encounter for backpack surveys, and an hour of electro-fishing at each site, we estimate that up to 50 steelhead per site would be captured and released, with an unintended lethal take for all sites of 5 steelhead.

Snorkeling. It is possible that a snorkeler could frighten a fish from its hiding place, causing it to be caught and eaten by a predator. However, the low number of surveys per year on any particular stream (up to 17,000 meters on the Upper Yakima and Naches and 8,000 meters on the tributaries for the distribution/habitat usage surveys), the short amount of time a snorkeler would spend in any reach, and the snorkeler's training to observe only, make it unlikely that the surveys would cause injury to or significantly disrupt normal behavior of listed fish as described in the NMFS definition of "harass" (NMFS 1996).

Strategy 2c. Determine life history timing.

Method: Use PIT-tagged fish to monitor hatchery smolt out-migration timing from the acclimation sites and selected parr release tributaries to CJMF and to McNary Dam.

Monitor naturally produced outmigrants (fall-spring) by PIT tagging summer-winter juveniles in rearing areas (see Table 2 for locations) and interrogating them at Roza Dam; at new detection sites in the upper Yakima, Naches, and lower Yakima subbasins (see Table 2); and/or at Chandler Juvenile Monitoring Facility and at McNary Dam. For fish that are interrogated at one of the PIT tag detection sites, life history information would be recorded. If taken at Roza, CJMF, or one of the tributary rotary traps, timing and fork length would be recorded.

Evaluate PIT-tagged adults/jacks at mainstem dams and at the denil ladder at Prosser Dam.

Risks: See Section 6.1, Strategy 1f.

6.3 Objective 3 Methods and Risks

Objective 3. Assess ecological interactions.

Strategy 3a. Study coho residualism in release locations where steelhead also are found.

Method: Because Phase 1A studies found low levels of residualism in hatchery coho smolts released in the upper Yakima and Naches basins (Section 5), Phase 1B residualism studies are proposed only near the new release site at Taneum Creek.

- Randomly sample downstream of the new release site in early summer.
- Conduct snorkel surveys in a downstream direction, using two snorkelers along each bank.
- Record the number of coho per section.

Risks: Snorkel surveys would not cause environmental impacts (see Section 6.2, Strategy 2b). Studies in the Yakima basin have so far shown low rates of hatchery smolt residualism (see Section 5). Fish culturing practices are not expected to change, so those low rates are expected to continue.

Whether planted coho parr will residualize in greater numbers than smolts remains a question. Although there is some overlap with steelhead spawning habitat in a few creeks, most coho parr plants are proposed downstream of steelhead habitat (see Section 6.1, Strategy 1b). Bull trout probably would not be affected by any residualized coho, as most bull trout habitat is upstream of fry planting areas. If there were overlap, however, coho parr likely would be prey for bull trout. See more discussion in Section 6.1, Strategy 1c.

Strategy 3b. Study interactions between natural-origin coho or surrogates and other salmonids.

Methods: Although Phase 1A studies show little risk of negative ecological interactions between hatchery coho smolts and other fish species (see Section 5), concerns remain about the potential for naturalized coho to negatively affect listed or sensitive species, particularly as coho numbers increase.

Competitive interactions between coho and other species are often investigated using two general techniques: controlled field studies and laboratory investigations. Each general approach has potential strengths and weaknesses. Field studies may lack statistical power, but are seldom criticized for lacking relevance to actual conditions. In laboratory conditions, on the other hand, statistical power is easily achievable through controlled replication, but natural conditions which closely parallel the stream ecosystem are difficult to replicate.

<u>Alternative approach considered</u>: The project considered conducting a controlled experiment similar to one being conducted in the Wenatchee basin, using hatchery-fed fry as surrogates for natural fish. Two stream reaches or two tributaries would be selected, where one reach or one tributary is seeded with hatchery coho (treatment) and the other is the control. Using snorkel surveys in both the treatment and control reaches/tributaries, the following parameters would be measured:

- distribution of coho and species of concern;
- macro/micro habitat usage by individual coho and species of concern (water depth, flow, cover, substrate type and velocity);
- body length and weight and condition factor for both coho and species of concern.

The results would be evaluated, looking for significant changes over the summer in macro/micro habitat shifts, changes in distribution, and/or changes in condition factor or growth rates.

<u>Proposed approach:</u> The proposed study approach is similar to the alternative except that naturally produced fish would used, and the surveys would be done using electro-fishing.

The project proposes to sample one treatment and one control tributary in the Naches and upper Yakima subbasins. The paired streams are (see Figures 10 and 12):

- Upper Yakima: Taneum (treatment: RM 2.25 – 12.7); Swauk (3 control reaches from RM 1-14 coincide with WDFW study reaches)

- Naches: Pileup (treatment: RM 0.25 - 2); Quartz (control: RM 1 - 2)

In the upper Yakima, the two streams selected coincide with streams and reaches that have been the focus of WDFW *O. mykiss* abundance, distribution, and growth surveys for at least ten years; their data will provide an excellent baseline from which to monitor changes that might be attributable to the introduction of coho. The streams selected in the Naches will not have that level of baseline data available but have been subject of similar studies by the coho program in the late 1990s.

In Taneum Creek, 120 adult females and 160 adult males would be released in the fall and allowed to spawn naturally. In Pileup Creek, twenty pairs of adults would be released. In summer, during low flows, project staff would install a block net and electro-fish three 200-meter reaches in each of the four streams to measure abundance. The fish would then be captured, weighed, measured, and released. Changes in abundance would be examined. The control reaches, particularly in Swauk Creek, would help researchers determine if variations are attributable to environmental conditions. If they see variation in the treatment stream that is outside the range of variation in the control stream, it could signal that further study is needed to determine if the change is attributable to the coho introductions.

Risks: These studies require deliberately posing a risk of negative interactions between coho and steelhead. As discussed in BPA's most recent Supplement Analysis of the effects of the Yakima coho program (BPA 1999), researchers in other areas have reported conflicting results in studies of coho competitive interactions with other species. Some studies showed that coho displaced other species, while others showed apparent differences in preferred habitat between species. In 1998, the YN conducted field experiments with coho fry to address the impacts of coho on the growth, abundance, and broad-scale geographical displacement of cutthroat and rainbow/steelhead trout in the Yakima basin. Researchers found no evidence that coho salmon influenced the abundance of cutthroat or rainbow trout when they compared the abundance of each species at sites where coho were stocked as well as where coho were not stocked. In addition, they found no evidence that coho affected the growth of cutthroat or rainbow trout when they compared the condition factor of each species in areas with and without coho (Dunnigan and Hubble 1998; Dunnigan 1999). However, sample size was small, and the primary focus of the study was not species interactions. See summary in Section 5.

It is unknown whether adults planted will reproduce successfully, or, if they do, whether their progeny will increase coho densities enough to provide statistically significant results. Alternatively, if the coho successfully spawn in natural habitat, and if they in fact pose a competitive risk to other species, it might be too late to eliminate the coho from the habitat. Although the risk assessment (Table 9) showed a risk to upper Yakima steelhead of 18 out of a possible 100 (fairly low), the uncertainty number was almost 10, indicating a noticeable difference of opinion on the level of risk among the biologists doing the assessment.

Electro-fishing poses a certain amount of risk to all fish in the study reaches, but use of trained personnel and compliance with established electro-fishing guidelines and permits would minimize the risk (see Section 6.2, Strategy 2b). An initial estimate of take of listed fish is approximately one percent of all fish sampled.

6.4 Objective 4 Methods and Risks

Objective 4. Develop and test use of additional acclimation, culturing, and monitoring sites.

Strategy 4a. Develop additional acclimation sites in upper Yakima River subbasin (Holmes, Boone Pond, and Taneum Creek).

Method: In Phase 1A, the project relied on a few permanent fixed sites at which to acclimate and release coho smolts. However, the project has had problems at these sites because many fish are lost to predation before they are released, or fish get out at the wrong times and compromise the experimental design. In Phase 1B, the project proposes to develop and use new acclimation sites in the upper Yakima subbasin: Holmes, Boone Pond, and Taneum Creek (for smaller release numbers). If excessive bird predation continues, existing alternate sites (Clark Flat or Easton Ponds) or, possibly improvements at Roza Dam, would be used.

The general characteristics and risks of using each site are discussed below.

Holmes Acclimation Site:

Location: Upper Yakima (RM 159.5) about two miles north of Ellensburg, WA, in T18N, R18E, Section 13, SW corner. This site was once an historic side channel that now functions as the fish bypass route for the Cascade canal. It enters the mainstem Yakima River below an I-90 crossing about 1.5 road miles east of the Thorp exit. The Cascade diversion dam is located at about RM 161.3, and the side channel enters the mainstem around RM 159.

Within the side channel are two ponds, most likely the remains of gravel extraction adjacent to I-90 for construction of the interstate highway. The only action required to make the site suitable for coho acclimation would be to block the outlets using nets or dam boards. Approximately 250,000 out-of-basin coho smolts would be acclimated there, but numbers could fluctuate, depending on production of Yakima-origin smolts.

Ownership: private.

Ecotype: historic floodplain, now disturbed ground used for agriculture.

Water Quality: Further downstream from this site, in Section 33, the Yakima River is 303d-listed for copper (WDOE 1998).

Listed fish species: steelhead.

Risks: Use of existing side channels and the upper pond would cause little environmental impact. YN biologists have observed juvenile spring chinook and coho in these ponds. *O. mykiss* probably inhabit the side channel with other non-salmonid species. Given the time of year for acclimation, there would be no fry-size *O. mykiss*. Though they are emerging, fry-size spring chinook are unlikely because the majority of spawning occurs above the Teanaway River (about 15 river miles upstream from the site). Thus, placing dam boards or nets for 6-8 weeks is not likely to hinder habitat use or passage for other species. However, to monitor actual usage, YN proposes to place a trap at the head of the upper pond to see if *O. mykiss* or spring chinook fry are attempting to move into the pond. If so, the fry could be moved downstream of the acclimation site to prevent them from becoming prey for coho smolts.

The shoreline of the upper pond is highly vegetated with wild rose, red osier dogwood, and other brushy species, which prevents cattle from accessing it. (Cattle do access the un-vegetated lower pond.) Project staff would use the farmer’s existing roads to access the ponds and the weir site. The roads and other access areas show evidence of considerable disturbance, with canarygrass and knapweed being the dominant species, so it is highly unlikely that sensitive plant species would be present or affected.

Boone Pond Acclimation Site:

Location: Upper Yakima (RM 180.5), about two miles south of Cle Elum, Washington, adjacent to Interstate 90. The pond was created during I-90 construction, and is directly connected to the Yakima River. Approximately 250,000 coho would be acclimated there initially, but numbers could increase if production of Yakima-origin fish improves.

The pond is shallow, fed by two small perennial streams from the south. Shorelines are steep on the north, east, and south. The site could be used by placing a barrier net across the backwater. However, the water level of the pond directly reflects water level in the river, which is low in the spring, when coho would be acclimated. Water level could be increased by constructing a check dam using masonry blocks (or possibly inflatable dams as are used for flood control), and hand-digging. A PIT detector could be placed at a notch in the check dam to monitor out-migration.

Ownership: private.

Ecotype: historic floodplain, now disturbed ground.

Water Quality: The area of the site appears to be on the 303d list for pesticides (WDOE 1998). The listing was based on tissue samples.

Listed fish species: steelhead.

Risks: The effect of developing this site probably would be low. Little additional ground disturbance would be required; the small amount necessary to install the check dam could be done by hand. In general, riparian and upland vegetation structure is limited; the disturbed nature of the site is evident by the prevalence of knapweed, though some wetland vegetation (e.g., cattails) is also present. The site is grazed by horses, but the landowners have initiated upland vegetation enhancement. Although the pond is in the floodplain, installation of a check dam would lead to, at most, only minor, short-term increases in sediment downstream, especially using standard erosion control practices. Water quality issues would need to be investigated.

Taneum Creek Acclimation Site:

Location: U.S. Bureau of Reclamation (USBOR)/Taneum ditch company diversion located at approximately RM 4.

Ownership: Uncertain, possibly USBOR.

Ecotype: Floodplain; ponderosa pine/cottonwood riparian zone along creek.

Water Quality: Supports *O. mykiss* population. Experiences low flow in late summer and fall below the diversion (lowest four river miles); this segment of the stream is 303d-listed for low instream flows and temperature (WDOE 1998).

Listed fish species: steelhead, bull trout.

Risks: This site would be used to test releases of a smaller number of smolts into a tributary stream (as opposed to mainstem smolt releases); and to test survival of early-run vs. late-run fish. Effects of volitional smolt releases are discussed under Strategies 1a and 1b.

Development of this site would cause minimal environmental impacts because the site has already been developed with construction of the fish bypass system. Fish would be acclimated within the fish bypass structure, thus no structures would be set up on the existing site.

ESA-listed species in the Yakima basin include bald eagle, spotted owl, snowy plover, lynx, and grizzly bear (all listed as Threatened), and gray wolf (listed as Endangered). There are also a variety of state-listed species in the basin (Berg and Fast 2001). Given the proximity of the Holmes and Boone Pond sites to I-90, it is unlikely that listed birds or wildlife occupy the areas; but if they do, they would be only temporarily disturbed by the installation of equipment, and perhaps by staff accessing the site for feeding and other activities. Effects on listed fish species of coho releases from these sites were discussed in Section 6.1, Strategies 1a and 1b.

Strategy 4b. Establish additional monitoring sites in the Yakima and Naches subbasins.

Method: The project proposes to install three new smolt traps to monitor out-migration and survival in new release areas:

- Naches River (Selah-Naches Diversion Canal, RM 18.4)
- Wilson Creek irrigation dam (RM 2)
- Taneum Creek (RM 4)

Risks:

Selah Naches Diversion Canal. Two options exist: 1) to place a capture box on the outfall pipe of the canal; or 2) to place a rotary trap in the canal immediately upstream of the outfall. Option 2 would probably catch more fish and give better monitoring results for the project but it poses more risk to listed fish, because more of them would also be captured.

Wilson Creek irrigation dam: Either a box trap or rotary trap could be installed at the site of the dam. The site is adjacent to the freeway and already disturbed (evidenced by canarygrass in the creek). Listed fish are unlikely to be trapped at this location because there is little if any spawning or rearing habitat for them in Wilson Creek.

Taneum Creek: Install a rotary trap in the canal between the headgate and screens, or in the creek immediately upstream of the canal headgate. Steelhead would be trapped at this facility.

Strategy 4c. Test use of a small-scale fish culturing facility.

Method: The proposed site is on land owned by and adjacent to LaSalle High School, at RM 2.2 on Ahtanum Creek. School officials recently expressed interest in the possibility of developing the site as a small-scale, full-life-cycle coho rearing facility. At this point, a reasonably foreseeable option would be to use this site to rear 30,000 coho eggs to summer parr. However, no specific proposal exists at this time.

If a proposal were to be developed, facilities could include a shed to house incubation raceways using stacked trays or Heath trays; portable raceways for rearing up to 30,000 parr or smolts (the acclimation and rearing vessel would be the same); and a holding pond for adults.

The adult holding pond likely would consist of a portable vessel. If a small incubation raceway is used for egg incubation using stacked trays, then once the eggs hatch, the stacks can be removed and the raceway used as the start vessel until the fish are ready to be ponded (moved outside to the big rearing raceways). There is an existing building that could be used for an incubation shed (although a prefabricated or portable cinder-block shed could also be used), and the site has a pump that pumps surface water out of the creek.

Risks: All required facilities and vessels would occupy approximately ¼ acre of already disturbed land. It is unlikely that rare vegetation or sensitive terrestrial or avian species would be found or affected, given the previous disturbance and the site’s proximity to the school and other development.

To achieve gravity flow at this site, we probably would need to excavate at least two feet to install the portable raceway below grade, with the water inflow and discharge pipes laid on the surface. This could result in the removal of approximately 1,280 cubic feet of soil from the floodplain. Effects on floodplain characteristics, including the floodplain's capacity to contain flood waters, would be evaluated during the permitting process.

Ahtanum Creek water would be used for rearing and acclimation. Summer water temperatures at the site are unknown. The latest available information from Washington Department of Ecology (WDOE) has no listings for Ahtanum Creek (WDOE 1998). The site has no well, so ground-water would not be available to reduce water temperature, if necessary. Flow requirements for rearing are 5-6 gallons per minute; approximately half this amount is needed for incubation. Wastewater would be discharged directly back into the creek. Even if the project were to rear coho to smolts—up to 25,000 smolts at 20 fish per pound at release (1,250 pounds of fish)—the project would be well within the WDOE limit of 20,000 pounds of fish before a settling pond is required. If the rearing vessel is installed partly below ground surface, the discharged wastewater would be cooler and probably would not increase water temperature in the creek.

If a specific proposal were made, the project would further evaluate existing water quality and supply, and if federal funding were involved, undertake a NEPA and ESA review (including, potentially, surveys for listed species, wetlands, and cultural resources). State review through the JARPA (Joint Aquatic Resource Permits Application) process also would be undertaken.

6.5 Objective 5 Methods and Risks

Objective 5. Determine long-term facility needs.

Strategy 5a. Investigate potential permanent spawning and incubation sites more suitable than Prosser for coho.

Rationale:

- The project's experience with rearing coho at Prosser has not been good. The water temperature at Prosser is too warm for summer rearing coho, and, due to agricultural pollutants, occasionally sub-lethal to lethal conditions have been experienced at the hatchery. The project has repeatedly lost fish there, which makes it difficult to meet production levels and to develop a locally adapted population. Lost fish means that dollars invested in feasibility studies and facilities are not used effectively.
- Prosser's capacity is limited to 500,000 coho smolts. In order to meet release goals of one million coho smolts annually, half the production must be reared out-of-basin, potentially slowing the project's ability to establish a locally adapted population.

Method: Project staff believe that, in order for coho to be reintroduced successfully, a more suitable rearing facility must be found or developed. For Phase 1B, the project proposes to investigate potential sites.

These investigations would be primarily "paper" research or site visits. Existing records on water quality, temperature, and flows; on water rights and ownership; and on other relevant issues would be researched. Research would be supplemented by site visits and initial engineering calculations. No test wells or ground disturbance would be required. The potential for small-scale as well as larger facilities would be examined, as well as the less favored option of rearing progeny of Yakima returns out-of-basin.

Risks: There is no environmental risk to this research. The research would benefit the project by finding and evaluating sites that could be suitable for coho incubation and rearing. Should feasibility studies prove promising, the information gathered could be used in evaluating proposals for a long-term reintroduction program.

Strategy 5b. Investigate the feasibility/desirability of establishing additional permanent, fixed acclimation sites in the upper Yakima, Naches, or other subbasins.

Method: This would be primarily an analytical exercise, similar to that for Strategy 5a.

Risks: This exercise poses no environmental or project risks.

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APPENDIX A. HYPOTHETICAL BROODSTOCK COLLECTION NUMBERS FOR YAKIMA COHO

Appendix A. Hypothetical Broodstock Collection Numbers for Yakima Coho

Fecundity:	3004.8	3004.8 eggs/female	
Assumed run ratio:		HOR	0.667
		NOR	0.333
Assummed sex ratio:	0.5		
Assummed 1-to-1 male/female spawning			
P.Hatchery collect-spawn survival:		90%	
P.Hatchery egg-release survival:		80%	

Broodstock Criteria: 50% cap on NORs & 75% cap on HORs as a function of run size

HOR Cap:	0.75
NOR Cap:	0.5

Run Size	NOR	HOR	Natural Escapement of NORs	Natural Escapement of HORs	Total Natural Escapement	Cap of 50% of NORs (40% denil capture efficiency)	Cap of 75% of HORs (40% denil capture efficiency)	Max. Broodstock Available	Actual NORs Collected	Actual HORs Collected	In-Basin Smolts Produced	Out-of-basin Needs Expressed as Smolts	Broodstock females	Broodstock males	Total
1000	333	667	266	467	733	67	200	267	67	200	288,497	711,503	462	462	924
1200	400	800	320	560	880	80	240	320	80	240	346,196	653,804	462	462	924
1400	466	934	373	654	1,027	93	280	373	93	280	403,896	596,104	462	462	924
1600	533	1,067	426	747	1,173	107	320	427	107	320	461,595	538,405	462	462	924
1800	599	1,201	480	840	1,320	120	360	480	120	360	519,294	480,706	462	462	924
2000	666	1,334	533	934	1,467	133	400	533	133	400	576,994	423,006	462	462	924
2200	733	1,467	586	1,027	1,613	147	440	587	147	440	634,693	365,307	462	462	924
2400	799	1,601	639	1,121	1,760	160	480	640	160	480	692,392	307,608	462	462	924
2600	866	1,734	693	1,214	1,907	173	520	693	173	520	750,092	249,908	462	462	924
2800	932	1,868	746	1,307	2,053	186	560	747	186	560	807,791	192,209	462	462	924
3000	999	2,001	799	1,401	2,200	200	600	800	200	600	865,491	134,509	462	462	924
3200	1,066	2,134	852	1,494	2,347	213	640	853	213	640	923,190	76,810	462	462	924
3400	1,132	2,268	906	1,587	2,493	226	680	907	226	680	980,889	19,111	462	462	924
3466	**1,154**	**2,312**	**923**	**1,618**	**2,542**	**231**	**694**	**924**	**231**	**694**	**999,930**	**70**	**462**	**462**	**924**
3600	1,199	2,401	959	1,681	2,640	240	720	960	240	720	1,000,000	0	462	462	924
3800	1,265	2,535	1,012	1,774	2,787	253	760	1,013	253	760	1,000,000	0	462	462	924
4000	1,332	2,668	1,066	1,868	2,933	266	800	1,067	266	800	1,000,000	0	462	462	924
4500	1,499	3,002	1,199	2,101	3,300	300	900	1,200	300	900	1,000,000	0	462	462	924
5000	1,665	3,335	1,332	2,335	3,667	333	1,001	1,334	333	1,001	1,000,000	0	462	462	924
5500	1,832	3,669	1,465	2,568	4,033	366	1,101	1,467	366	1,101	1,000,000	0	462	462	924

APPENDIX B. COST ESTIMATES FOR YAKIMA COHO PROGRAM

Coho M&E annual budget:

Personnel	$136,050
Supplies & Materials	$47,532
Indirect Cost	$35,798
Sub-Contracts	$ 0
Total	**$208,743**

Coho O&M annual budget:

The total amount covers operation of the Prosser and Marion Drain Hatchery sites. Fall chinook and coho are raised at Prosser. Coho costs are not tracked separately.

Total	**$1,061,012**

Administration annual budget:

Administrative costs are included in YKFP's budget for M&E Management, Data and Habitat. Coho program costs are not tracked separately.