# ❖Nooksack/Samish Rivers

## Overview

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

### FISHERIES[31]

Early chinook, winter steelhead, pink, Samish coho, and chum salmon harvest management in the Nooksack/Samish region is directed primarily towards the needs of natural production. Fall chinook and Nooksack coho are managed primarily for hatchery production, with due consideration for increasing the productivity of natural production to the capacity of existing habitat. Pre-terminal harvests of hatchery and wild-origin fish occur primarily in Canada, Washington ocean fisheries, North Puget Sound, and in the Strait of Juan de Fuca. Terminal harvests on hatchery-origin coho, pink and chum occur primarily in Bellingham Bay and the Nooksack River. Terminal harvests on hatchery-origin fall chinook occur primarily in Bellingham Bay, the Nooksack River and Samish Bay.

Where possible, harvests are scheduled and located to target hatchery-origin fish and minimize the harvest of ESA-listed North, Middle and South Fork Nooksack chinook and other depressed stocks. There is no targeted terminal harvest of wild-origin, odd-year pink salmon because of its overlap in migration timing with protected, early, natural chinook returning to the Nooksack River. Sea-run cutthroat management is based entirely on natural production. Steelhead management targets the hatchery production of Chambers Creek stocks, with maximum protection to natural production of winter and summer stock.

### CONSERVATION[32]

The tribes in this region face difficult decisions when balancing their cultural values relating to conserving the natural environment against their economic and cultural needs for adequate fisheries reserved by treaty. The tribes have participated in plans to increase natural production, but have been reluctant to reduce hatchery production until watersheds depleted by human development demonstrate a capacity to meet the needs of treaty fisheries.

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

[31] *Provided by Darrell Mills, Washington State Department of Fish and Wildlife and Alan Chapman, Lummi Nation, November and December 2002.*
[32] *Ibid.*

rebuild, as habitat conditions improve to allow greater production. In 1981, a focused hatchery enhancement effort, to rebuild the North and Middle Fork Nooksack chinook population, was begun at the Kendall Creek Hatchery. Managers are using hatchery-enhanced returns of the native stock to re-establish the stock to the North and Middle Fork Nooksack. The *Puget Sound Salmon Management Plan* provides for fisheries to be managed as primary or secondary management units.

Nooksack/Samish coho fisheries are currently being managed in a status intermediate between primary hatchery unit (optimized to harvest all hatchery surplus production without harm to the natural stocks) and primary wild stock management (optimized to ensure escapements to maximum sustainable levels of future harvest). In many areas of Puget Sound, coho are managed under preliminary exploitation rate guidelines and escapement breakpoints from the co-managers' *Comprehensive Coho Management Plan*. However, at this time, no escapement breakpoints have been developed for natural production in the Nooksack Basin stocks or small streams entering Bellingham Bay. The low terminal harvest of Samish coho is incidental to directed fisheries on coho in Northern Bellingham Bay and the Nooksack River.

Natural origin chum have been managed for fixed escapement goals. Fisheries have been managed to exceed escapement goals in recent years, in order to develop better information on the productivity of the stock. The stated objective for odd-year pinks is for the expected natural spawning escapement to exceed the goal for the Nooksack River. In practice, it is difficult to selectively fish for Nooksack pinks during their co-migration with the North, Middle and South Fork native chinook.

The goal of regional winter steelhead management is to harvest the surplus production of the Chambers Creek-origin hatchery run, while avoiding harvest of naturally-produced winter and summer steelhead from the Nooksack and Samish Basins. In the absence of agreed-upon, co-manager escapement goals, and given the depressed state of natural production, no fisheries are directed on naturally-produced 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[33]

### *Nooksack River*

The Nooksack River has three principle forks, each originating in the high slopes of the Cascade Mountains. Flowing westward through mostly steep, heavily forested terrain, the north and middle forks converge on a relatively broad valley floor about five miles upstream of the confluence with the south fork, to form the mainstem Nooksack River. Much of the south fork drainage is through mountainous and moderately forested terrain. However, in its lower reaches the stream flows through a broad, gently sloping valley to its confluence with the Mainstem Nooksack River. Below the confluence, the mainstem meanders northwest, west and then south, where it enters Bellingham Bay about four miles northwest of Bellingham.

There are 654 rivers and streams in the Nooksack drainage, providing 1,325 linear miles of stream in the independent drainages, mainstem Nooksack and its tributaries. Three of the basin's smaller independent drainages are located north of the Nooksack River system. The major portions of Dakota,

[33] *Provided by Alan Chapman, Lummi Nation, April 2002.*

California and Terrell creeks flow in a northwest direction through very gently sloping farmland. The headwaters of Dakota and California creeks are formed by springs and surface run off from moderately sloped, partially timbered hillsides, while Terrell creek has its origin in Lake Terrell and in the spring of Fingalson Creek. Dakota and California creeks enter Drayton Harbor. Terrell Creek enters Birch Bay. Five relatively small drainages flow directly into Bellingham Bay. These are Silver, Squalicum, Whatcom, Padden and Chuckanut creeks, all flowing in a generally westerly direction. Silver and Chuckanut are predominately surface run-off streams, while Squalicum, Whatcom and Padden creeks have their headwaters in lakes and enter the bay after passing through industrial areas in Bellingham. Each of these streams have slight to moderate gradients and each travels some distance through semi-residential or residential areas. Oyster Creek to the south originates in Lost Lake on Chuckanut Mountain and flows generally west over steep, moderately timbered slopes. The marine shorelines and estuaries so vital to the production of marine fish and shellfish include Drayton Harbor, Birch Bay, Lummi Bay, Bellingham Bay and Samish Bay.

For many streams in the Nooksack River system, steep sloped drainage basins create fast run-off conditions causing intensive early winter and spring flooding, followed by low summer flows. Heavy logging in the upper watersheds in the three forks has aggravated these run-off patterns. The falls on the north and south forks and Maple Creek eliminate 25 miles of mainstem river and eleven miles of good quality salmon streams. There is additional productive area above the barriers imposed by the middle fork diversion dam at river mile seven, and the falls/cascades sections of Glacier, Canyon and Skookum Creeks. Increased temperatures during the summer low flow periods and questionable water quality are prevalent in all lowland drainages, particularly in the lower mainstem Nooksack, its tributaries and the independent streams. Industrial discharges in the estuarial waters of Bellingham Bay degrade the habitat quality. Due to the season flash run-offs in the upper watersheds, there is extensive streambed shifting. Much of the suitable spawning substrate has washed downstream, leaving heavy boulders and rubble in areas of moderate gradient. Silt and mud deposits are extensive in many stretches of the slower, flat gradient, deeper waters of the mainstem Nooksack below the community of Everson. Small independent streams of the basin suffer from low summer flows and warm water temperatures above the tolerance of juvenile salmon.

Rural residential and commercial areas are expanding along the streams on the outskirts of Bellingham. Riverfront property development is now actively underway in the upper basin. These activities are causing increased demand for stream bed channelization and diking. Extensive agricultural activities in the northern part of the basin draw heavily on stream flows through irrigation withdrawals. Levee constructions and revetments, and other flood control measures, alter the natural stream environment through out the system.

### *Samish River*

There are 85 streams in the Samish basin, providing over 215 lineal miles of drainage. Every tributary to the mainstem Samish River and Friday Creek presents some accessible area to anadromous fish, and many of the watercourses are inhabited by numerous resident fish stocks.

The Samish River originates near the Community of Saxon in the South Fork Nooksack Valley, and flows south for ten miles before entering into Warner Valley at river mile 18. Principal tributaries along this reach are Ennis, Thunder, Dry and Swede creeks. The Samish Channel, and a good portion of most of the tributaries in this section, wind across a relatively broad, gently sloping valley floor. Upper, steeper slopes of some tributaries are densely forested. Otherwise, streams encounter mostly cleared farmland with intermittent patches of deciduous growth. In the upper Samish River, there are two environmental types. Above Thunder Creek, the gradient is nearly flat and the stream slow

moving. There are some marshes, and the bottom is sand and small gravel. Stream widths range from 3–15', banks are stable and, for the most part, have good over-hanging cover. Below Thunder Creek at river mile 22, the gradient is moderate with good to excellent pool-riffle character. Widths range from 12–30 feet, carrying flows of 30–200 cubic feet per second. The bottom is clean gravel and rubble, with sand in pools. Most banks are naturally stable, offering gently sloping gravel beaches and some cut banks. There is only intermittent bank cover along this stretch.

The lower Samish River and Edison Slough drain into Samish Bay. The Samish River consists of 12 miles of mainstem and 35 total miles of tributaries. From river mile 12 about two miles east of Belfast, the Samish River flows west, turns south for a few miles and arcs north entering Samish Bay about one mile west of Edison. Five tributaries enter along this reach, the major ones being Friday Creek, the outlet of Lake Samish, and Thomas Creek. The Samish River and the major length of its tributaries flow over flat to moderately sloping agricultural land. Except for immediate stream bank cover, adjacent land is cleared for grazing or annual crops. Summer home construction is beginning along the upper tributary reaches.

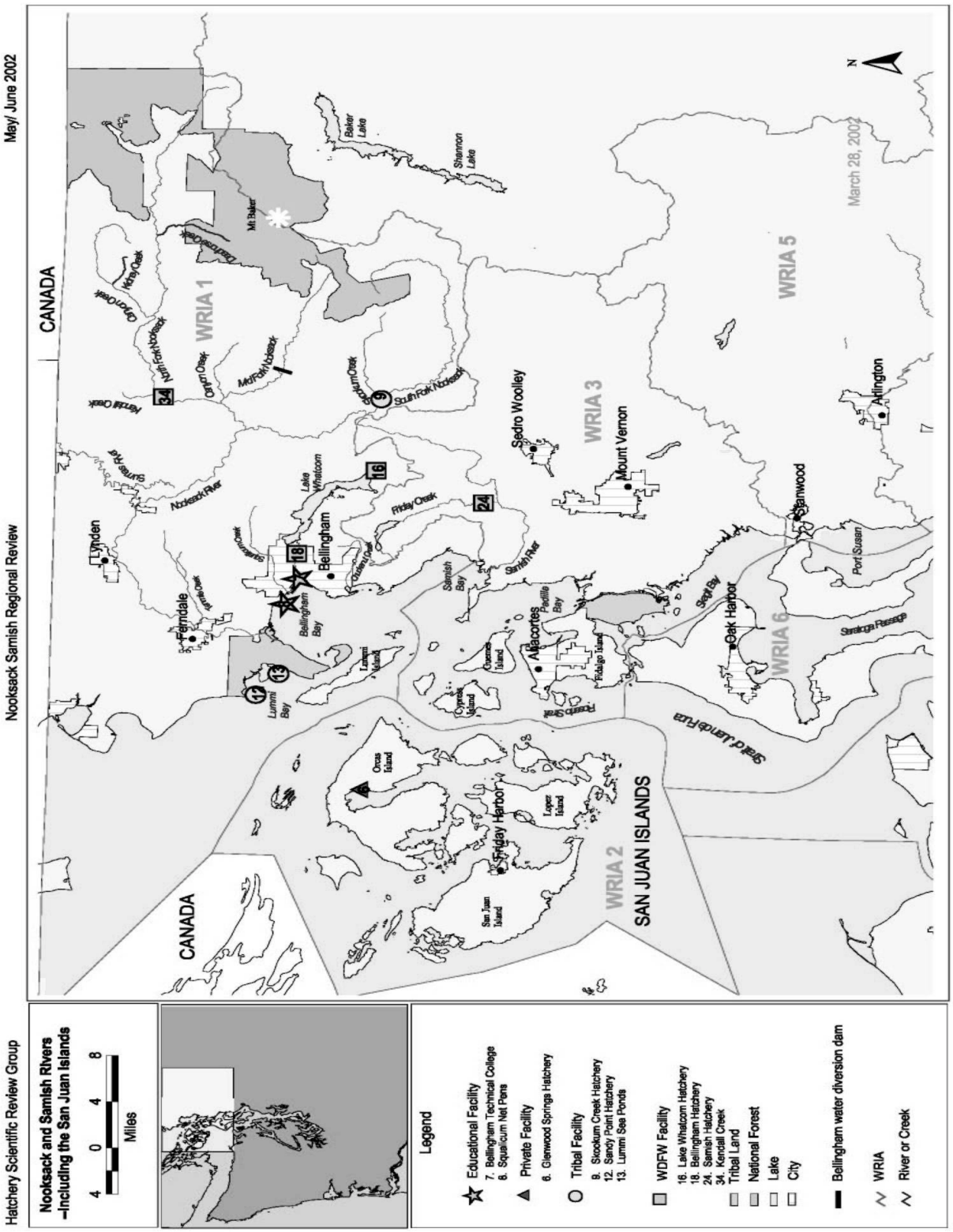
The mainstem Samish River offers two types of stream habitat. The lower half, with a flatter gradient, is predominantly a continuous, slow moving, moderately deep stream course 30–40 feet wide. Tidal influence extends upstream to river mile four, where the channel bottom is mostly sand and silt. Continuous dikes confine the river up to river mile five. Intermittent diking occurs between river miles five and 12. Most banks are cleared and steep sloped, having been stabilized by rip rap or artificial sloping. The channels upper section has a moderate gradient with a good riffle-pool balance. The bottom is mostly cleaned gravel and rubble. A few short sections of bank have been stabilized, but for the most part, the banks are naturally stable, consisting of gently sloping gravel beaches interrupted by occasional cut-banks. Relatively dense, deciduous growth provides nearly ideal shade and protective cover in this reach as well as along the upper tributaries.

Edison Slough was the old north fork Samish River. However, diking for flood control cut off this watercourse. The slough serves as a source of irrigation water, and a tide gate controls salt water intrusion. Salmon spawn in the main channel from river miles five to 12, and in the tributaries. They rear in all accessible sections of the drainage. The drainage is affected by low summer flows, removal of water for irrigation, stream bank clearance and bank stabilization projects. Water quality is affected by gravel mining, run-off from agricultural sprays, feed lots, silage pits and septic drainage. The sloughs have marginal water quality in the summer months.

Friday Creek is the largest tributary of the Samish River and contains over 14 miles of mainstem and 15 tributaries contributing an additional 40 stream miles. Friday Creek is formed by the overflow from Lake Samish. Seven small precipitous tributaries drain into this deep lake, forming the head water reservoir that controls the flow of the creek. From the lake outlet to river mile eight, the creek flows through heavily wooded, bottom land. Due to flooding, no residences are located until river mile six. Some residences and low intensity agriculture (grazing and garden crops) are found in the lower six miles. The lower mile of the creek is diked. The stream is bordered by deciduous and conifer trees in the lower six miles. Excellent spawning ground is found in the lower six miles, with more riffles than pools. From river miles six to eight, the stream meanders through a low gradient and gentle flows through agriculture and pasture land. The bottom is fine gravel and sand. The limiting factors in this drainage are low summer flows, high water temperatures, flooding, bank stabilization, logging and siltation. The surface waters of the lake exacerbate the summer high temperatures. There is a diversion dam for hatchery water supply at river mile 1.4, with fish passage facilities.

### *Habitat Improvement*

Adherence to Timber/Fish/Wildlife Agreement rules should result in forest upland habitats improving in the long-term. Lowland habitat in agricultural areas should improve as the result of current efforts to improve stream buffers, dairy waste management, etc. However, urban areas will continue to expand, increasing impervious surfaces and storm water driven problems for streams.


Hatchery Scientific Review Group
Nooksack Samish Regional Review
May/ June 2002
Nooksack and Samish Rivers
–Including the San Juan Islands
4 0 4 8
Miles
Legend
Educational Facility
7. Bellingham Technical College
8. Squalicum Net Pens
Private Facility
6. Glenwood Springs Hatchery
Tribal Facility
9. Skookum Creek Hatchery
12. Sandy Point Hatchery
13. Lummi Sea Ponds
WDFW Facility
16. Lake Whatcom Hatchery
18. Bellingham Hatchery
24. Samish Hatchery
34. Kendall Creek
Tribal Land
National Forest
Lake
City
Bellingham water diversion dam
WRIA
River or Creek
CANADA
WRIA 1
WRIA 2
SAN JUAN ISLANDS
WRIA 3
WRIA 5
WRIA 6
March 28, 2002
N
Lynden
Ferndale
Bellingham
Lake Whatcom
Nooksack River
South Fork Nooksack
Middle Fork Nooksack
North Fork Nooksack
Mt Baker
Baker Lake
Shannon Lake
Sedro Woolley
Mount Vernon
Arlington
Stanwood
Port Susan
Skagit Bay
Oak Harbor
Strawberry Point
Samish Bay
Samish River
Padilla Bay
Fidalgo Island
Anacortes
Guemes Island
Cypress Island
Lummi Island
Lummi Bay
Bellingham Bay
Orcas Island
Lopez Island
San Juan Island
Friday Harbor
Strait of Juan de Fuca
Rosario Strait

## STOCK STATUS[34]

| 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) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Goals | | | Goals | | | Goals | | | Goals | |
| | | Now | Short-Term | Long-Term | Now | Short-Term | Long-Term | Now | Short-Term | Long-Term | Now | Short-Term | Long-Term |
| Glenwook Springs Hatchery Summer/Fall Chinook | Y | L | L | L | H | H | H | L | L | L | H | H | H |
| Lummi Bay Hatchery Summer/Fall Chinook | Y | L | L | L | H | H | H | L | L | L | H | H | H |
| Mainstem Nooksack Hatchery Summer/Fall Chinook | Y | L | L | L | M | M | M | L | L | M | H | H | H |
| Nooksack North Fork/Middle Fork Spring Chinook | Y | H | H | H | L | L | H | L | L | H | 0 | L | M |
| Nooksack South Fork Spring Chinook | N | H | H | H | L | L | H | L | L | H | 0 | 0 | M |
| Samish Summer/Fall Chinook | Y | L | L | L | L | L | L | M | M | M | H | H | H |
| Drayton/Bellingham Bay Ind. Tributaries Coho | N | M | M | M | M | M | M | M | L | L | L/H | L/H | L/H |
| Glenwood Springs Hatchery Coho | Y | L | L | L | L | L | L | L | L | L | H | H | H |
| Kendall Creek Coho | Y | L | L | L | L | L | L | M | M | M | H | H | H |
| Lummi Bay Hatchery Coho | Y | L | L | L | H | H | H | L | L | L | H | H | H |
| Skookum Creek Hatchery Coho | Y | L | L | L | H | H | H | M | M | M | H | H | H |
| Nooksack Coho | Y | L/M | L/M | L/M | M | M | M | M | M | M | H | H | H |
| Samish Coho | N | M | M | M | H | H | H | H | H | H | H | H | H |
| Squalicum Net Pen Coho | Y | L | L | L | H | H | H | L | L | L | H | H | H |
| Mainstem/South Fork Chum | N | H | H | H | M/L | M/L | M/M | L/L | L/L | M/M | H | H | H |
| North Fork Nooksack Chum | Y | H | H | H | H | H | H | M | M | H | H | H | H |
| Samish Chum | Y | M | M | M | M | M | M | M | M | H | L | L | M |
| Whatcom Creek Hatchery Chum | Y | M | M | M | M | H | H | L | L | L | H | H | H |
| Nooksack Even-Year Pink | N | H | H | H | M | M | M | L | L | L | 0 | 0 | 0 |
| Nooksack Odd-Year Pink | N | H | H | H | H | H | H | M | M | H | L | L | M |
| Whatcom Creek Hatchery Pink | Y | H | H | H | M | M | M | L | L | L | L | H | H |
| Independent Tributaries Steelhead | N | H | H | H | M | M | M | M | M | M | 0 | 0 | L |
| Nooksack Hatchery Winter Steelhead | Y | L | L | L | M | M | H | M | M | M | H | H | H |
| Nooksack Winter Steelhead | N | H | H | H | M | M | H | L | L | H | 0 | L | M |
| Samish Hatchery Winter Steelhead | Y | L | L | L | M | M | H | M | M | M | H | H | H |
| Samish Winter Steelhead | N | H | H | H | H | H | H | M | M | M | 0 | 0 | L |
| Whatcom Creek Hatchery Winter Steelhead | Y | L | L | L | M | M | H | L | L | L | H | H | H |
| Nooksack/Samish/Ind. Tribs. Sea-Run Cutthroat | N | H | H | H | M | M | M | L | L | M | H | H | H |
| Nooksack Bull Trout | N | H | H | H | M | M | M | M | M | H | 0 | 0 | L |
| Nooksack Riverine Sockeye | N | H | H | H | M | M | H | L | L | H | 0 | 0 | 0 |

***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.

[34] *This table contains ratings for all the salmonid stocks in the sub-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

### *Kendall Creek Hatchery*[35]

WDFW's Kendall Creek hatchery is located on Kendall Creek, a tributary to the Nooksack River. The hatchery site, on Kendall Creek, is immediately upstream from the confluence with the north fork Nooksack River, at river mile 45.8. Kendall Creek Hatchery rears North Fork Nooksack spring chinook, Kendall Creek coho, Kendall Creek chum, Chambers Creek stock winter-run steelhead, Tokul Creek Hatchery cutthroat and Ford Hatchery brown trout. The facility is funded by the State General Fund.

There are four residences, two hatchery buildings (one old and one new), and a storage building. There is one gravity intake, one pump intake, and four wells. The new hatchery building uses vertical incubators. The old hatchery building, which is still used, has shallow troughs for starting rainbow and cutthroat trout. There are three, one-third acre asphalt ponds, 12 10' x 100' raceways, four 20' x 140' raceways, six 3' x 15' intermediate ponds, eight Capilano starter ponds with 75 cubic foot capacity, and a large, asphalt, adult trapping and holding pond.

### *Samish Hatchery*[36]

WDFW's Samish Hatchery is located on Old Highway 99 north of Burlington. It is on Friday Creek, 1.4 miles from the confluence with the Samish River, at river mile 10.5. Samish Hatchery rears summer/fall chinook of Green River origin stock to provide a harvest opportunity in marine waters and in the Samish River.

There are two residences and a large hatchery building. The hatchery uses vertical incubators, twelve 20' x 80' concrete rearing ponds (these ponds are being replaced), and a one-half acre asphalt pond. There is a separate asphalt adult holding and rearing pond downstream from the hatchery, on the Samish River at river mile 10.4. Starting in the fall of 2002, there should be seven to eight 10' x 100' ponds to replace the eight 20' x 80' ponds.

### *Lummi Bay Hatchery*[37]

The Lummi Bay Hatchery program has several components in and around the Lummi Bay area on Southeast Georgia Strait, in the Nooksack River Basin (WRIA 1), Sections 8, 9, 10 Townships Range 1 East, South of the Lummi River on the Lummi Reservation. It is associated with the 750 acre Lummi Sea Pond, a diked enclosure of the eastern shore of Lummi Bay with regulated tidal exchange. The goal of the facility's programs is to provide harvestable chinook and coho salmon, in a manner which does not impede the recovery of listed stocks or conflict with other treaty right fisheries objectives, to support Lummi treaty right fisheries around the reservation that have been adversely affected by habitat degradation in the Nooksack watershed since treaty times, and conforms with the obligations set forth in US v. Washington. The Lummi Bay Complex is owned by the Lummi Nation and is operated with funds appropriated by the Lummi Indian Business Council (LIBC) to the Lummi Natural Resources Department, originating from the US Department of the Interior and various grant sources.

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[35] *Provided by Darrell Mills, Pete Castle, Ted Thygesen, Washington State Department of Fish and Wildlife, April 2002.*

[36] *Ibid.*

[37] *Provided by Alan Chapman, Lummi Nation, April 2002.*

The Lummi Bay Sea Ponds Complex on the southern dike has four buildings—the main office, a pole building for storage, a powerhouse, and a spawning shed. There are four 40' diameter, circular, concrete rearing ponds; two 80' x 18' concrete burrows raceways; two one-third acre dirt ponds; and two 8,000 cubic foot net pens. A fish way through the tidal gate on the southwest corner of the dike leads to a 40' x 40' concrete holding pond with a fencing network for the capture and processing of brood stock. There is a spawning shed adjacent to the concrete circular ponds, where brood stock is kept. The main building once contained an incubation room, filtration and re-circulating water systems and laboratory space. Associated with the facility is a water pumping station on Kwina Slough of the Nooksack River, transmission pipelines and a storage reservoir on Chief Martin Road. Part of the facility is now being used for marine fish research by the Northwest Indian College.

The Sandy Point Incubation Facility is located in a 56' x 31' pole building, adjacent to the Lummi Nation Sandy Point Sewage Treatment facility, 300 yards inland from the Strait of Georgia near Sandy Point. It was constructed in 1991 to provide an improved incubation environment, without the limitations imposed by the Nooksack River water source at the main facility. There are 1,736 square feet of sheltered floor space. It has an auxiliary generator and a 25,000 water storage tower associated with its independent well supply. Part of the facility is currently being used for experimental work by the Northwest Indian College.

### *Skookum Creek Hatchery*[38]

The Skookum Creek Hatchery is located along the south fork of the Nooksack River at river mile 14.3, just downstream of the confluence with Skookum Creek. The facility is located on approximately twelve acres owned by the Lummi Nation. The hatchery operations are funded by LIBC appropriations to the Lummi Nation Natural Resources Program, which receives its funding from the US Department of the Interior and various grant sources. The primary goal of the facility is to efficiently produce adult coho to support treaty right fisheries in and around the Lummi Reservation, and to mitigate for lost production due to habitat degradation in the basin since treaty times. A secondary goal is to provide additional harvest opportunity for other fishers in the terminal area and meet production obligations under the Pacific Salmon Treaty. Additionally, coho of the same generic stock returning to the Lummi Bay Facility are transported to this facility for hatching and subsequent rearing.

The facility consists of one separate residence, a combined residence and incubation facility, a workshop and a spawning shed. A 50 x 70 foot concrete pond holds the returning adults. The spawning shed is a pole structure located adjacent to the broodstock collection pond. The incubation facility is housed separately from rearing and spawning facilities. It consists of two large rooms with duplicate plumbing and equipment. Incubating trays can hold 320,000 green eggs. Well water is circulated through the trays and exits below. Fry are initially transferred to one of twelve raceways (90' x 10' x 3'). The coho are transferred at 250–300 fish per pound to one of four 50' x 325' asphalt-lined, rearing and acclimation ponds.

### *McKinnon Pond*[39]

McKinnon Pond is located on an unnamed outlet creek from Mosquito Lake, WRIA 01.0353, at river mile 4.75 on the south bank of the middle fork Nooksack River. It was built in 1986–87 by the local chapter of Trout Unlimited to rear and release winter-run steelhead into the middle fork Nooksack, to

[38] *Ibid.*

[39] *Provided by Darrell Mills, Pete Castle, Ted Thygesen, Washington State Department of Fish and Wildlife, April 2002.*

provide a recreational harvest opportunity. The first steelhead releases were in 1988. The pond site is leased from the US Forest Service. The current lease has been extended until 2003, at which time it will be up for review for another five-year lease.

The ~25' x 250' asphalt rearing pond was built entirely with volunteer labor. Its water supply is not secured by a water right. It is gravity fed via multiple collection pipes from a peat bog wetland. It operates on an average of 900 gallons per minute (two cubic feet per second) flow. Daily feeding and maintenance is coordinated by Trout Unlimited. Fish are supplied via the Kendall Creek Hatchery. Flows and space are adequate for more than the current 50,000 smolt release, but water flow and distribution limits the effectiveness of the rearing pond. A shallow and wide outlet channel necessitates trucking the fish from the pond to a point downstream for release.

### *Whatcom Creek Hatchery*[40]

Whatcom Creek hatchery is located on Whatcom Creek, which flows from Lake Whatcom, at river mile 0.5, at the base of the first set of falls. Bellingham Technical College, the local regional enhancement group (Nooksack Salmon Enhancement Association), the City of Bellingham Parks Department, state Aquatic Lands Enhancement Act funds, and WDFW fund Whatcom Creek Hatchery. Whatcom Creek Hatchery rears Nooksack River pink, Kendall Creek coho, Kendall Creek chum, and Chambers Creek stock winter-run steelhead.

There are two hatchery buildings (one old and one new one attached to the main building), a storage building, a feed shed, and a generator shed. There is one gravity intake that supplies all of the water to a settling pond. Fish ponds are gravity fed and a hatchery pump supplies the water to the hatchery building from the settling pond. Salt water influences the creek up to the facility, and fish can swim into the holding pond at low tide levels. The hatchery buildings use vertical incubators and have shallow tanks for handling eggs, four round tanks and a raceway for starting small groups of fish. The outside ponds consist of two 60' diameter round ponds, and two irregular shaped ponds used for trapping adults and holding fish in the fall, and rearing fish in the spring.

### *Glenwood Springs Hatchery*[41]

Glenwood Springs salmon hatchery is located on the eastern shore of East Sound, Orcas Island. The entire watershed on which the facility is located encompasses 300 acres of privately-owned land. The operating organization is Long Live the Kings. The watershed contains three springs that supply water to the hatchery and associated earthen rearing ponds, and the saltwater bay to which the fish return. There is one hatchery building with a gravity flow water system and small hydro turbine that generates electricity for the building. There are five earthen rearing ponds. There is a small fish ladder (less than 100') leading from the saltwater bay into a large (30' x 30'x 12') concrete pond supplied with both fresh and saltwater.

The primary goal of the Glenwood Springs is harvest augmentation for sport harvest in north Puget Sound and adjacent waters. Long Live the Kings' goals include evaluating the effects and components of natural rearing. Fish reared or handled include Glenwood Springs Hatchery summer/fall chinook, Nooksack/Glenwood Springs Hatchery coho, and Whatcom Creek Hatchery chum.

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[40] *Provided by Earle Steele, Bellingham Technical College; Darrell Mills and Ted Thygesen, Washington State Department of Fish and Wildlife, April 2002.*

[41] *Provided by Kathleen Hopper and Mike O'Connell, Long Live the Kings; Darrell Mills and Ted Thygesen, Washington State Department of Fish and Wildlife, April 2002.*

# Glenwood Springs Hatchery Summer/Fall Chinook

*Long Live the Kings and Washington Department of Fish and Wildlife*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Low | Low | Low |
| *Population Viability*[42] | High | High | High |
| *Habitat* | Inadequate | Inadequate | Inadequate |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest and Education | | |
| *Type* | Segregated | | |

## PROGRAM DESCRIPTION

Glenwood Springs hatchery summer/fall chinook derive from Green River origin fall chinook transplanted to Samish Hatchery in 1938 and Kendall Creek Hatchery in 1954. The Kendall Creek Hatchery program was discontinued in 1998, because of native chinook hybridization concerns. This program is maintained by adult returns to Samish and Glenwood Springs hatcheries. Samish fall chinook is one of about 25 stocks that belong to the south Puget Sound GDU. The purpose of this program is to provide for harvest and public education, while avoiding adverse interactions with other stocks. To this end, the program releases 500,000 sub-yearlings and 200,000 yearlings annually. This is a cooperative program conducted through the WDFW Volunteer Cooperative Fish and Wildlife Enhancement Program.

## OPERATIONAL CONSIDERATIONS

- Glenwood Springs has no habitat for natural fall chinook production. It is strictly a terminal area for harvest of hatchery-produced salmon.

## BENEFITS AND RISKS

***A. Consistent with short-term and long-term goals?***
This program is consistent with harvest goals and has provided significant educational opportunities and benefits.

***B. Likelihood of attaining goals?***
The program has provided harvest opportunities each year and is likely to continue to do so. It has served as a demonstration project for educational programs and has incorporated the concept of natural rearing in its operational protocols.

[42] *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?***
The risk of straying from this program is low, since it is geographically isolated. The available coded-wire tag data demonstrates little straying.

## RECOMMENDATIONS

- Coded-wire tag the fish frequently enough to monitor straying and the survival differences between sub-yearling and yearling release groups.
- Evaluate survival of the two release types and adjust the ratio to best meet goals (see HSRG Area-Wide Recommendations on yearling versus sub-yearling chinook).
- Modify spawning protocols to match HSRG Area-Wide Recommendations.
- Remove returning adults at a rate sufficient to not exceed the holding capacity of the adult pond. This will prevent straying (although normal operations result in little straying).

## COMMENTS

- None.

## MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG and intends to mark 100% of the fall chinook fingerlings and yearlings released.

# Lummi Bay Hatchery Summer/Fall Chinook

*Lummi Nation*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Low | Low | Low |
| *Population Viability*[43] | High | High | High |
| *Habitat* | Inadequate | Inadequate | Inadequate |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest and Cultural | | |
| *Type* | Segregated | | |

## PROGRAM DESCRIPTION

Lummi Bay hatchery summer/fall chinook derive from Green River origin fall chinook transplanted to Samish Hatchery in 1938 and Kendall Creek Hatchery in 1954. This program is maintained by adult returns to Samish Hatchery. Samish fall chinook are one of about 25 stocks that belong to the south Puget Sound GDU. 500,000 sub-yearlings are released into Lummi Bay from the Lummi Bay Tribal facility.

## OPERATIONAL CONSIDERATIONS

- Few adults are trapped, or spawned, at the Lummi Bay facility.
- Releases from Lummi Bay were marked with coded-wire tags in the early years. The last year of that program, the tagged fish released in Kwina Slough and Lummi Bay had the same code. Beginning in 2001, all fingerlings were adipose fin clipped, and 100,000 were marked and tagged.

## BENEFITS AND RISKS

***A. Consistent with short-term and long-term goals?***
The program appears to be consistent with the goal of providing harvest and cultural benefits to the Lummi Nation.

***B. Likelihood of attaining goals?***
The program has a high likelihood of achieving harvest goals.

***C. Consistent with goals for other stocks?***
Stray rates of returning adults to the Nooksack River are unknown. Some straying and genetic risks may exist to spring chinook populations in the Nooksack River, particularly those in the South Fork. However, these risks are not considered to be large. There may also be a by-catch risk to spring

[43] *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.*

chinook during harvest targeting the early portion of the hatchery-origin, summer/fall chinook returns. However, marking/tagging of released fish only began with the 2001 releases, so straying information and evaluations are forthcoming.

## RECOMMENDATIONS

- Do not increase the size of this program above the current release level (500,000) at Lummi Bay during on-going assessments of genetic and by-catch risks to spring chinook populations in the Nooksack River, particularly the South Fork population.
- Consider using an imprinting attractant during the final rearing phase of fall chinook at the Lummi Bay facility. The Lummi Nation is seeking to increase the attraction of adult fall chinook salmon back to the Lummi Bay facility. The HSRG recognizes that achieving this objective will be difficult.
- Replace or refurbish the raceways and ponds at Lummi Bay.

## COMMENTS

- The biological significance and population viability of naturally spawning summer/fall chinook in the Nooksack River need to be determined. The program should be re-evaluated based on the results.

## 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.

# Mainstem Nooksack Hatchery Summer/Fall Chinook

*Lummi Nation*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Low | Low | Low |
| *Population Viability*[44] | Medium | Medium | Medium |
| *Habitat* | Inadequate | Inadequate | Limiting |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest and Cultural | | |
| *Type* | Segregated | | |

## PROGRAM DESCRIPTION

Mainstem Nooksack hatchery summer/fall chinook derive from Green River origin fall chinook transplanted to Samish Hatchery in 1938 and Kendall Creek Hatchery in 1954. The Kendall Creek Hatchery program was discontinued in 1998 because of native chinook hybridization concerns. This program is maintained by adult returns to Samish Hatchery. Samish fall chinook are one of about 25 stocks that belong to the south Puget Sound GDU. 500,000 sub-yearlings from the Samish Hatchery are released directly into the lower mainstem Nooksack River, immediately below the Marine Drive Bridge.

## OPERATIONAL CONSIDERATIONS

- This program cannot be operated as a truly segregated program, because the opportunity for effective broodstock removal does not exist.
- 400,000 of the 500,000 fish released are adipose fin-clipped only and are expected to spend two weeks or more in the Lummi Bay Tribal facility, though they were released in 2001 with no intermediate rearing at that facility (direct release from Samish Hatchery).
- 100,000 of the 500,000 fish released are coded-wire tagged and adipose fin-clipped. These fish are transferred from the Samish Hatchery to the Lummi Bay Tribal facility for intermediate rearing, prior to direct release into the Nooksack River.
- Marking/tagging began with the 2001 releases.

## BENEFITS AND RISKS

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

No information is currently available on the harvest benefits derived from this program. The program provides cultural benefits to the Lummi Nation.

[44] *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.*

***B. Likelihood of attaining goals?***
This program may have a low likelihood of achieving harvest goals. In contrast to the Lummi Bay releases, direct releases into the mainstem Nooksack River are expected to yield high stray rates and quick passage of returning adults past the release site, because of the lack of spawning habitat and adult recapture facilities in the mainstem Nooksack, thereby reducing potential tribal harvest access.

***C. Consistent with goals for other stocks?***
Direct releases of fall chinook into the mainstem Nooksack River may pose genetic risks to spring chinook populations, particularly to the South Fork population. Preliminary genetic data (one year only) indicate that an estimated 83% of natural origin smolts in the South Fork Nooksack River are the progeny of hatchery fall chinook of Samish/Kendall ancestry. One hypothesis is that the parental source of those fall chinook smolts is adult strays from the mainstem Nooksack releases. Evaluation of this hypothesis is in progress. Harvests targeting returning fall chinook adults from the mainstem releases may also pose by-catch risks to spring chinook populations in the Nooksack River.

## RECOMMENDATIONS

- Conduct spawning ground surveys to determine the source and level of straying into the South Fork.
- Perform DNA sampling of juveniles to assess the reproductive contribution of fall chinook to the South Fork spring chinook population.
- Suspend this program for at least a generation and until its risks to the South Fork spring chinook population are understood and can be controlled, in light of the critical population viability status and high biological significance of that population.

## COMMENTS

- WDFW has suggested the release of summer/fall chinook sub-yearlings into Whatcom Creek as a possible alternative to direct releases into the mainstem Nooksack River. The HSRG concurs that releases into Whatcom Creek could substantially reduce potential risks to spring chinook populations in the Nooksack River.

## 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.

# Nooksack North Fork / Middle Fork Spring Chinook

*Washington Department of Fish and Wildlife*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | High | High | High |
| *Population Viability* | Critical | Critical | Healthy |
| *Habitat* | Inadequate | Inadequate | Healthy |
| *Harvest Opportunity* | None | Occasional | Most Years |
| **Hatchery Program:** | | | |
| *Purpose* | Conservation and Cultural | | |
| *Type* | Integrated | | |

## PROGRAM DESCRIPTION

This program is currently being changed. The program as reviewed by the HSRG in 2002 derived from North Fork Nooksack River wild spring chinook collected from 1980–82 and was maintained from adult returns to Kendall Creek Hatchery since 1982. North Fork Spring Chinook are the only population in the North Fork Nooksack GDU. The program included 1.6 million fingerlings (400,000 at Kendall Creek Hatchery; 200,000 outplanted into Middle Fork; one million into the North Fork acclimation ponds) and up to 500,000 unfed fry released from remote site incubators (RSIs) into the North and Middle Fork Nooksack River. Adult collection and eyeing occurs at Kendall Creek Hatchery for on-site releases, acclimation ponds and RSIs. There are three acclimation ponds: Deadhorse, Excelsior and Kidney Creek ponds. Releases strategies vary with site; the time of release has been determined by the area biologist.

## OPERATIONAL CONSIDERATIONS

- Otolith marks are used to distinguish among eight separate lots.
- On-site hatchery releases are split between April (200,000 at 100 per pound) and June (200,000 at 80 per pound).
- Acclimation ponds are poorly funded and exist as a result of a well-organized and committed volunteer force.
- All fish returning to the hatchery are spawned prior to August 24. After that date, otoliths are read to exclude any fall chinook individuals.
- A significant number of individuals return to the spawning grounds. Releases from the ponds are well distributed among the naturally spawning population.
- Increased escapement spawning in the wild is not translating into increased natural-origin recruits (NORs). Recent average of NORs is 120 (most recently 240).
- Habitat conditions are poor, with very hard, compact gravel.
- High straying has been recorded into the South Fork, and South Fork chinook populations are genetically distinct from those in the North Fork. In the last two years, chinook of North Fork cultured origin mostly from the on-site releases have represented 55% and 32 %, respectively, of the total number of spawners in the South Fork.

## BENEFITS AND RISKS

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

This project is successfully protecting the remaining genetic resources and increasing absolute numbers of North and Middle Fork Nooksack spring chinook, but has not significantly increased the number of natural origin recruits per spawner. Adequate numbers are being produced to seed the habitat. However, few if any natural origin recruits are being incorporated into the broodstock, increasing the risk of domestication. Acclimation ponds and RSIs may reduce the magnitude of this risk. Fry produced are larger than natural origin fry, potentially producing competition risk to these NORs. The April release from the Kendall Hatchery may not be fully migratory, and may pose a competition risk to the natural origin recruits. The program also contributes to a ceremonial and subsistence harvest.

***B. Likelihood of attaining goals?***

Reproductive success in the wild is low. This condition is likely to remain unchanged in the short term, until habitat conditions improve.

***C. Consistent with goals for other stocks?***

A large proportion of spawners in the South Fork are of North Fork origin. The exact origin of these spawners is unknown, but their presence represents a significant genetic risk to the South Fork population. The reproductive success of the North Fork spawners and the level of introgression between the North Fork and South Fork are presently unknown.

## RECOMMENDATIONS

- Reduce the size of the North Fork program to reduce the actual number of strays from the North Fork to the South Fork, and increase opportunities for rebuilding the South Fork population. Resize the program to a level appropriate for reducing straying, while continuing to meet conservation goals for the North and Middle forks.
- Release migration-ready smolts to the extent feasible, to minimize ecological interactions with naturally produced juveniles. Methods for achieving this include the continued use of acclimation ponds and volitional release. Acclimation ponds may more closely mimic natural life history patterns and coloration, and locate fish higher in the watershed than on-site releases from Kendall Hatchery.
- Include adults collected upriver in hatchery broodstock, in order to get a better representation of the entire natural run.
- Develop a long-term, stock recovery plan that takes into account available fresh water habitat in the watershed, domestication risks to North Fork spring chinook, straying risks to South Fork spring chinook, and maintenance of effective population size. The plan should also evaluate the effectiveness of the release strategies described above.
- Continue genetic analyses to more accurately characterize spawning populations. Continue temporal and geographic sampling of smolts to estimate the genetic composition of out-migrants at varying times and locations within the watershed.
- Conduct an evaluation of the risk to spring chinook from incidental harvest in terminal fisheries.
- Include a trap if a fish ladder is installed on the Middle Fork. This ladder would provide a demographic benefit for this and other stocks, with an estimated 16% increase of new chinook habitat. A trap would increase the management options available in the future. It could also be used to manage disease risks to the Lake Whatcom stocks (see Lake Whatcom kokanee comments).

## COMMENTS

- This program is the primary means of preserving the North Fork chinook stock, but seems to be "out in front" of habitat restoration. The program appears to be producing a larger population than the habitat can support at this time, potentially leading to the increased straying into the South Fork that has become a significant concern. The program is also larger than necessary to contain the risk of extinction.
- A comprehensive review of the status of the South Fork population and options for recovery is needed. An HSRG task team would be willing to assist the managers with this review. This review should include analysis of the release lots from the North Fork, to identify any particular release or treatment with a high proclivity for straying into the South Fork.
- Recent genetic data suggest that a high proportion of smolts of fall chinook-origin are present in the South Fork. Genetic analyses should continue, to more accurately define the origin and extent of this risk.
- The managers are to be commended for adaptively managing this program.

## MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG and has reduced the size of the program to a release of 800,000 fish.

The Nooksack Tribe believes most of the recommendations of the HSRG make sense, but notes the following (see Appendix B for the Tribe's full response):

- Along with WDFW and the Lummi Nation, the Tribe has put considerable energy into evaluating and adaptively managing the Kendall spring chinook program. Through this, the Tribe has learned how much effort and cost it takes to accomplish adaptive management through data collection, analyzing the results, interpreting data and adjusting the program. The Tribe encourages the HSRG to more clearly emphasize the need to provide adequate funding for this.
- The Tribe is disappointed with the recommendation to include a trap with a ladder, if built, on the Middle Fork "to increase management options," while restoring passage for ESA-listed North/Middle Fork spring chinook and bull trout, as well as for steelhead and coho. The Tribes concerns are for impacts to ESA-listed fish when holding, handling and sampling them, costs to test and man any trap, logistics (for example accessing the site during winter weather), and for excluding wild salmon and trout from their habitat.

# Lake Whatcom 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, only comments with options for managing risks to the stock—not recommendations—are provided.***

## PROGRAM DESCRIPTION

The Lake Whatcom kokanee program began in 1907 with native adults from Brannian Creek, a tributary to Lake Whatcom immediately adjacent to the Lake Whatcom Hatchery. Adult returns to Brannian Creek, maintain this program. Fertilization and incubation of the eggs are done at the hatchery on Brannian Creek and Lake Whatcom water. To maintain a healthy population of native-origin kokanee in Lake Whatcom, a portion of the eggs is hatched at Whatcom Creek Hatchery, with the resulting progeny reared at (with little or no feeding) and released from the hatchery into Lake Whatcom (five million fry). The remaining eggs are incubated to the eyed stage at the hatchery and then shipped to nine other Washington state hatcheries, to support sport fishery needs in western Washington (7,830,000 eggs). If additional eggs are available, they may be shipped out-of-state (e.g., to California and Idaho).

## OPERATIONAL CONSIDERATIONS

- To date, Lake Whatcom Hatchery kokanee have not been marked, so the extent to which the hatchery population interacts with wild kokanee populations in Lake Whatcom is unknown.
- Lake Whatcom kokanee are unique in having a history of freedom from reportable pathogens (e.g., IHN virus). This allows them to be shipped to other watersheds, without the risk of spreading these pathogens.
- Genetic analysis has recently occurred on Lake Whatcom kokanee but no comparisons have yet been done between this stock and Baker or Shannon Lake stocks, in the Skagit region.

## COMMENTS

- Under the present management plan to reintroduce salmon to the upper watershed, the following actions could be pursued to reduce, but not eliminate, the threat of disease to this population:
  - Include an adult trap if a fish ladder is planned for passing salmon upstream of the water intake, so that upstream passage can be denied to salmonids that test positive for reportable pathogens (this would also benefit Nooksack Hatchery winter steelhead, see recommendations for that program).
  - Sample spawned-out carcasses of all species of salmon spawning in the Middle Fork Nooksack for the next several years, to determine if reportable pathogens are present. The resulting information, together with pre-existing information, could be used to determine the prevalence, if any, of IHN virus and other reportable pathogens in these species.
  - Work with the City of Bellingham to halt the piping of water from the Middle Fork Nooksack to Lake Whatcom during the time any species carrying a reportable pathogen is allowed

access above the water intake to spawn and during the period of hatching and fry emergence for that species. Water-borne titers of reportable pathogens, including IHN virus, are likely to be highest during these periods.

- Determine the smallest size at which kokanee juveniles become refractory to IHN virus infections. If a refractory stage occurs (and the assumption is that it does), a portion of the hatchery releases to Lake Whatcom could be made at this stage (perhaps one million fish). This approach should reduce the impact of the virus on the kokanee population, should the infection be contracted. If all the rearing of these fish cannot be accomplished in Brannian Creek water (because of low flows in summer), then a pathogen-free water source should be found to satisfy this need.
- Accelerate and intensify efforts to identify and develop other kokanee stocks that could satisfy some or all of Washington state's demand for kokanee eggs.

## MANAGERS RESPONSE

WDFW generally supports the recommendations of the HSRG. A statewide inventory of potential alternatives to using Lake Whatcom kokanee is currently underway.

The Nooksack Tribe believes most of the recommendations of the HSRG make sense, but notes the following (see Appendix B for the Tribe's full response):

- The Tribe is disappointed with the recommendation to include a trap with a ladder, if built, on the Middle Fork "to increase management options," while restoring passage for ESA-listed North/Middle Fork spring chinook and bull trout, as well as for steelhead and coho. The Tribes concerns are for impacts to ESA-listed fish when holding, handling and sampling them, costs to test and man any trap, logistics (for example accessing the site during winter weather), and for excluding wild salmon and trout from their habitat.

# Samish Summer/Fall Chinook

*Washington Department of Fish and Wildlife*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Low | Low | Low |
| *Population Viability* | Critical | Critical | Critical |
| *Habitat* | Limiting | Limiting | Limiting |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest | | |
| *Type* | Integrated | | |

## PROGRAM DESCRIPTION

Samish summer/fall chinook were derived from Green River origin fall chinook transplanted to Samish Hatchery in 1938 and Kendall Creek Hatchery in 1954. The Kendall program was discontinued in 1998 because of native chinook hybridization concerns. This program is maintained by adult returns to the Samish River rack. Samish fall chinook are one of about 25 stocks that belong to the south Puget Sound GDU. Four million sub-yearlings are released on-site from the hatchery's holding pond into the Samish River. 100,000 yearlings are released on site, with intermediate rearing at Kendall from May to October. One million fingerlings are transferred to the Lummi Tribe for release of 500,000 each into Lummi Bay and the mainstem Nooksack River.

## OPERATIONAL CONSIDERATIONS

- Recent molecular genetic studies by WDFW indicate that significant genetic divergence now exists between this stock and the progenitor Green River stocks.
- Yearling intermediate rearing takes place at Kendall because of water quality/quantity problems associated with the Friday Creek water supply at Samish Hatchery.
- These water quality problems limit the ability to release fish at the optimal times.
- There are also disease problems at Samish Hatchery, particularly from enteric red mouth (ERM) disease.

## BENEFITS AND RISKS

***A. Consistent with short-term and long-term goals?***
The program appears to be consistent with short- and long-term goals for the Samish River.

***B. Likelihood of attaining goals?***
Sub-yearling releases result in good survival and contribute regularly to harvest. These sub-yearling releases thus appear to be achieving harvest goals. The program is managed as an integrated harvest program. There is natural spawning in the Samish River. If this population is self-sustaining, it will provide the opportunity to maintain an integrated genetic stock by inclusion of natural-origin fish into

the broodstock as needed or desired. Surplus hatchery-origin adults are allowed to pass upstream and assist with maintaining a naturally spawning population. On the other hand, overall survival and contribution of yearling releases to the "blackmouth" fishery in Puget Sound appear to be low.

***C. Consistent with goals for other stocks?***

There appears to be no significant straying of these hatchery fish from the Samish River Basin. However, a by-catch risk to Nooksack River spring chinook may occur in fisheries targeting Samish River fall chinook. By-catch risks to spring chinook salmon from the South Fork Nooksack River are of particular concern.

## RECOMMENDATIONS

- Adopt proactive management practices to address chronic disease problems at this facility, such as ERM vaccination and improved husbandry techniques.
- Terminate yearling releases from this facility.
- Review and evaluate rearing densities at the Samish Hatchery, in light of water quality problems.
- Recognize water quality problems at the Samish Hatchery during current redesign of the facility, and in future reprogramming. Meeting program goals will require an increase in ponding capacities and other means to address water quality problems and limitations. In particular, engineering and design of the new facilities should not rely on "standard" designs, but rather, must consider the specific biological requirements of the fish and the available water quality and quantity at the Samish Hatchery. Original designs and engineering specific to the hatchery may be necessary.

## COMMENTS

- None.

## MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG, but:

- Notes that additional funding will be required to upgrade the facilities as recommended; and
- Wishes to clarify that this is a segregated program. As noted by the HSRG, no significant straying occurs outside of the Samish Basin.

# Glenwood Springs Hatchery Coho

*Long Live the Kings and Washington Department of Fish and Wildlife*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Low | Low | Low |
| *Population Viability*[45] | Low | Low | Low |
| *Habitat* | Inadequate | Inadequate | Inadequate |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest and Education | | |
| *Type* | Segregated | | |

## PROGRAM DESCRIPTION

The Glenwood Springs coho program originated with Nooksack River Hatchery coho and is maintained by adult returns to the Glenwood Springs Hatchery trap. The purpose of this program is to provide for harvest and public education, while avoiding adverse interactions with other stocks. To this end, this program annually releases 100,000 yearling coho from Glenwood Springs and 10,000 fed fry from an educational cooperative. This is a cooperative program conducted through the WDFW Volunteer Cooperative Fish and Wildlife Enhancement Program.

## OPERATIONAL CONSIDERATIONS

- Glenwood Springs has little habitat for coho production. It is strictly a terminal area for harvest of hatchery-produced salmon.

## BENEFITS AND RISKS

***A. Consistent with short-term and long-term goals?***
This program is consistent with harvest goals and has provided significant educational opportunities and benefits.

***B. Likelihood of attaining goals?***
This program has provided harvest opportunities each year and is likely to continue to do so. It has served as a demonstration project for educational programs and has incorporated the concept of natural rearing in its operational protocols.

***C. Consistent with goals for other stocks?***
The risk of straying from this program is low, since it is geographically-isolated. The available coded-wire tag data demonstrates little straying.

[45] *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.*

## RECOMMENDATIONS

- Modify spawning protocols to match HSRG Area Wide Recommendations.
- Coded-wire tag the fish frequently enough to monitor straying and survival.

## COMMENTS

- None.

## MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG, but notes that additional funding will be required to implement a tagging program.

# Kendall Creek Coho

*Washington Department of Fish and Wildlife*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Low | Low | Low |
| *Population Viability* | Critical | Critical | Critical |
| *Habitat* | Limiting | Limiting | Limiting |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest and Indicator | | |
| *Type* | Integrated | | |

## PROGRAM DESCRIPTION

The Kendall Creek coho program began in 1950 with native Nooksack coho. In addition, Capilano (British Columbia), Clark Creek, Orcas Island, Green River, Samish, Skookum and Wallace stocks have augmented the Kendall Creek hatchery coho stock. This ceased in 1990. Adult volunteers (150 pairs) to Kendall Creek Trap from October to December maintain the present program.

## OPERATIONAL CONSIDERATIONS

- Although 150 pairs are used each year, they are spawned in pools of five. Because as few as one male in each pool may contribute all of the successful fertilizations, this tends to reduce the effective population size to something less than 300.

## BENEFITS AND RISKS

***A. Consistent with short-term and long-term goals?***
Risks to other stocks in the region (e.g., predation on early chinook fry) are low, due to the present program's small size. The purpose and benefit of the program is harvest, which the program achieves. Several hundred to a few thousand are taken in various fisheries, a large portion in Canada (as is true for other stocks in the region). A major benefit is as a wild stock index. Kendall Creek is the only double index, tagged coho stock in the region.

***B. Likelihood of attaining goals?***
High.

***C. Consistent with goals for other stocks?***
Yes.

## RECOMMENDATIONS

- Monitor and evaluate the contribution of hatchery origin spawners to coho spawning in Kendall Creek, as well as the contribution of natural origin spawners to the broodstock.

- Adopt HSRG area-wide spawning protocols to maximize effective population size.
- Alter rearing protocols to optimize smolt quality (such as ration control to moderate parr growth, maximize pre-smolt growth, reduce jacking and enhance survival).
- Consider the cost-effectiveness of having two coho index stocks in the basin and whether program effectiveness could be improved by consolidation (the HSRG recognizes that this is the only double index stock).

## COMMENTS

- None.

## MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG, but notes that additional funding will be required to monitor and evaluate the contribution of hatchery origin spawners to Kendall Creek.

# Lummi Bay Hatchery Coho

*Lummi Nation*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Low | Low | Low |
| *Population Viability*[46] | High | High | High |
| *Habitat* | Inadequate | Inadequate | Inadequate |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest | | |
| *Type* | Segregated | | |

## PROGRAM DESCRIPTION

The current program began in 1990 with Green River-origin, Soos Creek Hatchery eggs. This replaced a previous coho program at this facility, whose broodstock had to be reconstituted after the identification of VHS at the hatchery in 1989. Adult returns to Skookum Creek Hatchery and Lummi Sea Ponds maintain the current program. One million yearlings are released on-station after two to four weeks of acclimation to seawater. Returning adults are collected for broodstock at Lummi Bay in a trap (1,000–1,200 pairs), selected randomly throughout the run. Eggs are eyed at the Sandy Point Incubation Facility, hatched and reared at the Lummi Nation's Skookum Creek Hatchery. The stock is coded-wire tagged as a US/Canada index stock.

## OPERATIONAL CONSIDERATIONS

- Adults return considerably earlier than coho return to Skookum Creek, despite being the same ancestral stock.
- Vibriosis is the most significant fish pathogen during the yearling estuarine rearing phase. Vaccination has occurred during truck transfer from freshwater to the seawater site, but beginning with the 2001 brood, fingerlings were vaccinated during marking, a short time before transfer.
- The stock returns predominantly as three year-old fish.
- The current spawning protocol is to pool green eggs from 10 females and fertilize them with pooled sperm from 10 males.
- All eggs are incubated in well water.
- All releases are coded-wire tagged or adipose fin clipped.
- Adult survival from 1988–98 ranged from 0.8%–9.2%.

[46] *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.*

## BENEFITS AND RISKS

***A. Consistent with short-term and long-term goals?***
These fish provide a significant contribution to harvest in relative isolation from harvest of other stocks, and the program is therefore consistent with its goals. Potential risks from the program include whether released coho prey on chum and Nooksack spring chinook in the estuary. There may be potential straying, but coded-wire tag data show only minor straying to other hatcheries (three percent to Skookum Creek).

***B. Likelihood of attaining goals?***
The program attains its goal of coho harvestable in segregation from other stocks, with year-to-year variations probably associated with climate changes.

***C. Consistent with goals for other stocks?***
The program is consistent with goals for local, wild coho stocks as presently formulated by the co-managers.

## RECOMMENDATIONS

- Adopt HSRG area wide spawning protocols, which are designed to prevent erosion of the genetically-effective population size.
- Administer Vibrio vaccine some time prior to transfer from freshwater (perhaps two weeks to one month), to strengthen the protection given to the fish from this vaccine.
- Size this program to a scale appropriate to the demand for harvest. The HSRG notes that the market value of coho and other Pacific salmon has declined significantly in recent years and demand is therefore reduced.

## COMMENTS

- It would be valuable to know whether body size distribution in this non-selected stock differs from the distribution of size in the cousin stock at Skookum Creek.
- It would also be valuable to know if the earlier return timing at Lummi Sea Ponds reflects earlier ocean migration timing than the Skookum Creek stock, and how this relates to optimum management of harvest.
- The use of multiple pools of spawners (25 per bucket) tends to constrain effective population size. In the long term, it would be beneficial to use protocols closer to one-to-one mating.

## 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.

# Skookum Creek Hatchery Coho

*Lummi Nation*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Low | Low | Low |
| *Population Viability*[47] | High | High | High |
| *Habitat* | Limiting | Limiting | Limiting |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest | | |
| *Type* | Segregated | | |

## PROGRAM DESCRIPTION

The current program began in 1990 with Green River-origin, Soos Creek Hatchery eggs. This replaced a previous coho program at this facility, whose broodstock had to be reconstituted after the identification of VHS at the hatchery in 1989. The program is maintained from adult returns (1,000–1,200 pairs) to Skookum Creek Hatchery. A total of 1.5 million eggs are taken. One million yearlings are released on-station (a tributary of the South Fork Nooksack River). Adult collection, incubation and rearing are carried out on-station. The stock is tagged as a US/Canada index stock.

## OPERATIONAL CONSIDERATIONS

- Adults for broodstock are all taken at Skookum Creek and are selected for large size throughout most of the run, then selected randomly near the end of the run. Only adults that migrate up Skookum Creek from the South Fork Nooksack are used as brood fish. The stock returns predominantly as three year-old fish.
- The spawning protocol is to pool green eggs from ten females and fertilize them with pooled sperm from ten males.
- All eggs are incubated in well water.
- Skookum Creek Hatchery also rears coho destined for release at the Lummi Sea Ponds, but maintains them in separate raceways, as a distinct sub-population.
- Smolts are released at 16–20 per pound. All are coded-wire tagged or adipose fin clipped. Release is volitional, over a period of two to three weeks.
- Cold water disease is the most significant fish pathogen. It is exacerbated and transferred horizontally through the serial reuse of raceway water. BKD also causes loss. VHS was diagnosed in the Lummi Bay stock held at Skookum Creek in 1989, resulting in the destruction of all eggs obtained from both broodstocks.
- The stock is of Green River origin. The replacement stock for VHS-destroyed eggs in 1989 was Wallace River Hatchery. Some fish were also imported from Kendall Creek Hatchery in 1998.

[47] *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.*

- Adult survival in the period 1988-98 ranged from 0.9%–7.1%.
- Approximately five percent of Skookum Creek adults are known to stray to other hatcheries, mostly to the Lummi Sea Ponds. Less than one percent of adults stray to other regional hatcheries. An unknown number stray to the wild.
- Surveys in the watershed are presently underway to determine the character and origin of natural spawners. If a wild/hatchery mix is present, the program will change to an integrated program, to ensure the sustainability of natural production.

## BENEFITS AND RISKS

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

This program provides significant harvest benefits and is valuable as a US/Canada index stock.

***B. Likelihood of attaining goals?***

The program has been successful in achieving its goal of segregated harvest, separate and distinct from wild populations in the Nooksack Basin. However, little is known regarding the status of any remaining natural coho populations in the South Fork Nooksack.

***C. Consistent with goals for other stocks?***

Because the hatchery releases large numbers of large smolts, the Skookum Creek coho may represent a predation risk to smaller, wild South Fork spring chinook. Predation may be somewhat mitigated by the hatchery practice of volitional release, because fish allowed to migrate at their own volition are more likely to exit the river and estuary more rapidly than those forced from the raceways.

## RECOMMENDATIONS

- Regularly integrate natural spawners into the program if a wild/hatchery mix is found to be present in sufficient numbers. The HSRG believes that the value of the stock for US/Canada indexing is reduced by segregating it from any remaining wild fish.
- Conduct studies to determine predation rates on natural South Fork spring chinook juveniles, including predator/prey size relationships, and areas and times where significant predation is most likely to occur. Predation information will allow hatchery managers to program numbers, times and smolt size at release to best avoid unnecessary predation mortality of depleted natural South Fork spring chinook.
- Undertake a renewed effort to understand the genetic composition of remaining natural coho spawners in the South Fork Nooksack, and the impact, if any, that hatchery strays may have on the persistence and genetic integrity of these fish. The HSRG recognizes that there is a divergence of opinion on the value of residual South Fork Nooksack coho, and that these determinations will take time to accomplish.
- Formalize the selection program underway that seeks to increase the body size of returning adults, and monitor the effect of size-selection on survival of hatchery fish. To date, this directed selection program has been informal and not rigorously controlled.
- Adopt spawning protocols consistent with HSRG area-wide recommendations.
- Size this program to a scale appropriate to the demand for harvest. The HSRG notes that the market value of coho and other Pacific salmon has declined significantly in recent years and demand is therefore reduced.
- Replace broodstock production shortfalls with in-region stocks in the exceptional circumstances of a lost brood year, such as occurred in 1998. Do not use out-of-region stocks.

## COMMENTS

- None.

## 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.

# Nooksack Coho

*Washington Department of Fish and Wildlife*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Low/Intermediate | Low/Intermediate | Low/Intermediate |
| *Population Viability* | At Risk | At Risk | At Risk |
| *Habitat* | Limiting | Limiting | Limiting |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Education | | |
| *Type* | Integrated | | |

## PROGRAM DESCRIPTION

The Kendall Creek coho program began in 1950 with native Nooksack coho. In addition, Capilano (British Columbia), Clark Creek, Orcas Island, Green River, Samish, Skookum and Wallace stocks have augmented the Kendall Creek hatchery coho stock. This ceased in 1990. Adult volunteers to Kendall Creek trap from October to December maintain the present program. In this program, less than 100,000 fry—fed and unfed—are released in remote site incubators and classroom programs. They are incubated at Kendall Creek.

## OPERATIONAL CONSIDERATIONS

- None.

## BENEFITS AND RISKS

***A. Consistent with short-term and long-term goals?***
The program, because of its small size, presents low risk to other stocks and is consistent with the co-managers' goals for coho in the Nooksack River. The program provides a high benefit from education, as well as a potential benefit to restoration.

***B. Likelihood of attaining goals?***
High.

***C. Consistent with goals for other stocks?***
Yes.

## RECOMMENDATIONS

- None.

## COMMENTS

- The Scientific Group encourages WDFW in its efforts to use this program and others to evaluate the productivity of remote site incubators.

## MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG.

# Squalicum Net Pen Coho

*Bellingham Technical College and Washington Department of Fish and Wildlife*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Low | Low | Low |
| *Population Viability*[48] | High | High | High |
| *Habitat* | Inadequate | Inadequate | Inadequate |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest and Education | | |
| *Type* | Segregated | | |

## PROGRAM DESCRIPTION

The Kendall Creek coho program began in 1950 with native Nooksack coho. In addition, Capilano (British Columbia), Clark Creek, Orcas Island, Green River, Samish, Skookum and Wallace stocks have augmented the Kendall Creek hatchery coho stock. This ceased in 1990. Adult volunteers to Kendall Creek trap from October to December maintain the present program. 5,000 yearlings are released on-site into Squalicum Harbor. Adult collection, incubation and rearing prior to saltwater transfer are at Kendall Creek.

## OPERATIONAL CONSIDERATIONS

- None.

## BENEFITS AND RISKS

***A. Consistent with short-term and long-term goals?***
The program is consistent with the short- and long-term goals for education by teaching net pen culture at Bellingham Technical College. It is also consistent with the goal of contributing to coho harvest each year.

***B. Likelihood of attaining goals?***
Educational goals are being met. Fish produced in this program are making a small, annual contribution to coho harvest. A large harvest from this program will never be possible, because of the program's size.

***C. Consistent with goals for other stocks?***
Because of its small size, the program does not pose any significant risks to other stocks.

[48] *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.*

## RECOMMENDATIONS

- None.

## COMMENTS

- None.

## MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG.

# North Fork Nooksack Chum

*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* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest and Conservation | | |
| *Type* | Integrated | | |

## PROGRAM DESCRIPTION

This program began in 1978 with broodstock from native North Fork Nooksack chum adults. Volunteer chum returning to the Kendall Creek Trap maintain the program. Kendall Creek chum are one of 12 stocks that belong to the North Puget Sound GDU. Eggs are collected from adults returning to Kendall Creek Hatchery. Egg incubation and fry rearing are done at the hatchery. 400,000 unmarked fry are force-released from the hatchery in May.

## OPERATIONAL CONSIDERATIONS

- It is not known whether wild chum volunteer to the hatchery.
- Adults are selected randomly across the entire run without consideration of size, age or timing.
- Fry are released two weeks after the release of steelhead.
- At release, hatchery fry are larger than their wild counterparts.

## BENEFITS AND RISKS

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

The harvest benefit is likely to be constrained by the relatively small size of the program. A conservation benefit is also being compromised because the program is being operated in a segregated, rather than integrated, manner.

***B. Likelihood of attaining goals?***

There is currently minimal harvest benefit, but in the long-term the program may provide a harvest benefit as a broodstock source for Whatcom Creek Hatchery. In addition, the program provides eggs for schools. A conservation benefit is unlikely to be achieved unless the operation of the program is modified as recommended below.

***C. Consistent with goals for other stocks?***

The program is consistent with the goals for other stocks in the drainage system, as it poses no obvious threats to them.

## RECOMMENDATIONS

- Discontinue program or convert it into a properly integrated program by following the steps below:
  - Establish a new broodstock using 100% natural origin adults.
  - Thereafter, introduce into the hatchery stock a sufficient number of adults from the naturally spawning population to avoid genetic divergence over time (an annual average of 10-20%).
  - Collect adult broodstock at a location most likely to include natural origin fish.

## COMMENTS

- None.

## MANAGERS RESPONSE

WDFW has terminated this program as recommended by the HSRG.

# Samish Chum

*Washington Department of Fish and Wildlife*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Intermediate | Intermediate | Intermediate |
| *Population Viability* | At Risk | At Risk | At Risk |
| *Habitat* | Limiting | Limiting | Healthy |
| *Harvest Opportunity* | Occasional | Occasional | Most Years |
| **Hatchery Program:** | | | |
| *Purpose* | Conservation | | |
| *Type* | Integrated | | |

## PROGRAM DESCRIPTION

This program began in 1978 with Samish hatchery eggs. Adult returns to Bellingham Technical College maintained this program through brood year 1998, when the program began a broodstock transition to North Fork Nooksack chum. Samish chum are one of eleven stocks that belong to the North Puget Sound fall-run GDU. 500,000 unfed fry are outplanted from Whatcom Creek Hatchery into the Samish River. Adult collection is at Whatcom Creek hatchery, eyeing is at Kendall Creek hatchery, and hatching is at Whatcom Creek. 525,000 eggs or juveniles are also provided to miscellaneous sites, including regional fish enhancement groups. This program is ending after the 2002 brood year.

## OPERATIONAL CONSIDERATIONS

- Since this program is scheduled to end after the 2002 brood year, the program was not evaluated for consistency with goals or any operational considerations.

## BENEFITS AND RISKS

***A. Consistent with short-term and long-term goals?***
***B. Likelihood of attaining goals?***
***C. Consistent with goals for other stocks?***
See above.

## RECOMMENDATIONS

- Discontinue program, as planned.

## COMMENTS

- None.

## MANAGERS RESPONSE

WDFW has terminated this program as recommended by the HSRG.

# Whatcom Creek Hatchery Chum

*Bellingham Technical College and Washington Department of Fish and Wildlife*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Intermediate | Intermediate | Intermediate |
| *Population Viability*[49] | Medium | High | High |
| *Habitat* | Inadequate | Inadequate | Inadequate |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest, Conservation and Education | | |
| *Type* | Segregated | | |

## PROGRAM DESCRIPTION

This program began in 1978 with Samish Hatchery eggs. Adult returns to Bellingham Technical College's Whatcom Creek Hatchery maintained this program through brood year 1998, when the program began a broodstock transition to North Fork Nooksack chum. Eggs imported from Kendall Creek Hatchery in brood years 1999–2001 have been used to begin the transition. Two million fed fry are released on-station. Adult collection and eyeing currently occur at Kendall Creek. Hatching and rearing take place on-station. The program is in the developmental stage, with future adult collection planned from returns to Whatcom Creek Hatchery. The release number is the planned program size.

## OPERATIONAL CONSIDERATIONS

- None.

## BENEFITS AND RISKS

***A. Consistent with short-term and long-term goals?***
The primary goals for this program have been identified as harvest and education. A secondary goal has also been described, as a gene bank to ensure the long-term conservation of the Nooksack chum stock. The program is consistent with the short- and long-term goals for harvest and education. However, the Nooksack chum stock generally meets its escapement goal of 18,000 fish and has recently reached as high as 60,000 fish. This makes the need for a conservation program questionable.

***B. Likelihood of attaining goals?***
The program provides significant harvest benefits, particularly to the terminal area sport fishery in the vicinity of Whatcom Creek, and provides an educational benefit through the teaching of fish culture at Bellingham Technical College and through close ties with the Bellingham public schools. The size

[49] *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.*

of the program also appears to provide fish far in excess of the needs of the sport fishery, allowing for a contribution to commercial harvest. This additional escapement also contributes to the educational goal by selling some portion of the excess returns to recover program costs and provide equipment for the program. The broodstock management plan described for this program does not include any plans to maintain the proper, long-term integration with the natural Nooksack stock necessary for a gene bank, conservation program. In fact, the managers describe this program as segregated. This program does not pose any significant risks to the naturally spawning Nooksack chum stock, as long as it maintains its planned segregation.

***C. Consistent with goals for other stocks?***
The program does not pose any significant risks to other stocks.

## RECOMMENDATIONS

- Keep the primary focus of the program on meeting the educational goals of teaching good, progressive fish culture. Meeting harvest goals should be a secondary consideration. The program should not be considered as providing any long-term conservation benefits for Nooksack chum.
- Implement effective stock separation plans during the planned stock transition. This is extremely important.
- Strive to meet and teach the best operational practices, for the benefits of the students. Among others, the HSRG specifically suggests:
  - Implement and teach spawning protocols that maximize the effective population size of the stocks, rather than the current approach of pooling gametes (see HSRG Area Wide Recommendations).
  - Recognize the water quality limitations of the facility and their potential effect on pre- and post-release survival when sizing programs, and in loading incubators and ponds.
  - Reduce the reliance on prophylactic chemical treatments to meet production goals.
  - Establish and teach strict disinfection procedures, to prevent the transfer of pathogens between rearing containers and stocks.
  - Discontinue the practice of re-suspending accumulated fish waste and discharging it into the receiving water.

## COMMENTS

- Operating this as an integrated program could provide a potential back-up conservation program benefit and reduce potential risks of straying. This would require a broodstock collection strategy that ensures an adequate number of founders, and a plan to prevent divergence from the natural Nooksack stock.

## MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG.

# Whatcom Creek Hatchery Pink

*Bellingham Technical College 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 | Inadequate | Inadequate |
| *Harvest Opportunity* | Occasional | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest, Conservation and Education | | |
| *Type* | Integrated | | |

## PROGRAM DESCRIPTION

Fish for this program derive from wild fish collected in 1997 and 1999 from the Middle Fork Nooksack River. This program is maintained through adult returns to the Whatcom Creek Trap or, if necessary, adults seined from a Middle Fork Nooksack tributary. Whatcom Creek pink are one of two stocks in the Nooksack Pink GDU. Two million fry are released on-station. Adult collection is on-station (with the addition of sperm from natural spawners from the Middle Fork Nooksack River). Eyeing is at Kendall Creek Hatchery. Hatching and rearing take place on-station, at Whatcom Creek Hatchery.

## OPERATIONAL CONSIDERATIONS

- A relatively small number of fish were used to found this program.
- Current spawning protocols involve pooling gametes.

## BENEFITS AND RISKS

***A. Consistent with short-term and long-term goals?***
The program is consistent with the short-term and long-term goals for education, but does not appear to be necessary to meet the harvest and conservation goals identified for this stock.

***B. Likelihood of attaining goals?***
There is an educational benefit that can be provided by raising a variety of species at the Bellingham Technical College facility. This program adds to the diversity of experience for the students, along with the experience they are gaining by rearing chum, steelhead and saltwater-reared coho.

The likelihood of this program providing harvest benefits is uncertain. Terminal area sport fisheries for pink salmon exist and provide a recreational benefit in other areas, but the planned size of this program, like the chum program, will likely produce adults far in excess of the number that can be used in a sport fishery. A commercial fishery is not likely to develop, because of the relatively low market value of pink salmon. It is also difficult to identify a conservation benefit that can be derived from this program. The Nooksack pink stock appears healthy, with escapements for the last ten return

years averaging approximately 90,000 fish and exceeding 200,000 on occasion. Additionally, the relatively low number of fish used to found this program and the spawning protocols being used add to the uncertainty of this program providing a long-term, conservation benefit for Nooksack pinks.

Water quality limitations at this particular facility provide an additional concern about the advisability of adding a program of this size to the existing programs. Although a thorough examination of facility use throughout the rearing period has not been done, it appears that the addition of this program may not be consistent with the recommendation to reduce pond loading and densities in other programs.

***C. Consistent with goals for other stocks?***
The program does not pose any significant risks to other stocks.

## RECOMMENDATIONS

- Eliminate this program, the chum program, or scale back both programs, to fit the facility's water quality and pond space limitations.
- If this program continues, plan and operate it primarily to provide educational benefits and only secondarily to meet sport harvest needs.
- Do not consider this program necessary for providing long-term conservation benefits for Nooksack pink salmon.
- Strive to meet and teach the best operational practices, for the benefits of the students. Among others, the HSRG specifically suggests:
  - Implement and teach spawning protocols that maximize the effective population size of the stocks, rather than the current approach of pooling gametes.
  - Recognize the water quality limitations of the facility and their potential effect on pre- and post-release survival when sizing programs, and in loading incubators and ponds.
  - Reduce the reliance on prophylactic chemical treatments to meet production goals.
  - Establish and teach strict disinfection procedures, to prevent the transfer of pathogens between rearing containers and stocks.
  - Discontinue the practice of re-suspending accumulated fish waste and discharging it into the receiving water.

## COMMENTS

- None.

## MANAGERS RESPONSE

WDFW supports the recommendations of the HSRG.

# Nooksack Hatchery Winter Steelhead

*Washington Department of Fish and Wildlife*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Low | Low | Low |
| *Population Viability*[50] | Medium | Medium | High |
| *Habitat* | Limiting | Limiting | Limiting |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest | | |
| *Type* | Segregated | | |

## PROGRAM DESCRIPTION

This program began in 1978 with Tokul Creek Hatchery (Chambers Creek origin) yearling transplants. The program has been augmented with eggs from Barnaby Slough, Marblemount and Bogachiel hatcheries. The objective of this program is to provide fish for harvest, while avoiding any adverse interactions with other local stocks. To this end, 100,000 eggs are incubated, reared and released on-station as yearlings. 50,000 sub-yearlings are transferred in October to McKinnon Pond on the Middle Fork of the Nooksack River, for cooperative rearing and release.

## OPERATIONAL CONSIDERATIONS

- All releases are marked.
- McKinnon Pond was built by Trout Unlimited. Cooperative rearing occurs between WDFW, local school programs and Trout Unlimited volunteers. McKinnon Pond does not have adult collection capability.
- The program uses an HSRG-approved steelhead rearing and release process (release of yearling smolts between May 1 and May 15, at a target size of six to the pound and a condition factor of less than 1.0; see Area-Wide Recommendations).
- Early spawn timing of the hatchery stock minimizes genetic interaction with naturally-spawning winter steelhead.

## BENEFITS AND RISKS

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

The program is being operated in a manner consistent with its short- and long-term goals. It is providing a valuable harvest opportunity. Interbreeding of the hatchery stock with the naturally-spawning stock is minimized by the differences in spawn timing.

[50] *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.*

***B. Likelihood of attaining goals?***
There is a strong likelihood that program goals will continue to be met, although recent trends in adult returns are a concern (probably related to poor ocean conditions).

***C. Consistent with goals for other stocks?***
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.
- The HSRG encourages the use of 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.
- Discontinue releases at McKinnon Pond, due to a lack of adult collection capability. Reinstitute releases if a fish ladder is installed on the Middle Fork and the capability to remove hatchery releases is incorporated into the ladder (see comments for Lake Whatcom kokanee).
- Investigate the reasons for the recent decline in adult winter steelhead returns, formulate a working hypothesis for the decline, and take appropriate actions.

## COMMENTS

- Establishment of wild steelhead management zones should reduce the chances of ecological and genetic interactions with hatchery steelhead and help to ensure the availability of founding stocks for hatchery purposes, should the need for such stocks arise.

## 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.

The Nooksack Tribe believes most of the recommendations of the HSRG make sense, but notes the following (see Appendix B for the Tribe's full response):

- The Tribe is disappointed with the recommendation to include a trap with a ladder, if built, on the Middle Fork "to increase management options," while restoring passage for ESA-listed North/Middle Fork spring chinook and bull trout, as well as for steelhead and coho. The Tribes concerns are for impacts to ESA-listed fish when holding, handling and sampling them, costs to test and man any trap, logistics (for example accessing the site during winter weather), and for excluding wild salmon and trout from their habitat.

# Samish Hatchery Winter Steelhead

*Bellingham Technical College and Washington Department of Fish and Wildlife*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Low | Low | Low |
| *Population Viability*[51] | Medium | Medium | High |
| *Habitat* | Limiting | Limiting | Limiting |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| *Purpose* | Harvest | | |
| *Type* | Segregated | | |

## PROGRAM DESCRIPTION

This stock was originally imported from South Tacoma stock. Releases presently occur from Kendall Creek Hatchery fish transferred to Whatcom Creek Hatchery. Significant stock transfers into the watershed have occurred historically from Skagit, Tokul Creek and Bogachiel hatcheries. The objective of this program is to provide for harvest, while avoiding any adverse interactions with local stocks. To this end, 35,000 yearling smolts are released into the Samish River at river mile ten after incubation and early rearing at Kendall Creek and seven months of rearing at Whatcom Creek.

## OPERATIONAL CONSIDERATIONS

- All releases are marked.
- Fish are released directly into the Samish River without acclimation, and may not have sufficient time for imprinting. Thus, adult collection capability is lacking.
- The program uses an HSRG-approved steelhead rearing and release process (release of yearling smolts between May 1 and May 15 at a target size of six to the pound, and a condition factor of less than 1.0).
- Early spawn timing of the hatchery stock minimizes genetic interaction with naturally spawning winter steelhead.

## BENEFITS AND RISKS

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

The program is being operated in a manner consistent with its short- and long-term goals. It is providing a valuable harvest opportunity. Interbreeding of the hatchery stock with the naturally spawning stock is minimized by the differences in spawn timing.

***B. Likelihood of attaining goals?***

There is a strong likelihood that program goals will continue to be met, although recent trends in adult

[51] *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.*

returns are a concern and probably related to poor ocean conditions.

***C. Consistent with goals for other stocks?***
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.
- The HSRG encourages the use of 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.
- Discontinue releases into the Samish River, as part of the Wild Steelhead Management Zone for Nooksack/Samish region.

## COMMENTS

- Establishment of wild steelhead management zones should reduce the chances of ecological and genetic interactions with hatchery steelhead and help ensure the availability of founding stocks for hatchery purposes, should the need for such stocks arise.

## 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.

# Whatcom Creek Hatchery Winter Steelhead

*Bellingham Technical College and Washington Department of Fish and Wildlife*

| Stock Goals: | Current | Short-Term | Long-Term |
|---|---|---|---|
| *Biological Significance* | Low | Low | Low |
| *Population Viability*[52] | Medium | Medium | High |
| *Habitat* | Inadequate | Inadequate | Inadequate |
| *Harvest Opportunity* | Each Year | Each Year | Each Year |
| **Hatchery Program:** | | | |
| Purpose | Harvest and Education | | |
| *Type* | Segregated | | |

## PROGRAM DESCRIPTION

This program began in 1978 with Tokul Creek Hatchery (Chambers Creek origin) yearling transplants. The program has been augmented with eggs from Barnaby Slough, Marblemount, Bogachiel and Kendall Creek hatcheries. In the recent past, adult returns to Whatcom Creek Trap maintained the program. Yearling transplants from Kendall Creek currently maintain this program. If necessary, Kendall Creek receives eggs from Marblemount or Tokul Creek. The objective of this program is to provide harvest and educational benefits, while avoiding any adverse interactions with other local stocks. To this end, 5,000 yearling smolts are reared and released at the Bellingham Technical College Hatchery after early rearing at Kendall Creek.

## OPERATIONAL CONSIDERATIONS

- All releases are marked.
- Adult collection capabilities exist.
- The program uses an HSRG-approved steelhead rearing and release process (release of yearling smolts between May 1 and May 15 at a target size of six to the pound, and a condition factor of less than 1.0).
- Early spawn timing of the hatchery stock minimizes genetic interaction with naturally spawning winter steelhead.

## BENEFITS AND RISKS

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

The program is being operated in a manner consistent with its short- and long-term goals. It is providing a valuable harvest and educational opportunity. Interbreeding of the hatchery stock with the naturally spawning stock is minimized by the differences in spawn timing.

[52] *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.*

***B. Likelihood of attaining goals?***
There is a strong likelihood that program goals will continue to be met, although recent trends in adult returns are a concern (probably related to poor ocean conditions).

***C. Consistent with goals for other stocks?***
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.
- The HSRG encourages the use of 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.

## COMMENTS

- Establishment of wild steelhead management zones should reduce the chances of ecological and genetic interactions with hatchery steelhead and help ensure the availability of founding stocks for hatchery purposes should the need for such stocks arise.

## 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 and Regional Recommendations

Assembled below are the Hatchery Scientific Review Group's recommendations that involve capital improvements at hatchery facilities in the Nooksack/Samish region. Also included is a region-wide recommendation relating to chinook and coho stocks.

### KENDALL CREEK HATCHERY

- Improve capability to pass adult fish upstream.
- Upgrade the well fields and distribution system.
- Upgrade the early chinook acclimation ponds.
- Improve predator controls.
- Construct a Middle Fork acclimation/de-stressing pond.

### SAMISH HATCHERY

- Rebuild the fish ladders on Friday Creek and Samish River to facilitate upstream passage of naturally produced fish.
- Replace the screens on the Friday Creek intake to facilitate downstream passage of naturally produced fish.
- Create new raceways that recognize the facility's water limitations (poor quality water requires lighter density and flow index).

### LUMMI BAY HATCHERY

- Replace or refurbish the raceways and ponds.
- Improve coho trapping pond lead and associated tide gate modifications.
- Install security/predator fencing around collection areas and outside holding and rearing facilities.

### SKOOKUM CREEK HATCHERY

- Rebuild the raceways.
- Improve the Skookum Creek intake to preserve its integrity during storm events.
- Update the pollution abatement system to meet water quality standards.
- Improve the drainage system for the yearling ponds.
- Improve the facility's ability to enumerate releases and handle fish.

### WHATCOM CREEK HATCHERY

- Develop the Georgia Pacific water source, from Lake Whatcom.

### MIDDLE FORK NOOKSACK FISH LADDER

- Include a trap with this ladder, if it is built, to increase management options and manage disease risks to Lake Whatcom stocks.

### CHINOOK AND COHO

- Develop and implement a comprehensive wild chinook and coho monitoring and evaluation plan for the region.