❖Skagit River Basin

Overview

This region includes the watersheds contained by the Skagit River Basin. For the purposes of this review, the Scientific Group reviewed the hatchery programs involving each identified regional salmonid stock (for example, Skagit spring chinook). The review included a consideration of the program's effects on all other hatchery and naturally spawning regional salmonid stocks (see table below under Stock Status). This chapter provides an overview of the Skagit region, followed by reviews and recommendations for each salmonid stock that has an associated hatchery program.

FISHERIES[16]

Chinook, pink, coho and chum salmon harvest management in the Skagit region is directed primarily towards the needs of natural production. Hatchery releases are primarily intended for indicator stock research and escapement estimation, but coho fisheries targeting hatchery returns have been conducted in Swinomish Channel, Oak Harbor, and the Cascade River, and the co-managers are considering isolated harvest fisheries for chinook that could be conducted in future years on returns to such potential sites as Similk Bay, Swinomish Channel, the Baker River, and the Cascade River. Sockeye salmon harvest management in the region is directed primarily towards filling the Baker Lake artificial spawning beaches. Spawners in excess of spawning beach needs are used for harvest, tribal ceremonial and subsistence purposes, and to test the natural production capabilities of the Baker system.

Winter steelhead harvest management in the region is directed primarily towards harvesting surplus hatchery and wild production during the early part of the run, then reducing harvest intensity when the wild run predominates, in order to achieve wild escapement objectives. Summer steelhead recreational harvest management in the region is directed primarily towards harvesting hatchery steelhead and avoiding retention of wild steelhead. There are no tribal fisheries that target summer steelhead, and there are no escapement goals for summer steelhead in this region.

Pre-terminal harvests of hatchery and natural-origin fish occur primarily in Canada, the Washington ocean fisheries, north and central Puget Sound, and in the Strait of Juan de Fuca. Terminal harvests on hatchery and natural-origin coho, chum, pink, sockeye and steelhead occur primarily in the Skagit River and Skagit Bay. Where possible, harvests are scheduled and located to target harvestable wild and hatchery-origin fish and minimize the harvest of listed chinook and other depressed stocks. There is no targeted terminal harvest on natural-origin even-year pink salmon. Sea-run cutthroat and bull trout/Dolly Varden management is based entirely on natural production.

In the Skagit terminal area, the biggest fisheries (in terms of numbers) are those directed at pinks and chums. Coho harvests have become more substantial during the last ten years, and chinook harvests, which were once the primary income-producer, have declined sharply. Baker sockeye catches have been low, but it is possible that they have the potential for significant increases. For tribal ceremonial and subsistence purposes, the primary sources are Baker sockeye and test fishery catches of hatchery and wild spring chinook, summer chinook, coho, and chum.

[16] *Darrell Mills, Washington State Department of Fish and Wildlife and Bob Hayman, Skagit System Cooperative, November 2002.*

CONSERVATION[17]

All Puget Sound chinook are currently managed under the *Puget Sound Comprehensive Chinook Management Plan: Harvest Management Component*, March 23, 2001. The intent of this plan is to maintain exploitation rates on natural chinook populations at or below levels that will allow them to rebuild as habitat conditions improve to allow greater production. All spring, summer and fall chinook hatchery enhancement efforts within the Skagit Basin are aimed at conserving the native stocks and providing Pacific Salmon Treaty (PST) index stocks and wild stock indicators. The summer and fall programs may also be used to supplement natural production. The spring program was originally intended to be used for supplementation, but would now be used for that purpose only if Suiattle chinook failed to respond to current rebuilding efforts.

Puget Sound coho are currently managed under preliminary exploitation rate guidelines and escapement breakpoints from the co-managers' *Comprehensive Coho Management Plan*. Natural origin chum have been managed for fixed escapement goals, with different goals set for odd-year and even-year returns. Sockeye conservation efforts are focused primarily in the Baker River system. Escapement levels to the Baker system are aimed at achieving spawning beach capacities that were established by mitigation agreements with Puget Sound Energy, and at determining the natural production potential in the Baker System. Odd-year pinks are managed so that the expected natural spawning escapement exceeds the goals for the Skagit River. Even-year pinks have occurred in significant numbers only during the last two cycles. No management objectives have been established for even-year pinks.

The goal of regional winter steelhead management is to harvest surplus hatchery steelhead while restricting the harvest rate on wild steelhead to a low enough level to test the capacity of the Skagit system for producing wild steelhead. Under the management strategy for sea-run cutthroat, minimum size limits were set so that the majority of females are allowed to spawn at least once. Harvest under this scenario is allowed only where stocks are thought to be healthy and such harvest is consistent with management objectives.

HABITAT

Skagit River[18]

The Skagit River basin drains approximately 8,030 km^2 (3,190 mi^2) of the North Cascade Mountains of Washington state and British Columbia. Major tributaries include the Sauk, Suiattle, White Chuck, Baker and Cascade rivers. Elevations in the basin range from sea level to about 3,275 m (10,775 ft) on Mount Baker. Numerous peaks in the basin exceed 2,500 m in elevation. Average annual rainfall ranges from about 90 cm (35 in) at Mount Vernon on the lower flood plain, to over 460 cm (180 in) at higher elevations in the vicinity of Glacier Peak. Several vegetation zones occur in the area. Most of the lower elevations are in the western hemlock zone and the Puget Sound area. These forest zones typically include western hemlock, Douglas fir, western red cedar, and Sitka spruce. Deciduous species in this area include red alder, black cottonwood, and big leaf maple. Middle elevations are in the Pacific silver fir zone, and higher elevations are in the alpine fir zone.

[17] *Ibid.*

[18] *Brett Barkdull, Washington State Department of Fish and Wildlife, March 2002.*

About 1590 km^2 (615 mi^2, 19%) of the basin are in private and State of Washington ownerships. Land uses are dominantly agricultural and urban in the lower flood plain and delta areas. Upland areas are generally commercial forests. About 3680 km^2 (1420 mi^2, 44%) of the basin lies within the federally-owned North Cascades National Park, Mount Baker and Ross Lake National Recreation Areas, and Glacier Peak Wilderness Area. The US Forest Service controls an additional 1960 km^2 (755 mi^2, 24%) of the basin in the Mount Baker-Snoqualmie National Forest. Approximately 1040 km^2 (400 mi^2, 13%) of the basin is in the Province of British Columbia.

Access to anadromous fish is generally confined to streams at elevations below 700 m (2300 ft). Unrestricted access to the Baker River system has been eliminated by the installation of two hydroelectric dams, but anadromous fish production—primarily coho and sockeye salmon—is maintained through trapping and hauling operations, in addition to the maintenance of sockeye spawning beaches and smolt bypass trapping. Three hydroelectric dams regulate flows in the upper Skagit River, the first near the town of Newhalem. No anadromous stocks were known to utilize the Skagit River above the current location of the Gorge Power plant. Salmonid stocks present in the basin include chinook salmon, coho salmon, sockeye salmon, chum salmon, pink salmon, steelhead trout, cutthroat trout and Dolly Varden/bull char.

Baker River[19]

The Baker River project has two dams. One creates Baker Lake and the other creates Lake Shannon. Mount Baker is the defining feature of the region. Mountains border most of the upper Baker River region.

The Baker River enters the Skagit River at river mile 56.5, at the town of Concrete. The Baker River is about 32 miles long, with about 114 tributaries that add up to 314 miles. Only 14 of the 32 miles of the Baker River have flowing water. The river has two large hydropower dams and one fish barrier dam. The fish barrier dam is located 0.25 miles from the mouth of the Baker River. Adjacent to the fish barrier dam is a fish trap for moving adult fish upstream. The Lower Baker Powerhouse is located at river mile 0.9. Lower Baker Dam is at river mile 1.1. Lake Shannon is the reservoir behind Lower Baker Dam. It extends 8.1 miles up to Upper Baker Dam at river mile 9.1. Baker Lake is the 10.1 mile reservoir behind Upper Baker Dam. When Baker Lake is full, it extends to just beyond river mile 19. Prior to construction of Upper Baker Dam there was a natural lake between river mile 16 and 18. This was the historic Baker Lake. There are 20 tributaries to Lake Shannon, with 96.35 miles. Baker Lake has 17 tributaries, with 129.5 miles. There are 13 miles of the Baker River above Baker Lake, with 25 tributaries and 88 miles.

The Baker River Basin has a drainage area of 297 square miles, including snowfields on Mount Baker and Mount Shuksan. The Baker River originates in the North Cascades National Park. The river passes into the Mount Baker National Forest at about river mile 22, three miles above Baker Lake. The river then enters the upper reservoir (Baker Lake) and has Shannon, Swift, Boulder, Noisy, Park, and Sandy creeks as major tributaries. Baker Lake is bordered on the north and east by North Cascades National Park and the south and west by Mount Baker National Forest service land and Puget Sound Energy land, with some private ownership. Lake Shannon starts at the tailrace of the Baker dam and has Rocky, Diversion, and Bear creeks as major tributaries. Land surrounding Lake Shannon is likely owned by a combination of the following groups: the US Forest Service, Lone Star, Trillium Corporation, Puget Sound Energy, and private ownership.

[19] *Puget Sound Energy and Gary Sprague, Washington State Department of Fish and Wildlife, March 2002.*

Habitat Condition[20]

In general, the headwater areas of the Skagit River and its major tributaries originate from the North Cascades National Park, National Recreation Area, or one of several designated wilderness areas, and are in near-pristine condition. As you move downstream of these protected areas, down the watershed toward first rural and then urban areas including Mount Vernon and Burlington, the human impacts to the watershed both accumulate and increase in frequency, and the cumulative impacts to the associated streams and their habitats multiply. The most degraded habitats occur in the lower mainstem and estuary, where cumulative impacts are greatest and major hydro-modifications have occurred to prevent flooding, allow farming and settlement. Much of the rearing capacity for all species has been lost in the lower river below Sedro-Woolley and it has been estimated that 70% of the original Skagit estuary has been lost. Within these affected areas are mosaics of habitat qualities. Some streams and reaches are lower in quality, due to point disturbances. Specific habitat comments pertaining to individual reaches are as follows:

Skagit River Newhalem to Marblemount: Three dams regulate the flows in this reach, the first just above the town of Newhalem. The dams affect this reach by obstructing sediment movement and intercepting woody debris recruitment that has led to down cutting of the streambed, isolation of off-channel habitat, and a loss of spawning gravels. In spite of this, a large percentage of the spawning population for chinook, chum and pink salmon occur in this reach, due to the stability. Some impacts have occurred due to hydro-modification. Tributaries are generally in excellent condition and productive.

Skagit River Marblemount to mouth of Sauk River: This is a highly productive reach for all species, in spite of the many impacts due to hydro-modification, forest practices and suburbanization. Tributaries are generally in poor shape, except for Illabot Creek, which originates in the Glacier Peak Wilderness.

Skagit River, Sauk River to Alder Creek: This confined reach, which was once only modestly productive, is generally in poor condition due to cumulative impacts. Tributaries are in poor shape due to forest practices

Skagit River below Alder Creek: This was once a highly productive reach for all species, but is no longer. Extensive hydro-modification has occurred throughout this reach. The Ross Island/Day Creek Slough area is still mostly intact and extremely productive. The tributaries have all been heavily affected by forest practices. Farming and suburbanization have further degraded the Nookachamps system.

Skagit River Estuary: Approximately 70% of the original estuary area has been lost due to diking. Much of the rest is degraded. The area bracketed by Tom Moore and Freshwater sloughs on the South Fork Skagit is the only marginally functional area.

Cascade River: The upper Cascade River is in excellent condition, with only isolated impacts, mostly due to roads. Some forestry-related activity has occurred, but those areas are currently in recovery. The lower Cascade is more heavily affected by forest practices and by hydro-modification, on the left bank by private landowners and by the WDFW Cascade River hatchery near the mouth. This is a productive tributary for most species.

[20] *Brett Barkdull, Washington State Department of Fish and Wildlife, March 2002.*

Sauk River above Darrington: The upper Sauk is generally in excellent condition, but has had impacts from roads and forestry, and from hydro-modification at two small communities—Bedal and Forgotten Mountain. Forestry activities continue. Spawning and rearing habitat quality is high, but decreases downstream of the White Chuck River, due to gradient. This is a productive tributary for most species.

Sauk River below Darrington to the mouth of the Suiattle River (Sauk Prairie). This is a highly productive reach for all species, due to the extensive floodplain in the unconfined reach above the mouth of the Suiattle River. There have been moderate to high impacts to the tributaries from forestry, farming and private residences.

Sauk River, Suiattle to mouth: Habitat quality is much lower in the confined reach below the Suiattle River, due to forestry practices, increasing human impacts, hydro-modification and glacial flour from the Suiattle River. Tributaries are generally in moderate to poor shape. This is not nearly as productive a reach as Sauk Prairie.

White Chuck River: The White Chuck River is glacial in nature and high in gradient, with moderate turbidity due to glacial flour during summer. Habitat is nearly pristine, but low in productivity for most species except char.

Suiattle River: The Suiattle is a glacial river, with extremely high turbidity during summer. The glacial flour has a natural impact on habitat quality in the Suiattle River, the Sauk River below its confluence, and the Skagit River below the confluence of the Sauk River. The impact seems to be increasing recently as glaciers recede on Glacier Peak. Spawning occurs in the clear water tributaries of this drainage and the spawning habitat is mostly pristine. Big, Tenas, Straight, Circle, and Lime creeks—important spawning tributaries—have all been affected to varying degrees by forestry-related activities; all are currently in recovery. Forestry impacts increase in the lower river, where most land is privately owned. This is a moderately productive tributary.

Baker River: The Baker River originates from the North Cascades National Park and then flows into two reservoirs—first Baker Lake and then Lake Shannon. The river above Baker Lake is in near pristine condition and very productive for coho and char. Baker Lake is very productive for sockeye, but is somewhat impacted by heavy recreational use. Fish can only get into Lake Shannon if spilled at upper Baker Dam. Fish production is limited in this system by the inefficient juvenile collection facilities at the two dams.

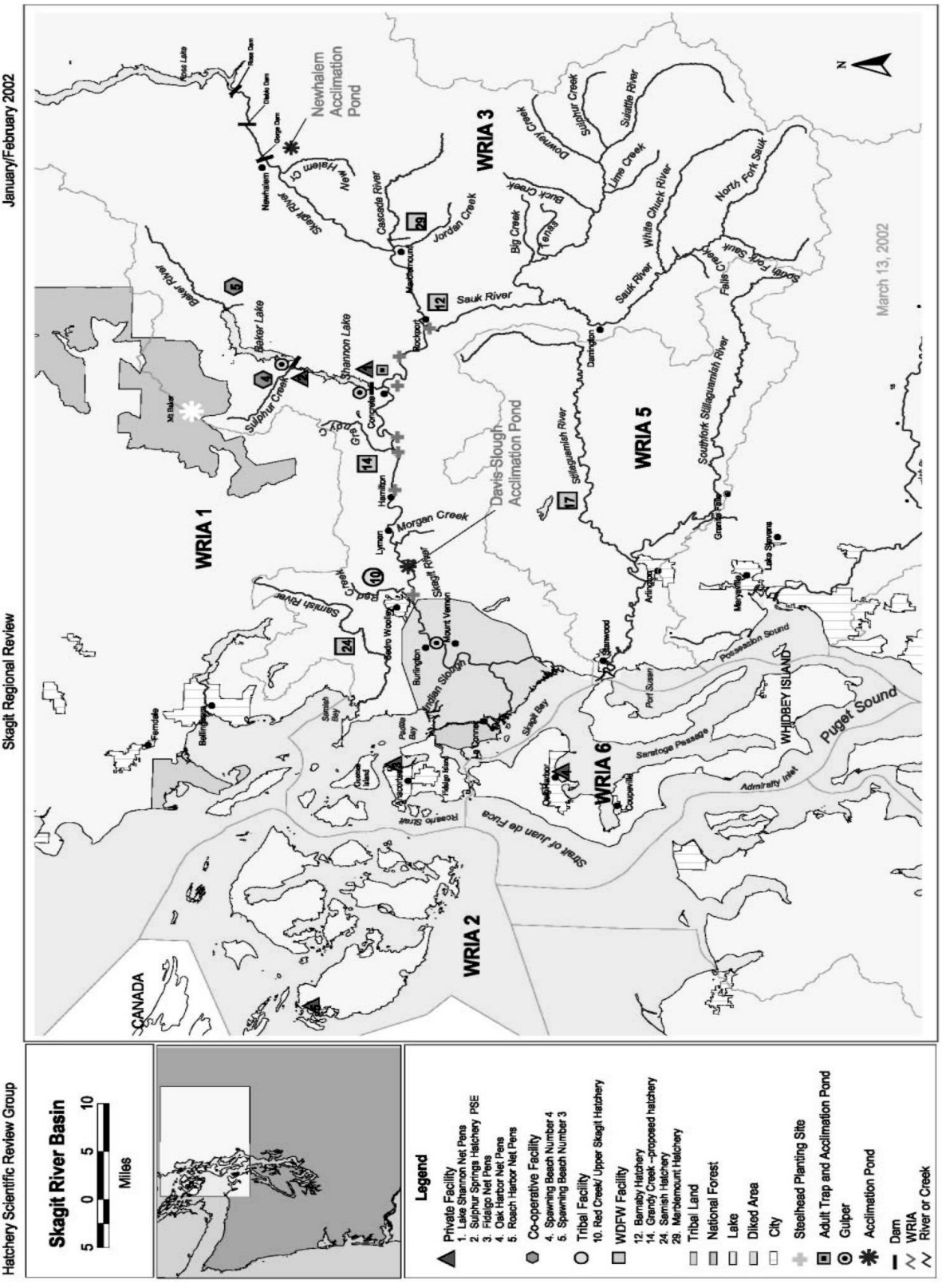
Habitat Improvement[21]

The following habitat improvement projects are in process for this region: 1) a complete fish passage inventory of man-made structures in the Skagit Basin has been completed and efforts are underway to repair fish passage barriers; 2) restoration planning and implementation is underway in the hydro-modified reaches of the Skagit Basin by removing rip-rap and diking, and allowing natural channel forming process to occur; 3) estuary restoration is in the planning stage; 4) minimum riparian buffers on all fish bearing streams are in the planning stage.

The quality of habitat in this region will probably stay about the same in the next ten to twelve years, even though major restoration efforts are currently underway. These efforts will likely be offset by habitat losses due to population growth. The long term may well be a "mixed bag." As growth

[21] *Provided by Brett Barkdull, WDFW*

continues into rural areas, many habitats will continue to be degraded. But there has been recognition of the importance of the floodplain and estuary habitats, and major efforts are being discussed in the estuary and the floodplain to purchase and restore these areas. The long-term WDFW goal is no net loss of habitat.


Hatchery Scientific Review Group
Skagit Regional Review
January/February 2002
Skagit River Basin
5 0 5 10
Miles
Legend
Private Facility
1. Lake Shannon Net Pens
2. Sulphur Springs Hatchery PSE
3. Fidalgo Net Pens
4. Oak Harbor Net Pens
5. Roach Harbor Net Pens
Co-operative Facility
4. Spawning Beach Number 4
5. Spawning Beach Number 3
Tribal Facility
10. Red Creek/ Upper Skagit Hatchery
WDFW Facility
12. Barnaby Hatchery
14. Grandy Creek –proposed hatchery
24. Samish Hatchery
29. Marblemount Hatchery
Tribal Land
National Forest
Lake
Diked Area
City
Steelhead Planting Site
Adult Trap and Acclimation Pond
Gulper
Acclimation Pond
Dam
WRIA
River or Creek
CANADA
WRIA 1
WRIA 2
WRIA 3
WRIA 5
WRIA 6
Newhalem Acclimation Pond
Davis Slough Acclimation Pond
Skagit River
Sauk River
Baker Lake
Shannon Lake
Ross Lake
Diablo Dam
Gorge Dam
Newhalem
Marblemount
Rockport
Concrete
Hamilton
Lyman
Morgan Creek
Red Creek
Mount Vernon
Burlington
Bellingham
Ferndale
Samish Bay
Padilla Bay
Fidalgo Island
Anacortes
La Conner
Skagit Bay
Oak Harbor
Coupeville
Whidbey Island
Saratoga Passage
Admiralty Inlet
Port Susan
Stanwood
Arlington
Marysville
Lake Stevens
Possession Sound
Puget Sound
Strait of Juan de Fuca
Roseario Strait
Cascade River
Jordan Creek
Sulphur Creek
New Halem Cr
Baker River
Mt Baker
Grandy Cr
Big Creek
Texas Creek
Buck Creek
Downey Creek
Sulphur Creek
Lime Creek
Suiattle River
White Chuck River
North Fork Sauk
South Fork Sauk
Falls Creek
Sauk River
Stillaguamish River
Southfork Stillaguamish River
Granite Falls
Darrington
March 13, 2002
N

STOCK STATUS[22]

Stocks	Hatchery Program?	Biological Significance (L=Low, M =Intermediate, H =High)			Population Viability (L=Critical, M = At Risk, H = Healthy)			Habitat (L = Inadequate, M = Limiting, H = Healthy)			Harvest Opportunity (0 = None, L = Occasional, M = Most years, H = Each year)		
		Now	Goals		Now	Goals		Now	Goals		Now	Goals	
			Short-Term	Long-Term		Short-Term	Long-Term		Short-Term	Long-Term		Short-Term	Long-Term
Skagit/Cascade Spring Chinook	N	H	H	H	M	M	H	M	M	H	L	M	H
Skagit/Sauk Spring Chinook	N	H	H	H	M	M	H	M	M	H	L	M	H
Skagit/Suiattle Spring Chinook	N	H	H	H	M	M	H	M	M	H	M	M	H
Skagit/Sauk Summer Chinook	N	H	H	H	M	M	H	M	M	H	L	M	H
Skagit River Summer Chinook	Y	H	H	H	H	H	H	M	M	H	L	M	H
Skagit River Fall Chinook	Y	M	M	M	M	M	H	M	M	H	L	M	H
Skagit Hatchery Spring Chinook	Y	M	M	M	M	H	H	M	M	M	M	M	M
Spring Chinook in Baker	Y	L	L	M	L	M	H	L	L	M	0	L	M
Skagit River Coho	N	M	M	M	H	H	H	M	M	H	M	H	H
Skagit River Hatchery Coho	Y	M	M	M	H	H	H	M	M	H	M	M	H
Baker/Skagit Coho	Y	L	L	M	L	L	M	L	L	M	M	M	H
Other Hatchery Coho	Y	L	L	L	H	H	H	L	L	L	H	H	H
Skagit River Odd-Year Pink	N	M	M	M	H	H	H	H	H	H	H	H	H
Skagit River Even-Year Pink	N	H	H?	H?	M	M?	M?	M	M	M	0	0	0
Skagit/Baker River Sockeye	Y	H	H	H	M	M	M	L	M	M	M	H	H
Skagit Riverine-type Sockeye	N	H	H	H	M	M	H	M	M	H	L	L	L
Skagit River Chum	Y	M	M	M	H	H	H	M	M	H	H	H	H
Skagit River Natural Winter Steelhead	N	H	H	H	M	M	H	M	M	H	M	M	H
Skagit River Hatchery Winter Steelhead	Y	L	L	L	M	M	H	M	M	H	H	H	H
Skagit River Natural Summer Steelhead	N	M	M	M	M	M	H	M	M	H	M	M	H
Skagit River Sea-run Cutthroat	N	M	M	M	M	M	H	M	M	H	M	H	H
Upper Skagit Basin DV/Bull Trout	N	M?	M?	M?	M?	M?	H?	M	M	H	H	H	H
Lower Skagit Basin DV/Bull Trout	N	M?	M?	M?	M?	M?	H?	M	M	H	H	H	H

Biological significance *is determined by considering a number of specific factors relating to stock origin, biological attributes and population subdivisions, with the stock defined as being of either* low, intermediate *or* high *significance.*

Population viability *is determined by considering a number of specific factors such as age class structure, spawner escapement and proportion of hatchery-origin fish in natural spawning, with the stock's viability defined as being either* critical, at risk *or* healthy. *This rating refers to the stock's ability to sustain itself in the natural environment (except in the case of a segregated harvest program, in which case the ratings are* low, medium *and* high *and refer to the stock's ability to sustain itself in the culture environment).*

The stock's spawning, freshwater, migration and estuarine ***habitat*** *is rated as either* inadequate *(target stock is unproductive and the population will go extinct, even without terminal harvest),* limiting *(target stock is productive enough for the population to sustain itself at a low level terminal harvest) or* healthy *(productivity of the stock is high and the population is capable of growth and supporting significant terminal harvest).*

Harvest opportunity *is rated according to whether the goal is to provide* no *directed harvest opportunity,* occasional *opportunity, opportunity* most years, *or opportunity* each year.

[22] *This table contains ratings for all the salmonid stocks in the region, as provided by the managers. For a more detailed definition of these ratings, see HSRG Scientific Framework and Hatchery Review Program, Benefit/Risk Tool chapter.*

HATCHERIES[23]

Marblemount Hatchery

Marblemount Hatchery is located one mile east of Highway 20 and the town of Marblemount on Fish Hatchery Road. It is on the Cascade River, about one mile upstream from the confluence of the Cascade and Skagit rivers. Clark Creek passes through, and the Jordan River skirts, this site. The land is owned by WDFW. There are three residences, one hatchery building and an old storage building. There are two pump intakes, one gravity intake and five wells (of which four work). The State General Fund supports this facility. Currently, the incubation room has 66 new vertical incubators and 16 new indoor starter tanks. There are 21 10' X 100' X 3' raceways, four large asphalt rearing ponds, one large earthen rearing pond, and one large asphalt adult trapping and holding pond. The hatchery rears spring, summer and fall chinook (all Skagit River origin), coho (Skagit, Minter, and Wallace river origin), and winter-run steelhead (Chambers Creek origin). Skagit River wild rainbow were reared once at this facility.

Barnaby Slough

Barnaby Slough rearing pond is located on Martin Ranch road about three miles from the town of Rockport. The land is owned by Seattle City Light and leased to WDFW. The outflow from the ponds enters the Skagit River about one mile above the bridge at Rockport. Barnaby has one large rearing pond with a gravity water supply, two adult traps, two small raceways used for steelhead production, and five wells (of which three work). There is also a small egg incubation building not currently being used. There is one residence on site. The State Wildlife Fund supports this facility. Barnaby Slough rears Chambers stock, hatchery origin winter steelhead. These fish support an intensive recreational fishery along the entire length of the Skagit River, below the dams and a tribal net fishery in the lower river.

Baker Spawning Beaches/Sulphur Creek Hatchery

The Baker Spawning Beaches are located on the Baker River and owned by Puget Sound Energy (PSE), as mitigation for two dams on the Baker River. The facility consists of an adult trap on the lower Baker River and four artificial spawning beaches along Baker and Shannon lakes. Beaches number one, two and three are on Channel Creek, a spring fed water supply at the upper end of Baker Lake. Only beach three is operational. The site is on about ten acres of US Forest Service (USFS) property leased to PSE. There are three buildings: an A-frame that used to be a residence, a large galvanized storage building with a cement slab, and a small, galvanized building over the screens at the intake. PSE owns all buildings and equipment. Beach four was built at the mouth of Sulfur Creek, just below the Baker Dam, because of the risk to beaches one through three from the instability of the Baker River, as far as its course near the delta. The intake is on USFS property and is a spring source that feeds by gravity to a "denitro" tower, then on to beach four. Effluent water drains into Sulfur Creek. Beach four is divided into four sections, using hypolon curtains, for improved disease control. There is a 20 X 20 chemical storage building and an office/storage building at this site, both owned by PSE. WDFW, with PSE, will build an additional incubation facility (vertical incubators) at this site in 2002. This site is less than ten acres and shares water with PSE's fish culture facility, just adjacent, where there are five circulars, four small raceways, two starter troughs, and an asphalt pond. There are five small buildings for office and storage space. PSE operates several small rearing ponds to rear coho (for dam gulper testing) and rainbow trout (for recreational enhancement in the lakes).

[23] *Darrell Mills, Steve Stout and Kevin Kurras, Washington State Department of Fish and Wildlife, March 2002.*

Upper Skagit/Red Creek Hatchery

The Upper Skagit Hatchery is on the Upper Skagit Reservation and draws water from Red Creek # 268, which is on Skagit River kilometer 36.62. This program is tribally owned and operated by the Skagit System Cooperative, the fisheries consortium of the Upper Skagit, Swinomish and Sauk-Suiattle tribes. The Bureau of Indian Affairs is the current funding source for the hatchery and raceways. This facility is operated with one full-time and one part-time position. The goal of this facility is to increase the harvestable numbers of chum salmon returning to the Skagit River for a tribal chum fishery. This program provides additional surplus chum salmon for treaty net fisheries in WDFW Areas 8 and 78-D, Skagit Bay and Skagit River. The program also benefits the non-treaty net and sport fisheries in the same areas.

Skagit River Summer Chinook

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
Biological Significance	High	High	High
Population Viability	Healthy	Healthy	Healthy
Habitat	Limiting	Limiting	Healthy
Harvest Opportunity	Occasional	Most Years	Each Year
Hatchery Program:			
Purpose	Indicator, with Secondary Harvest and Conservation		
Type	Integrated		

PROGRAM DESCRIPTION

The Skagit summer chinook program began in 1995. The primary purpose of this program is to establish an exploitation rate indicator stock to represent the Skagit River natural summer chinook stock. Secondary purposes include contributing to harvest, plus serving as a gene bank in case of catastrophic stock crash. Skagit summer chinook derive from, and are maintained by, adults collected in the upper Skagit River (between river mile 80 and 84). These chinook are in the Stillaguamish and Skagit GDU. 200,000 fingerlings are released from County Line Pond (river mile 91) into the Skagit River. Approximately 90 adults (40 females) are collected by gillnet from Skagit River spawning grounds (river miles 80–84). Spawning, incubation and early rearing take place at Marblemount Hatchery.

OPERATIONAL CONSIDERATIONS

- Adults are collected from natural stock (although some hatchery returns may be used in the program) at random, over the length of the spawning season.
- Adults are selected randomly for spawning and mated with single family pairing using a primary and back-up male.
- Incubation and rearing take place on well water that does not reflect the water temperature regime of the natural environment, but is used to reduce homing to the hatchery upon return as adults.
- Fish are released at a time and size (75 fish per pound in June) similar to their wild counterparts.
- Releases are 100% adipose fin clipped and coded wire tagged.
- Adult sampling and recovery on the spawning grounds does not meet performance standard cited in the US/Canada Type I Indicator Stock proposal.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?
Understanding the exploitation rates of intercepting fisheries, the program is consistent with the indicator stock goals established for this stock.

B. Likelihood of attaining goals?
This program is likely to provide information on the catch distribution of Skagit River summer chinook, but accurate estimation of exploitation rates also requires adequate recovery of tagged fish in the natural escapement. Since tag recoveries rates from spawning ground surveys are generally lower than recoveries from trapping facilities, there is likely to be a wide variance in escapement and exploitation rate estimation. There appear to be no significant risks to the target population because of the relatively small size of the hatchery program, the broodstock source and operational guidelines. However, during years of low adult returns, there is a risk to the natural population from "broodstock mining," if the return rates and subsequent production from natural spawning of the program fish are significantly lower than the natural population as a whole.

A program of this size is unlikely to achieve a harvest benefit offsetting the reduction in natural spawning resulting from adults removed for the program. No gene bank conservation program is necessary for a stock whose population viability is rated as healthy.

C. Consistent with goals for other stocks?
The program poses no significant risk to other stocks and is consistent with the goals for those stocks.

RECOMMENDATIONS

- Evaluate whether or not there are other stocks that could be used as an indicator for this stock and would provide a more precise estimate of exploitation and rebuilding rates, without the added cost of maintaining this program
- Discontinue the program if these conditions can be met and/or if the adult sampling effort on the spawning grounds cannot be improved sufficiently to reduce variance and meet US/Canada standards.

COMMENTS

- The HSRG recognizes that a number of ongoing processes expect to benefit from this indicator program and that a thoughtful transition would be required to move to another stock.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG.

Skagit River Fall Chinook

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
Biological Significance	Intermediate	Intermediate	Intermediate
Population Viability	At Risk	At Risk	Healthy
Habitat	Limiting	Limiting	Healthy
Harvest Opportunity	Occasional	Most Years	Each Year
Hatchery Program:			
Purpose	Indicator, with Secondary Harvest and Conservation		
Type	Integrated		

PROGRAM DESCRIPTION

The Skagit fall chinook program began in 1998. Skagit fall chinook derive from, and are maintained by, adults collected in the lower Skagit River (river mile 32–42) from September 20 through November 7. These chinook are in the Stillaguamish and Skagit GDU. 222,000 fingerlings are released into the Baker River from the Baker Trap acclimation ponds. Adults (40 pairs) are collected by gillnet from lower Skagit River spawning grounds (river miles 32-40). Spawning, incubation and rearing take place at Marblemount Hatchery.

OPERATIONAL CONSIDERATIONS

- Eggs and resulting hatch are reared in well water at Marblemount Hatchery, to minimize the risk that adults will return to the hatchery.
- Fish are released as fingerlings (sub-yearlings) at a time and size that mimics that of their wild counterparts (no yearlings are reared for release, although yearlings are a component of the wild fall chinook population).
- All releases are adipose fin clipped and coded-wire tagged.
- For release, fish are trucked to the Baker Trap, where they are held (acclimated?) for three days and then released (release site is in the natural spawning zone of the stock).
- Duration of the program is described as “on-going.”
- Adult sampling and recovery on the spawning grounds does not meet performance standard cited in the US/Canada Type I Indicator Stock proposal.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

This indicator program would provide a benefit if it can indeed serve as a valid indicator stock and if fisheries management is altered as a result. However, it is potentially in conflict with conservation goals for this at-risk stock. The potential risk is that adults resulting from the releases will return to Baker Trap, rather than to their natural spawning grounds. Were this to occur, it could have a deleterious (“broodstock mining”) effect on the stock.

B. Likelihood of attaining goals?
It seems likely that the program will yield data on catch distribution, but its value as an indicator stock is questionable, because of the difficulty foreseen in collecting adequate numbers of adult samples on the spawning grounds in the large, fast-flowing, turbid Skagit River. In view of the small size of the program, no significant conservation or harvest benefits are likely to result. In order for this program to be successful, a large number of adults need to return to the Baker Trap, where they will be sacrificed for coded-wire tags.

C. Consistent with goals for other stocks?
Considering the life stage released and the relatively small size of the program, the program is not likely to pose any significant risks to other stocks in the drainage.

RECOMMENDATIONS

- Continue this program only for a period sufficient to determine how well its harvest contribution pattern correlates with the summer chinook stock.
- Consider, at the same time, whether there is another stock more suitable for the indicator stock purpose. If so, use that stock in place of the Skagit fall chinook. The selected indicator stock should not only be representative of Puget Sound fall chinook, but should occur in a river that is amenable to adequate adult carcass sampling.
- Increase the acclimation period to a minimum of 30 days (the longer the better), at a suitable location on the lower river, to increase juvenile imprinting to the return site.
- If there is no other more suitable indicator stock and the program continues, develop an integrated program for the long term, using returns from this program and incorporating 10–20% naturally-spawning fish for broodstock each year.[24]

COMMENTS

- The principal value of this program is in determining how well its harvest contribution pattern correlates with the summer chinook stock. There is a significant conservation tradeoff for fall chinook in pursuing this experimental indicator stock program.
- The co-managers, in a verbal communication, have indicated that they are hoping sampling of the program's returning fall chinook adults will be facilitated by collecting those returning to the release site (Baker Trap). However, it is not at all certain that a three-day acclimation period at Baker Trap would ensure significant returns to the trap. In addition, should returns occur at the trap, identifying their source would require slaughter. This would result in loss of contribution to the "at-risk" population, unless the hatchery program is modified to include the rearing and release of progeny from adults collected at Baker Trap.

MANAGERS RESPONSE

WDFW generally supports the recommendations of the HSRG. However, if the program continues, WDFW notes that identification of the source and number of broodstock is a complex topic that will require discussion with the affected tribes.

[24] *See HSRG Area-Wide Recommendation on operating integrated and segregated hatchery programs.*

Skagit Hatchery Spring Chinook

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
Biological Significance	Intermediate	Intermediate	Intermediate
Population Viability[25]	Medium	High	High
Habitat	Limiting	Limiting	Limiting
Harvest Opportunity	Most Years	Most Years	Most Years
Hatchery Program:			
Purpose	Indicator and Cultural, with Secondary Conservation		
Type	Segregated		

PROGRAM DESCRIPTION

Fish for this program were derived from wild fish collected from six Suiattle River tributaries and from Marblemount Hatchery adult returns and unmarked volunteers from 1974–88. This stock has been maintained exclusively with marked adults (approximately 100 pairs) returning to the Marblemount Hatchery since 1989. Skagit hatchery spring chinook are in the Stillaguamish and Skagit GDU. The principal goal of this program is to serve as an index stock for spring chinook in the Skagit River.

OPERATIONAL CONSIDERATIONS

- A secondary goal of this program is to provide a conservation "back-up" for natural spring chinook in the Suiattle River (although WDFW may be abandoning this goal). This stock also makes an important contribution to tribal ceremonial and subsistence fisheries.
- A total of 486 wild fish (277 females, 209 males) were collected from the Suiattle River tributaries during the establishment of the program, although a major fish loss in 1981 due to water failure reduced those numbers to 254 females and 171 males, or an average of only 17 females and 11 males per year during the period 1974–88. In addition, a total of 26 unmarked males and 35 unmarked females, presumably representing wild fish volunteers from the Cascade River population, were included in the broodstock 1981–84. Approximately 12% of the hatchery population may have thus been derived genetically from Cascade River strays.
- Genetic (allozyme frequency) comparisons among Suiattle spring chinook, Upper Sauk spring chinook, Upper Skagit summer chinook, lower Skagit fall chinook, lower Sauk summer chinook , and Skagit Hatchery spring chinook showed that the Skagit Hatchery spring chinook stock had the largest, average genetic distance to the other stocks than those other stock had among themselves (*WDFW unpublished data*). These results are consistent with the hypothesis that the Skagit Hatchery spring chinook stock has experienced significant genetic change from the

[25] *In the case of a segregated program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.*

Suiattle River population due to founder effects, genetic drift, and/or other genetic factors associated with artificial propagation.

- 250,000 sub-yearlings are released in June at 70 to the pound. All are adipose fin-clipped and coded-wire tagged.
- 150,000 yearlings are released the following April at ten to the pound. 75,000 are adipose fin-clipped and coded-wire tagged; 75,000 are coded-wire tagged only.
- Sub-yearlings are allowed to volitionally exit the hatchery; remainders are forced out.
- Both yearlings and sub-yearlings from the Marblemount Hatchery are larger than their wild counterparts, as revealed by fish trapped at the WDFW screw traps at river mile 17 in the lower Skagit River.
- Surplus adults have been out-planted into Baker Lake.
- The Skagit Hatchery spring chinook stock is treated as a single, "composite" Skagit River stock for providing index information.
- Adults are trapped volitionally from returnees back to the hatchery, approximately May 1 to August 15.
- Adults are spawned in August, at approximately 4,500 eggs per female or 450,000 eggs total.
- Adults are pair-spawned with a secondary (back-up) male added one minute after fertilization. This back-up male then becomes the primary male for the next female.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

Although this hatchery population was developed initially to serve as a back-up conservation stock for the Suiattle River, and subsequently to serve as a "composite" index stock for the Skagit River, the suitability of this hatchery stock for either purpose is questionable. This stock is propagated as a segregated hatchery population, and the degree to which it is representative of spring chinook salmon in the Skagit River is unknown.

B. Likelihood of attaining goals?

This program will most likely not be able to achieve the conservation goals initially intended for this population. In addition, it is unclear whether this segregated stock can adequately represent Skagit River spring chinook as an index stock.

C. Consistent with goals for other stocks?

A potential genetic risk to the wild Cascade River population may exist, but this risk is low because of the small number of hatchery-origin carcasses found in the Cascade River. There is some predation risk from released yearling spring chinook on wild summer chinook sub-yearlings in the Skagit River. This risk could increase if the hatchery program is expanded. Access to a harvestable surplus conflicts with goals for natural spring chinook stocks.

RECOMMENDATIONS

- Abandon a conservation purpose for this hatchery stock. The hatchery population has not been propagated in a manner consistent with conservation goals.
- Evaluate the benefits of this hatchery stock as an "index" stock for spring chinook in the Skagit River relative to the economic costs and biological risks of maintaining this program.
- Discontinue this program if the hatchery stock does not accurately represent spring chinook in the Skagit River, or if the benefits derived from its use as an index stock are minimal.

- Develop a contingency conservation plan for spring chinook in the Sauk and Suiattle Rivers, in case natural populations become depleted or decline significantly.
- Develop an integrated, index program from a new broodstock if the existing hatchery index stock is not representative of the wild populations in the Skagit River and if an index stock is clearly needed. Only start this new program if the wild stocks of spring chinook are strong enough to support it.

COMMENTS

- Out-planting surplus adults into Baker Lake could pose significant predation risks to sockeye salmon in that system.
- Expanding the existing program, with the goal of providing harvest opportunities, could pose unacceptable risks to natural populations of spring chinook.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG, but recognizes that program modifications will require consultation with the affected tribes.

Spring Chinook in Baker

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
Biological Significance	Low	Low	Intermediate
Population Viability	Critical	At Risk	Healthy
Habitat	Inadequate	Inadequate	Limiting
Harvest Opportunity	None	Occasional	Most Years
Hatchery Program:			
Purpose	Conservation		
Type	Integrated		

PROGRAM DESCRIPTION

Fish for this program derive from six Sauk River tributaries and from Marblemount Hatchery adult returns from 1974–88. From 1981–88, eggs were also collected from marked and unmarked adults in the Cascade River. This stock is currently maintained by marked adult returns to Marblemount Hatchery. Skagit hatchery spring chinook are in the Stillaguamish and Skagit GDU. This program's goal is to determine if spring chinook can successfully be introduced into the Baker River. To that end, up to 2,000 adult spring chinook from the Marblemount Hatchery are supplemented into Baker Lake each year. An additional goal described for this program is nutrient enhancement of the upper Baker River. The program is planned to last for four years, ending with brood year 2002.

OPERATIONAL CONSIDERATIONS

- Adult fish are transported from the Marblemount Hatchery to Baker Lake.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?
The benefits are currently unknown, since this is a new program. There are potential benefits to the ecosystem through nutrient enhancement and potential conservation benefits to Skagit River spring chinook from expanding the natural spawning population. This would be consistent with the overall conservation goal for spring chinook in this system.

B. Likelihood of attaining goals?
The goal for this stock, in terms of a relatively small change to its biological significance and viability, is likely attainable. Long-term improvement of the stock's status will be dependent on the ability of the stock to adapt to the natural environment in the upper Baker River and improvement in the habitat's ability to support the stock.

C. Consistent with goals for other stocks?
There is a potential risk of predation by juveniles produced from this program, particularly on Baker

Lake sockeye. This program may therefore be inconsistent with the conservation goals for Baker Lake sockeye.

RECOMMENDATIONS

- Complete evaluation of the conservation benefit from this program.
- Select adults used for the program at random and to be representative of the entire return to the Marblemount Hatchery.
- Use returns to the Baker Trap for broodstock, if the program continues beyond 2002.
- Define the size of the adult supplementation program based primarily on the risk it poses to Baker Lake sockeye. Residualism rates for chinook, the size of the chinook population, and their predation rate on sockeye juveniles should be included in the risk evaluation.

COMMENTS

- None.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG.

Skagit River Hatchery Coho

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
Biological Significance	Intermediate	Intermediate	Intermediate
Population Viability	High	High	High
Habitat	Limiting	Limiting	Healthy
Harvest Opportunity	Most Years	Most Years	Each Year
Hatchery Program:			
Purpose	Indicator and Harvest		
Type	Segregated		

PROGRAM DESCRIPTION

The Skagit coho program began in 1946 from wild fish collected on the Skagit and Cascade rivers (at approximately river mile 78). From shortly thereafter until the present day, this program has been maintained as a segregated stock by Marblemount Hatchery adult returns. The primary goal is to provide a tagged index stock for assessment of regional and distant (Canadian) fisheries. In addition to the 250,000 yearling coho reared and released on-station, 1,500,000 coho eggs are received from Wallace River and Minter Creek in the South Sound region, for rearing to 400 per pound, after which they are transferred to Skookumchuck Ponds for additional rearing, prior to final rearing and release from the South Sound Net Pens. 100,000 coho are reared for release at Indian Slough, in addition to other small net pen and classroom educational programs.

OPERATIONAL CONSIDERATIONS

- None.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?
This program is consistent with the goals and objectives. The conservation risks posed by this program to naturally-spawning salmon in the region are relatively small. Homing fidelity to the hatchery appears good, with minimal straying and interaction with wild adults on the spawning grounds.

B. Likelihood of attaining goals?
Past success suggests a likelihood of meeting objectives. However, a segregated hatchery stock poses some risk, especially in the long-term, for representing wild stocks as an index stock.

C. Consistent with goals for other stocks?
The only inconsistency with this program and its goals for other stocks is that the hatchery staff at Marblemount Hatchery is spread too thin.

RECOMMENDATIONS

- Manage this as an integrated, rather than segregated, hatchery program[26] if the intent is to maintain a coho index program. This assumes the stock origin and history allows the managers to phase in an integrated stock.
- Verify the assumption that the stock has maintained its integration with the natural Skagit coho stock. If it is incorrect, restart the program with new broodstock drawn from natural spawners and maintained through proper gene flow (incorporate an annual average of 10–20% naturally spawning fish in hatchery broodstock).

COMMENTS

- Given the complexity of programs at Marblemount Hatchery, staffing levels need to be reevaluated.

MANAGERS RESPONSE

WDFW understands the concerns raised by the HSRG regarding the potential divergence of the indicator stock and the natural stock. However, this divergence may not manifest itself in significant differences in catch distribution or harvest rates. If differences do exist, they may result as much from the rearing history, time and size at release as from the percentage of natural origin broodstock used in the program. For these reasons, WDFW suggests evaluating prior to program modification: a) the magnitude of the difference of the harvest rates and the catch distribution of tag groups of wild and hatchery origin coho salmon; and b) the costs and benefits of implementing an integrated program.

[26] *See HSRG Area-Wide Recommendation on operating integrated and segregated hatchery programs.*

Baker / Skagit Coho

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
Biological Significance	Low	Low	Intermediate
Population Viability	Critical	Critical	At Risk
Habitat	Inadequate	Inadequate	Limiting
Harvest Opportunity	Most Years	Most Years	Each Year
Hatchery Program:			
Purpose	Harvest and Conservation		
Type	Integrated		

PROGRAM DESCRIPTION

Baker River coho derive from adults captured in the Baker River trap beginning in 1924. This program is currently maintained by adult returns to the Baker River trap, which are spawned at Sulphur Creek Hatchery. Approximately 100,000 fry are released into Shannon Lake. 50,000 yearlings are also released (35,000 reared at Shannon and released in the Baker River; 5,000 released in Shannon Lake for the lower gulper efficiency tests; 10,000 released in Baker Lake for the upper gulper efficiency tests). Adult broodstock is collected from the 3,000–5,000 returning adults taken at the trap. Eggs are incubated, and fry are early reared, at Sulfur Creek. Yearlings are reared in net pens at Shannon Lake and trucked to the Baker River.

OPERATIONAL CONSIDERATIONS

- None.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?
The program provides a management tool to measure dam passage efficiency as a surrogate for sockeye smolts. However, it provides limited harvest and conservation benefits to the Baker River coho stock, because of the relatively small size of the program in comparison to the number of naturally-produced adults returning to the Baker Trap.

B. Likelihood of attaining goals?
The program is not likely to contribute to attaining either the harvest or conservation goals for this stock.

C. Consistent with goals for other stocks?
There are minimal predation risks associated with this program, because of its relatively small size.

RECOMMENDATIONS

- Rear only the number of smolts needed for the gulper efficiency tests.

COMMENTS

- None.

MANAGERS RESPONSE

WDFW supports the recommendation of the HSRG.

Other Hatchery Coho

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
Biological Significance	Low	Low	Low
Population Viability[27]	High	High	High
Habitat	Inadequate	Inadequate	Inadequate
Harvest Opportunity	Each Year	Each Year	Each Year
Hatchery Program:			
Purpose	Harvest		
Type	Segregated		

PROGRAM DESCRIPTION

This program is used for cooperative projects in the Skagit region and relies on annual outplants from Marblemount Hatchery. The purpose of this program is to provide harvest and/or educational opportunity. To this end, coho are transferred in February for final rearing and release from saltwater net pens at Oak Harbor (30,000) and Roche Harbor (5,000). Another 100,000 coho are reared until February and transferred to Indian Slough (near La Conner). 1.5 million coho eggs are reared at Marblemount until the fish reach 400 per pound, at which time they are transferred for additional rearing with eventual release from the South Sound net pens. An additional 12,750 eyed eggs are transferred to miscellaneous cooperatives and schools.

OPERATIONAL CONSIDERATIONS

- The saltwater net pens receive yearling coho in February from Marblemount. The fish are then acclimated, reared and released mid-May.
- The Indian Slough fish are also transferred from Marblemount Hatchery in February, but are released without acclimation or additional controlled rearing.
- Eyed and green eggs are transferred in from Wallace River and Minter Creek in the South Sound region, for the South Sound Net Pens program.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?
The Skagit region net pens and Indian Slough releases are consistent with the goals, as are the educational programs with eyed eggs for schools and cooperatives.

B. Likelihood of attaining goals?
Continued harvest opportunity is expected from this program, along with an educational benefit. Higher survival rates on Indian Slough releases could probably be realized with a later release time.

[27] *In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.*

C. Consistent with goals for other stocks?
Straying from the net pens and Indian Slough could pose genetic risks to the critical viability of native stocks. However, the risk is a moderated because of the relatively small release numbers and relative low survival of Indian Slough releases.

RECOMMENDATIONS

- Discontinue rearing of coho destined for release in the South Sound at Marblemount Hatchery, in accordance with the HSRG's South Sound Regional Hatchery Review recommendations for the South Sound Net Pens.
- Release Indian Slough smolts in April or later to improve survival and harvest benefits.

COMMENTS

- Switching stocks for saltwater net pens and Indian Slough releases will provide two benefits. First, adult straying and mixing with wild adults from these releases will have less potential for negative genetic effects, since the Baker stock is an integrated stock as opposed to the segregated Marblemount Hatchery stock. Second, less workload on Marblemount Hatchery staff from this recommendation would allow staff more time to concentrate on other priorities.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG.

Skagit / Baker River Sockeye

Puget Sound Energy and Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
Biological Significance	High	High	High
Population Viability	At Risk	At Risk	At Risk
Habitat	Inadequate	Limiting	Limiting
Harvest Opportunity	Most Years	Each Year	Each Year
Hatchery Program:			
Purpose	Harvest and Conservation		
Type	Integrated		

PROGRAM DESCRIPTION

The Baker River sockeye hatchery program began in 1896, but was discontinued in 1933 when the Baker Lake Hatchery on Silver Lake was closed, due to low returns. The program was reinstituted in 1957 with the artificial beach program. Baker River sockeye return to the lower Baker River, where they are trapped and transported above one or both dams to spawn in the protective custody of artificial beaches provided with gravel substrate and upwelling spring water. Up to 3,000 adults are allowed to spawn at beach four. An additional 550 spawners are placed at beach three, at the head of Baker Lake. Some surplus adults may be passed into Baker Lake, to spawn naturally in the lake tributaries. Fry from beach four are enumerated, collected and trucked to Baker Lake. Fry from beach three exit the beach directly into Baker Lake.

OPERATIONAL CONSIDERATIONS

- This program is operated by Puget Sound Energy (PSE) on behalf of WDFW, as part of a licensing agreement for the dams on Baker and Shannon lakes.
- IHN-V is the most significant disease risk during culture at the artificial spawning beaches. As adult spawners begin to die, the incidence of IHN rises. To avoid infecting eggs and juveniles, adult spawners are removed from the beaches during the later part of the run.
- The efficiency of the gulpers in both Baker and Shannon lakes remain a concern. Inefficiency in these collectors represents a potentially high risk to migrating juvenile sockeye. Furthermore, stranding of redds due to draw-down continues to affect overall population abundance and viability.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

Minimal harvest opportunity benefits are presently being attained. Hatchery intervention in the form of artificial spawning beaches has been adequate to maintain the stock at low but acceptable levels of abundance. In most years since 1990, the program has attained the goal of returning at least 3,000 spawners to the lake system and artificial beaches.

B. Likelihood of attaining goals?
Although the population is depleted, the stock has been successfully maintained, with little alteration of its natural life history pattern, since the inception of the program in 1957. Overall, the program is consistent with its harvest and conservation goals of maintaining a demographically viable, genetically intact population. Proposed changes in management, by confining spawners to a single artificial spawning beach, would substantially increase the demographic risk to the population from natural events like siltation, flooding and disease. There is a risk associated with the inability to properly sort returning adults at the Baker River Trap. There is a potential risk associated with the general lack of information on the hydrology, nutrient input, predation and food availability in the receiving waters of Baker Lake.

C. Consistent with goals for other stocks?
The goals for Baker River sockeye pose little or no threat to other indigenous stocks in the Baker River system and are consistent with the goals for other stocks and species.

RECOMMENDATIONS

- Refit, remodel or replace the trap on the lower Baker River, to accommodate the need for more efficient, less stressful sorting and handling of returning adults.
- Make vertical incubation trays at the beach four site a permanent feature of the program, to cloister and protect a reserve of eggs as an "insurance policy" against demographic losses due to IHN.
- Upgrade spawning channels with concrete dividers and bird netting, to reduce risk of disease transmission.
- Develop an additional water source, or increase reliability of the existing source, for the incubation and rearing systems at Sulphur Creek, in order to assure an adequate supply of silt-free water at that facility.
- Retain and upgrade beach three by protecting the beach from river migration and flooding. Address the problem of a declining flow of upwelling beach water.
- Move the rainbow trout release location to Depression Lake to remove potential sockeye predators from the main lake.
- Delay the opening of the kokanee fishing season, to protect out-migrating sockeye smolts.
- Devise a new strategy for distributing sockeye fry to upper Baker Lake, in order to avoid the concentration of predators and apparent high initial predation rate at the present release site. For example, use barges to scatter plant fry throughout the lake.
- Institute a comprehensive, limnological study to better understand the lacustrine habitat in which the juvenile sockeye rear. The HSRG envisions a multi-year study to investigate seasonal current flows, stratification, turnover rates, zooplankton, standing stock, predator/prey interactions and nutrient availability. A better understanding of the limnological processes in the lake system would provide managers with essential information on nutrient budgets, juvenile sockeye energetics and carrying capacity, and provide the scientific basis for whether a need exists to fertilize this heavily altered lake system. A two to three year limnology baseline study will be required before initiation of a fertilization program.
- Improve the mechanical operation of the gulper collectors. The HSRG understands that re-licensing discussions are underway that include modification to, or replacement of, the existing system. The group encourages the development of an innovative approach to the pressing problem of fish passage at the dams.

- Focus programs in the upper lake on the sockeye conservation program, and on efforts to improve and understand lake conditions, reduce predation and improve fish passage. Lake Shannon should become the focus of all other programs, such as net pen rearing of coho, and the recreational kokanee program.
- Incorporate flexibility into the new licensing agreement, to allow for adaptive management and the various studies and adjustments recommended above.[28]
- Do not introduce other stocks at Sulphur Creek Hatchery, due to potential transmission of disease from sockeye to these stocks.

COMMENTS

- The Baker Lake sockeye hatchery program is unique in the State of Washington. The spawning beaches represent the least invasive type of artificial propagation used to supplement wild populations.
- The program is operated as part of a specific license agreement. The HSRG is concerned that this prevents the program from being able to respond to changing fishery and conservation needs. Strong communication between PSE and the co-managers is extremely important.
- The program is an example of a hatchery program that has been successful in preventing the extirpation of a stock that would go extinct if present human intervention (trap, haul, and spawning beach activities) were suspended.

MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG, but notes:

- Modification of facilities and implementation of enhanced monitoring will require additional funding.
- WDFW has completed a microsatellite analysis of fish sampled from the Lake Shannon catch. The analysis indicates that fish of Lake Whatcom origin "were at most a very minor component of the harvest" (Sewall, Young, personal communication). WDFW will utilize this information as it reevaluates the artificial production and fishery management in this area.

[28] *See HSRG Area-Wide Recommendations on Flexibility, p. 7.*

Skagit / Shannon Lake Kokanee

Washington Department of Fish and Wildlife

Note: This program is not directed at an anadromous salmonid and therefore is not within the Hatchery Scientific Review Group's usual scope of programs to review. Therefore, it is described and discussed below only as it may affect Skagit/Baker River Sockeye with only comments—not recommendations—provided.

PROGRAM DESCRIPTION

Adult kokanee of Lake Whatcom origin are spawned at the Lake Whatcom Hatchery. 300,000 to 500,000 unfed fry from the Lake Whatcom Hatchery have been planted into Lake Shannon each year since 1989.

OPERATIONAL CONSIDERATIONS

- In 2001, 100% of the Whatcom fry planted in Lake Shannon were thermally marked, in order to identify their contribution to the kokanee fishery.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?
The harvest benefits of this program are largely unknown, as nothing is known regarding their survival or their contribution to Lake Shannon fisheries. It is possible that there are native kokanee still residing in the lake, or residualized anadromous sockeye, and that these are the major contributors to the fishery.

B. Likelihood of attaining goals?
It is not known whether the goals of this program are being met, because the fate of the released fry is unknown.

C. Consistent with goals for other stocks?
If a genetically unique population of indigenous kokanee exists in Shannon Lake, then over-planting with the non-indigenous, Whatcom Lake stock will have a detrimental genetic impact. If the planted fish survive, there is a risk of competition with migrating anadromous sockeye smolts. Additionally, there is a risk that large numbers of migrating sockeye smolts will be captured in the recreational fishery, as the present fishing season overlaps with the outmigration timing.

COMMENTS

- Consider suspending any planned planting program in the upper lake, pending outcome of the genetic analysis, due to the uncertain nature of the origin of Baker Lake kokanee.
- Consider delaying the fishing season in Lake Shannon, to avoid capture of migrating anadromous sockeye smolts.

- The fish captured in the recreational fishery are of unknown origin. Studies suggest that they are of four possible origins:
  1. They may be Lake Whatcom stock from years of planting unfed fry. Based on known susceptibility of the fry to IHN-V, it is unlikely that these fish survive to be recruited into the fishery.
  2. They may be Baker Lake stock. Strontium testing of kokanee in Baker indicates that the majority of their parents are of marine origin. No similar testing has taken place in Shannon Lake. Creeks in Baker Lake contain spawning kokanee.
  3. They may be a discreet resident population unique to Shannon Lake that may have a distant relationship to Baker sockeye or Whatcom kokanee. There are kokanee spawning in tributaries of Lake Shannon.
  4. Combinations of the above.
- Additional genetic studies are presently being carried out to determine the origin of the Shannon population, using mitochondrial DNA analysis. Significant differences exist between Baker sockeye and Whatcom kokanee. Similar analysis is underway for Shannon kokanee from creel census fish, as well as from Sulphur Creek spawners.

MANAGERS RESPONSE

WDFW has completed a microsatellite analysis of fish sampled from the Lake Shannon catch. The analysis indicates that fish of Lake Whatcom origin "were at most a very minor component of the harvest" (Sewall, Young, personal communication). WDFW will utilize this information as it reevaluates the artificial production and fishery management in this area.

Skagit River Chum

Skagit System Cooperative

Stock Goals:	Current	Short-Term	Long-Term
Biological Significance	Intermediate	Intermediate	Intermediate
Population Viability	Healthy	Healthy	Healthy
Habitat	Limiting	Limiting	Healthy
Harvest Opportunity	Each Year	Each Year	Each Year
Hatchery Program:			
Purpose	Education and Cultural		
Type	Integrated		

PROGRAM DESCRIPTION

The Skagit chum program began 1990. Adults are collected annually, but not necessarily throughout the run. Adult broodstock for this program (250 pairs) is collected by tangle net from Skagit River spawning grounds (river mile 40–44). Spawning, incubation, and early rearing take place at the Red Creek Hatchery. The chum fry (about 500,000) are then reared at the Swinomish Raceways, before being released into Swinomish Slough. The co-managers identify three chum stocks in the Skagit River—Skagit mainstem, Sauk, and Finney Creek (a lower Skagit tributary). This program is a component of the Skagit mainstem stock. Skagit chum belong to the Northern Puget Sound fall-run GDU. There are eleven chum stocks in this GDU.

OPERATIONAL CONSIDERATIONS

- During years when the run is low, adults may be collected during the entire run. However, in years when the run is abundant, adults may be collected only two or three times.
- In 1997, when there was a record low adult return, smolts were planted directly into the Skagit River near Sedro Woolley.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?

The primary purpose of this program is educational. The program also provides cultural benefits. A smaller program could probably meet these goals. The extent to which it also contributes to the short- and long-term harvest goals cannot be determined, due to a lack of data. Because of the small size of the program relative to the size of the naturally spawning component of the chum population, it probably has minimal impact on biological significance and viability goals for the Skagit chum stock.

B. Likelihood of attaining goals?

Goals for the Skagit chum population are already met under current conditions.

C. Consistent with goals for other stocks?
There is a potential concern about passage of juveniles and adults by the hatchery intake when flows are low, possibly affecting coho and cutthroat populations. Since Red Creek is an intermittent stream, these risks are small.

RECOMMENDATIONS

- Reduce program size to a level appropriate for an educational/cultural program.
- Improve fish passage by the hatchery intake. These improvements would require only a moderate investment and would provide both conservation and educational benefits.
- Enhance the educational and cultural values provided by this program. Consult HSRG operational guidelines for ways to improve the educational benefits.[29]

COMMENTS

- The HSRG felt this program was well justified on the basis of its educational/cultural value, especially if facilities were upgraded to better serve this purpose.
- If the program is changed to have a harvest purpose, data should be collected to evaluate contribution to harvest goals.

MANAGERS RESPONSE

No response received at time of publication. Check Hatchery Reform Project web site for responses received after publication date: www.lltk.org/hatcheryreform.html.

[29] *See HSRG Scientific Framework and Hatchery Review Program, chapter on Hatchery Operational Guidelines.*

Skagit River Hatchery Winter Steelhead

Washington Department of Fish and Wildlife

Stock Goals:	Current	Short-Term	Long-Term
Biological Significance	Low	Low	Low
Population Viability[30]	Medium	Medium	High
Habitat	Limiting	Limiting	Healthy
Harvest Opportunity	Each Year	Each Year	Each Year
Hatchery Program:			
Purpose	Harvest		
Type	Segregated		

PROGRAM DESCRIPTION

The Skagit hatchery winter steelhead program began in the mid-1960s. Originally, this program was maintained through transplants from South Tacoma Hatchery (Chambers Creek stock). Final rearing occurred at Barnaby Slough ponds and the smolts were planted in the Skagit River. In the mid-1990s, the program changed and now is maintained by adult returns to Marblemount Hatchery and Barnaby Slough, and from marked fish returning to the Baker River Trap. Adults are trapped and spawned at both Marblemount Hatchery and Barnaby Slough. Fertilized ("green") eggs at Barnaby are transferred and incubated at the Marblemount Hatchery. 535,000 smolts are released (135,000 at Marblemount, 135,000 at Barnaby Slough, 172,000 at Grandy Creek and Fabors Ferry, 60,000 into the Baker River acclimation facility, 30,000 into the Davis Slough acclimation facility).

OPERATIONAL CONSIDERATIONS

- Fish are released May 1–15.
- Released fish are 100% adipose fin-clipped, with no coded-wire tags.
- If needed, adults or eggs from hatchery fish trapped at the Baker River Trap are transferred to Marblemount Hatchery.
- The management goal is to release 51% of the smolts in the lower river (below river mile 68) and 49% above in the upper river, to focus the sport fishery downstream of the primary bald eagle winter nesting and feeding areas.
- WDFW is tentatively planning to construct an acclimation and adult recapture facility at Grandy Creek, which is located at river mile 45.5, to further focus the sport fishery in the lower Skagit River.
- Harvest goals are 10,000 fish (5,000 for sport harvest, 5,000 for tribal harvest). The tribal goal is not being achieved, nor is it a priority, due partially to the low price currently paid for steelhead.
- The broodstock goal is to return 400 adults each to Marblemount Hatchery and Barnaby Slough.

[30] *In the case of a segregated harvest program, population viability ratings are low, medium and high and refer to the stock's ability to sustain itself in the culture environment.*

- Adults are trapped from December 1 to February 28 at both sites. Only clipped hatchery fish are used for broodstock. Unclipped (or wild) fish are rarely trapped before February 28.
- Eggs are fertilized in mixed gamete pools of five males and five females.
- Fertilized eggs are incubated in well water at Marblemount.
- After ponding, fish are reared on Clark Creek water at Marblemount and a mixture of spring and surface water at Barnaby.

BENEFITS AND RISKS

A. Consistent with short-term and long-term goals?
There are potential competition risks to wild winter-run steelhead, coho, and wild summer-run steelhead, but these risks appear small. Interbreeding of the hatchery stock with the naturally spawning stock is minimized by the differences in spawn timing. In general, the program appears to be highly successful at achieving harvest goals, especially sport fishery harvests, while minimizing impacts to wild populations.

B. Likelihood of attaining goals?
The program is achieving its goals.

C. Consistent with goals for other stocks?
Yes, but there are potential predation risks to pink and chum fry, and age zero-plus chinook. There is the potential for genetic interaction with naturally spawning winter steelhead, but this is likely to be minimized for the reason stated in A, above.

RECOMMENDATIONS

- Implement Area-Wide Recommendations regarding establishing a regional system of wild steelhead management zones, where streams are not planted with hatchery fish and are instead managed for native stocks. Fishing for steelhead in these zones would not be incompatible with this approach, but no hatchery-produced steelhead should be introduced. Such zones would reduce the risk of naturally spawning fish interbreeding with hatchery fish, and provide native stocks for future fisheries programs. To meet harvest goals, hatchery releases may be increased in those streams selected for hatchery production.
- Select both wild and hatchery streams based on stock status and a balance of large and small streams and habitat types.
- Use locally-adapted stock (of Chambers Creek origin) for those streams. Decrease reliance on other facilities (such as Tokul Creek or Bogachiel hatcheries) to backfill shortages in locally adapting hatchery stock. Actions such as harvest restrictions should be implemented to achieve 100% local broodstock.
- Manage the hatchery stock to maintain its early spawn timing and reduce the likelihood of interaction with naturally spawning steelhead.
- Include adult collection capability wherever steelhead are released, to capture as many adults from the returning segregated population as possible. Discontinue releases where adults cannot be collected at return.
- Size the hatchery program in a manner that achieves harvest goals with minimal impact on wild populations.
- Release hatchery yearling steelhead smolts between May 1 and May 15, at target size of six fish to the pound, and a condition factor of less than 1.0.

- Conduct a workshop to implement this wild steelhead management zones concept.
- Implement monitoring and evaluation as a basic component, of both wild steelhead management zones and hatchery harvest streams.
- Investigate the reasons for the recent decline in adult winter steelhead returns, formulate a working hypothesis for the decline, and take appropriate actions.
- Develop an acclimation and adult trapping facility such as Grandy Creek for the lower river releases, at a site that reduces potential ecological and genetic interactions with wild populations.
- Establish the Sauk River as a wild steelhead management zone, with no releases of hatchery-origin fish.

COMMENTS

- None.

MANAGERS RESPONSE

WDFW appreciates the HSRG recommendations on Wild Steelhead Management Zones, but notes:

- A "white paper" on this topic could increase our understanding of HSRG concerns and recommended remedies.
- As a companion to the HSRG white paper, WDFW proposes to conduct a series of workshops on steelhead during 2003 to discuss recent research, performance of the hatchery programs, and management options (including integrated and segregated programs).
- Implementation of any changes in the steelhead program will require consultation with the Fish and Wildlife Commission and the affected tribes.

WDFW supports the HSRG recommendation for improved monitoring, but notes that additional funding will be required.

Facility Recommendations

Assembled below are the Hatchery Scientific Review Group's recommendations that involve capital improvements at hatchery facilities in the Skagit region. Note that they include a series of alterations that may need to be made at Marblemount Hatchery. Future use of this facility will depend on evaluations and management decisions relating to the HSRG's recommendations to modify or discontinue several programs.

MARBLEMOUNT HATCHERY

- Upgrade pollution abatement ponds if they fail to meet water quality standards.
- Upgrade steelhead ponds for flood control purposes.
- Improve intake structures.
- Improve capability to enumerate out-migrating juveniles.
- Redevelop asphalt rearing channels.
- Provide fencing and upgrade bird netting to control predators.
- Reevaluate staffing levels, given the complexity of programs.

BAKER SPAWNING BEACHES

- Refit, remodel or replace the trap on the lower Baker River, to accommodate the need for more efficient, less stressful sorting and handling of returning adults.
- Make vertical incubation trays at the beach four site a permanent feature of the program, to cloister and protect a reserve of eggs as an "insurance policy" against demographic losses due to IHN.
- Upgrade spawning channels with concrete dividers and bird netting, to reduce risk of disease transmission.
- Develop an additional water source, or increase reliability of the existing source, for the incubation and rearing systems at Sulphur Creek, in order to assure an adequate supply of silt-free water at that facility.
- Retain and upgrade beach three by protecting the beach from river migration and flooding. Address the problem of a declining flow of upwelling beach water.
- Improve the mechanical operation of the gulper collectors. The Scientific Group understands that re-licensing discussions are underway that include modification to, or replacement of, the existing system. The group encourages the development of an innovative approach to the pressing problem of fish passage at the dams.

UPPER SKAGIT / RED CREEK HATCHERY

- Improve fish passage by the hatchery intake. These improvements would require only a moderate investment and would provide both conservation and educational benefits.

ACCLIMATION AND ADULT TRAPPING

- Develop an acclimation and adult trapping facility such as Grandy Creek for the lower river releases, at a site that reduces potential ecological and genetic interactions with wild populations.