HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Hood Canal Steelhead Supplementation Project
Species or Hatchery Stock:	Hood Canal Winter Steelhead
Agency/Operator:	Hatchery operators: Washington Department of Fish and Wildlife & Long Live the Kings
Watershed and Region:	Hood Canal, WA
Date Submitted:	30 November 2006
Date Last Updated:	1 October 2009

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.
Hood Canal Steelhead Supplementation Project (HCSSP)

1.2) Species and population (or stock) under propagation, and ESA status.
Hood Canal Winter Steelhead *(Oncorhynchus mykiss)*, Threatened (pre-decisional)

1.3) Responsible organization and individuals
Indicate lead contact and on-site operations staff lead.

1) McKernan Hatchery

Name (and title): Ron Warren, Region 6 Fish Program Manager

	Rich Eltrich, Complex Manager	
Agency or Tribe:	Washington Department of Fish and Wildlife	
Address:	600 Capitol Way North, Olympia, WA. 98501-1091	
Telephone:	(360) 204-1204	(253) 589-7233
Fax:	(360) 664-0689	(253) 589-7098
Email:	**warrerrw@dfw.wa.gov**	**eltrirje@dfw.wa.gov**

2) Lilliwaup Hatchery:

Name(and title):	Michael Schmidt, Fish Program Coordinator (Seattle)	
	Rick Endicott, Facility Manager (Lilliwaup)	
Organization:	Long Live the Kings (LLTK)	
Address:	1326 5th Ave. Suite 450, Seattle, WA 98555	
	P.O Box 205 Lilliwaup, WA 98555	
Telephone:	(206) 382-9555 (Seattle)	(360) 877-6960 (Lilliwaup)
Fax:	(206) 382-9913 (Seattle)	(360) 877-9096 (Lilliwaup)
Email:	mschmidt@lltk.org , rendicott@lltk.org, lltk@lltk.org	

3) Quilcene National Fish Hatchery
Name and title: Ron Wong, Project leader; Larry Telles, Assistant Project Leader
Agency or Tribe: US Fish & Wildlife Service
Address: 281 Fish Hatchery Rd.
Telephone: 360-765-3334
Fax: 360-765-3398
Email: ron_wong@fws.gov; larry_telles@fws.gov

4) NOAA Fisheries Manchester Research Station
Name and title: Barry Berejikian, Project leader
Agency or Tribe: NOAA Fisheries, Northwest Fisheries Science Center
Address: 7305 Beach Drive E., Port Orchard, WA 98366
Telephone: 360-871-8301
Fax: 206-842-8364
Email: barry.berejikian@noaa.gov

Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

The Skokomish Tribal Nation and Hood Canal Salmon Enhancement Group are involved in broodstock (eyed egg) collection, abundance monitoring, juvenile sampling, coordination and other activities related to the monitoring and evaluation of the program.

1.4) Funding source, staffing level, and annual hatchery program operational costs.

NOAA is providing primary funding for the HCSSP monitoring and evaluation, and provides some funding for hatchery operations. Additional funding for hatchery operations comes from WDFW (Mckernan Hatchery), LLTK (Lilliwaup Hatchery), and NOAA (Manchester Research

Station**.**

McKernan Hatchery

- Staff: 2 FTEs
- Annual Operational Costs: 160,059

LLTK and Lilliwaup Hatchery

- Staff: 2.5FTEs. Michael Schmidt (Fish Program Coordinator), Rick Endicott (Facility Manager), Joy Lee (Steelhead Biologist)
- Annual Operational Costs: $200,000 (this includes hatchery, field support and project coordination assistance provided by LLTK)

Manchester Research Station

- 1.5 FTE responsible for steelhead culture and facilities maintenance.
- Facility has over 20 FTE total
- Annual operational costs: $400,000 for fish culture, maintenance, field sampling, data collection, and biological monitoring

1.5) Location(s) of hatchery and associated facilities.

Include name of stream, river kilometer location, basin name, and state. Also include watershed code (e.g. WRIA number), regional mark processing center code, or other sufficient information for GIS entry. See "Instruction E" for guidance in responding.

The HCSSP involves the collection of eyed embryos and culture of three stocks of winter steelhead in Hood Canal: Dewatto R. (WRIA # 15.0420), Duckabush R. (WRIA # 16.0351), and Skokomish R. (WRIA # 16.0001), all of which are located in Hood Canal. Eyed embryos from the Dewatto R and Duckabush R will be transferred to the Quilcene National Fish Hatchery for incubation, early rearing, and pathology screening. Eyed embryos from the Skokomish R will be transferred to McKernan Hatchery for incubation, early rearing and pathology screening. Once testing is completed and no regulated viral pathogens are detected the fry reared at Quilcence will be transferred to the respective rearing facilities. The Skokomish River stock will be reared at the WDFW McKernan hatchery (47° 20' North, 123° 10' West), located at RM 1.0 on Weaver Creek (WRIA # 16.0006), a tributary of the lower Skokomish River (WRIA # 16.0001)); the Duckabush River stock and the Dewatto stock will be reared at Lilliwaup Hatchery (47 28.18 North, 123 06.856 West) Washington State, Hood Canal. The hatchery is located on Lilliwaup Creek at RM 0.5. The Skokomish River adult release group will be transferredas smolts to the NOAA Fisheries, Manchester Research Station, (7305 Beach Drive E., Port Orchard, WA) for seawater rearing to sexual maturity.

1.6) Type of program.

Define as either: Integrated Recovery; Integrated Harvest; Isolated Recovery; or Isolated Harvest (see Attachment 1 - Definitions" section for guidance).

Integrated Recovery

1.7) Purpose (Goal) of program.

Define as either: Augmentation, Mitigation, Restoration, Preservation/Conservation, or Research (for Columbia Basin programs, use NPPC document 99-15 for guidance in providing these definitions of "Purpose"). Provide a one sentence statement of the goal of the program, consistent with the term selected and the response to Section 1.6. Example: "The goal of this program is the restoration of spring chinook salmon in the White River using the indigenous stock".

The goals of this program are to 1) help restore winter-run steelhead in the Skokomish R., Duckabush R, and Dewatto R. using indigenous stock, 2) maintain the genetic integrity of the existing natural populations, and 3) assess the demographic, ecological, and genetic benefits and risks of supplementation on natural steelhead populations.

1.8) Justification for the program.

Indicate how the hatchery program will enhance or benefit the survival of the listed natural population (integrated or isolated recovery programs), or how the program will be operated to provide fish for harvest while minimizing adverse effects on listed fish (integrated or isolated harvest programs).

The program will benefit the survival of the listed natural populations by increasing the embryo to adult survival of indigenous natural origin steelhead. Eyed embryos will be removed from the gravel and reared to the smolt stage. The expected egg-to- smolt survival is 85%, compared to less than 2% survival if left in the natural environment (Ward 2000, Bocking 2001). Some of the fish will be reared to age-4 and age-5 adult to be released for natural spawning. Approximately 80% of the embryos collected are expected to survive to adult compared to 0.05% if left in the natural environment. Thus, the program should quickly amplify the respective spawning populations during the period of supplementation. Population amplification has been demonstrated in the Hamma Hamma River steelhead supplementation program (Berejikian et al. 2005). The goal of the research and monitoring efforts will be to determine whether there is a long-term benefit to natural productivity.

1.9) List of program "Performance Standards".

"Performance Standards" are designed to achieve the program goal/purpose, and are generally measurable, realistic, and time specific. The NPPC "Artificial Production Review" document attached with the instructions for completing the HGMP presents a list of draft "Performance Standards" as examples of standards that could be applied for a hatchery program. If an ESU-wide hatchery plan including your hatchery program is available, use the performance standard list already compiled.

1) Conserve the genetic and life history diversity of Hood Canal winter steelhead population through the 13 year embryo collection, rearing and release portion of the program;

2) Aid in restoration of viable naturally spawning populations of winter steelhead using conservation hatchery approaches that include ecologically safe reintroduction strategies;

3) Identify factors (e.g., freshwater productivity, marine survival) limiting the productivity of

natural steelhead populations in Hood Canal.

1.10) List of program "Performance Indicators", designated by "benefits" and "risks."

"Performance Indicators" determine the degree that program standards have been achieved, and indicate the specific parameters to be monitored and evaluated. Adequate monitoring and evaluation must exist to detect and evaluate the success of the hatchery program and any risks to or impairment of recovery of affected, listed fish populations.

The NPPC "Artificial Production Review" document referenced above presents a list of draft "Performance Indicators" that, when linked with the appropriate performance standard, stand as examples of indicators that could be applied for the hatchery program. If an ESU-wide hatchery plan is available, use the performance indicator list already compiled. Essential 'Performance Indicators" that should be included are monitoring and evaluation of overall fishery contribution and survival rates, stray rates, and divergence of hatchery fish morphological and behavioral characteristics from natural populations.

The list of "Performance Indicators" should be separated into two categories: "benefits" that the hatchery program will provide to the listed species, or in meeting harvest objectives while protecting listed species; and "risks" to listed fish that may be posed by the hatchery program, including indicators that respond to uncertainties regarding program effects associated with a lack of data.

1.10.1) "Performance Indicators" addressing benefits.
(e.g. "*Evaluate smolt-to-adult return rates for program fish to harvest, hatchery broodstock, and natural spawning.*").

1) Quantify the annual abundance of redds constructed in supplemented and non-supplemented streams

2) Calculate spawner-recruit ratios for supplemented and non-supplemented populations.

3) Estimate the annual number of naturally produced and hatchery-reared adults on spawning grounds.

4) Estimate population-specific smolt-to-adult return estimates for Hood Canal Steelhead

5) Estimate freshwater productivity (egg-to-smolt survival) in supplemented and non-supplemented streams

1.10.2) "Performance Indicators" addressing risks.

1) Quantify changes in the genetic composition of supplemented and non-supplemented populations

2) Quantify egg-to-smolt and egg-to-adult mortality in the hatchery to assess demographic risks

3) Monitor freshwater productivity in supplemented and non-supplemented streams to assess whether ecological interactions may depress the productivity of natural-origin steelhead

4) Monitor changes in distribution and relative abundance of alternative life history forms (i.e., rainbow trout and steelhead).

1.11) Expected size of program.

In responding to the two elements below, take into account the potential for increased fish production that may result from increased fish survival rates effected by improvements in hatchery rearing methods, or in the productivity of fish habitat.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).

No adults will be captured for any population included in this rearing program. Steelhead redds will be enumerated, marked, and hydraulically pumped to remove eyed embryos. This eliminates the need to take all of the eggs from a single female, and allows a portion of the eggs from each female to remain in the gravel with the potential to contribute to natural production. It also allows more families to be represented without having to take more eggs than the program needs. The egg collection goals are provided by river system in Section 1.11.2. These goals will not be exceeded because egg collections will stop when goals have been reached.

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location.
(*Use standardized life stage definitions by species presented in* Attachment 2).

Dewatto River

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling		
Yearling		
Smolts	Dewatto River	7,400 (includes age-1 and age-2 smolts)

Life Stage	Release Location	Annual Release Level
Age – 4 and – 5 adults	Dewatto River	253 (every other year)

Duckabush River

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling		
Yearling		
Smolts	Duckabush River	6,667 (includes age-1 and age-2 smolts)
Age – 4 and – 5 adults	Duckabush River	230 (every other year)

Skokomish River

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling		
Yearling		
Smolts	S. Fork Skokomish River	34,500 (includes age-1 and age-2 smolts)
Age – 4 and – 5 adults	S. Fork Skokomish River	400

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data. *Provide estimated smolt-to-adult survival rate, total adult production number, and escapement number (to the hatchery and natural areas) data available for the most recent twelve years (roughly three fish generations), or for the number of years of*

available and dependable information. Indicate program goals for these parameters.

N/A – this is a new program

1.13) Date program started (years in operation), or is expected to start.

Egg collections expected to commence in spring of 2007

1.14) Expected duration of program.

2007-2014: Embryo collections
2007-2018: Culture and release
2007-2022: Research and monitoring

1.15) Watersheds targeted by program.
Include WRIA or similar stream identification number for desired watershed of return.

Dewatto River (WRIA # 15.0420)
Duckabush River (WRIA #16.0351)
Skokomish River (WRIA # 16.0001)

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

Alternative actions to be considered and implemented will include integration with habitat and harvest recovery measures identified in the Hood Canal component of the steelhead resource management plan (which is currently under development).

SECTION 2. PROGRAM EFFECTS ON NMFS ESA-LISTED SALMONID POPULATIONS. (USFWS ESA-Listed Salmonid Species and Non-Salmonid Species are addressed in Addendum A)

2.1) List all ESA permits or authorizations in hand for the hatchery program.

During 2004-06, WDFW wrote HGMP's to cover all stock/programs produced at the McKernan facility for NOAA Fisheries to determine program impacts to the summer chum and Chinook ESU.

2.2) Provide descriptions, status, and projected take actions and levels for NMFS ESA-listed natural populations in the target area.

2.2.1) Description of NMFS ESA-listed salmonid population(s) affected by the program.
Include information describing: adult age class structure, sex ratio, size range, migrational timing, spawning range, and spawn timing; and juvenile life history strategy,

including smolt emigration timing. Emphasize spatial and temporal distribution relative to hatchery fish release locations and weir sites

- **Identify the NMFS ESA-listed population(s) that will be directly affected by the program.** *(Includes listed fish used in supplementation programs or other programs that involve integration of a listed natural population. Identify the natural population targeted for integration).*

Steelhead ESUs were identified by the NOAA Fisheries steelhead BRT as part of their coastwide reviews of steelhead status (Bubsy et al. 1996, Good et al. 2005). Individual ESUs were identified based on genetic and ecological evidence for reproductive isolation, including the presence of natural barriers that could serve to isolate populations. Genetic and ecological distinctiveness were assessed based on information about migration and spawn timing, life history patterns, zoogeography and hydrology. Hood Canal steelhead are part of the Puget Sound ESU, which also includes river basins of the Strait of Juan de Fuca and Puget Sound. The majority of steelhead produced within the Puget Sound region appear to be of hatchery origin. However, release of non-local, domesticated steelhead smolts (derived from Chambers Creek) were discontinued in all rivers in Hood Canal as of 2004. Since that time the only hatchery production has been from the Hamma Hamma stock as described throughout this document and in Berejikian et al. (2005) and Kuligowski et al. (2005). The NOAA Fisheries 2005 Status of Puget Sound Steelhead (i.e., the 'status review' : http://www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Steelhead/Steelhead-Status-Reviews.cfm), indicated that most populations in Hood Canal were depressed, with the steepest declines in run size occurring in the Skokomish River.

There are three Hood Canal winter steelhead populations that will be directly affected by the supplementation efforts in this program: Dewatto River, Duckabush River, and Skokomish River. The estimated adult abundance of these populations is provided in the tables under section 2.2.2. A portion of the embryos from all three populations will be hydraulically removed (see section 2.2.3), reared in hatcheries and released as either smolts or adults into their natal streams (see sections 9 and 10). Four additional control populations (non-supplemented) will be monitored and will be affected by those activities (see section 2.2.3 and Section 11).

- Identify the NMFS ESA-listed population(s) that may be incidentally affected by the program.
(Includes ESA-listed fish in target hatchery fish release, adult return, and broodstock collection areas).

Puget Sound ESU Chinook (Skokomish chinook, mid-Hood Canal chinook (draft SaSI, WDFW, 2002):

Watersheds flowing into Hood Canal from the west, draining out of the Olympic Mountains, are high gradient rivers with limited access to anadromous fish due to natural barriers; major watersheds include the Hamma Hamma, Duckabush and Dosewallips

rivers. Watersheds flowing into Hood Canal from the east, off the Kitsap Peninsula, are lower gradient, smaller systems; these include the Union, Dewatto, and Tahuya rivers. The Skokomish River, including the South and North forks, is the largest watershed and enters Hood Canal from the southwest. Natural salmon production occurs throughout the Hood Canal basin, but chinook salmon occur in only these few streams. In Hood Canal, most natural chinook spawning occurs in the Skokomish River (including the South and North forks) (Skokomish chinook), with smaller populations in the Dosewallips, Duckabush, and Hamma Hamma rivers (mid-Hood Canal chinook). Small numbers of chinook spawners have been periodically observed in the Union, Dewatto and Tahuya rivers, but it is unknown whether these streams historically supported naturally sustainable chinook populations.

We have little information on the adult age structure, sex ratio, size range or smolt distribution and emigration timing of wild chinook in Hood Canal streams. We do not know if Hood Canal hatchery-origin fingerling fall chinook interact with wild Hood Canal chinook. Hood Canal wild chinook are thought to emigrate mainly as sub-yearlings, probably from April through early June. The summer flows in the South Fork Skokomish River may be too low to support chinook through the summer, though some areas in the Lower North Fork do have sufficient water (C. Baranski, WDFW, personal communication, March 2000). Hood Canal fall chinook spawn from mid-September through October with a peak in mid-October (WDFW and WWTIT 1992). Chinook spawning occurs in the mainstem Skokomish River, the lower South Fork Skokomish and tributaries such as Vance Creek, lower North Fork Skokomish and tributaries, and the lower reaches (below anadromous barriers) of Lilliwaup Creek, John Creek, the Duckabush, Dosewallips, Big and Little Quilcene Rivers, and the lower Union, Tahuya and Dewatto Rivers. Chinook spawning in many of these streams may be largely the result of hatchery releases.

In 2002, WDFW (SaSI, unpublished data) classified Hood Canal summer/fall chinook as two stocks (see above) of mixed origin (both native and non-native) with composite production (sustained by wild and artificial production) (WDF et al. 1992). The combination of recent low abundances (in all tributaries except the Skokomish River) and widespread use of hatchery stocks (primarily originating from sources outside Hood Canal) led to the conclusion in SASSI (1992), that there were no remaining genetically unique, indigenous populations of chinook in Hood Canal. However, a sampling effort is currently under way (led by WDFW in cooperation with NMFS and Treaty Tribes) to collect genetic information from chinook juveniles and adults in the tributaries of Hood Canal. This investigation is intended to provide further information on the genetic source and status of existing chinook populations. The current distinction between these two populations is based on spawning distribution as per SaSI in 2002 (WDFW, unpublished data).

Genetic characterization of the Skokomish chinook stocks has, to date, been limited to comparison of adults and juveniles collected from the Skokomish River with adults from other Hood Canal and Puget Sound populations. Genetic collections were made during 1998 and 1999 in the Skokomish River and there appeared to be no significant genetic

differentiation between natural spawners and the local hatchery populations. It appears that Hood Canal area populations may have formed a group differentiated from south Puget Sound populations, possibly indicating that some level of adaptation may be occurring following the cessation of transfers from south Puget Sound hatcheries (Anne Marshall, WDFW memo dated May 31, 2000). Current adult returns are a composite of natural- and hatchery-origin fish. During 1998 and 1999, known hatchery-origin fish comprised from 13% to 41% of the samples collected on the natural spawning grounds. Genetic analysis of samples collected from Lake Cushman was inconclusive as to stock origin, and exhibits low genetic variability (Ann Marshall, WDFW memo dated April 14, 1995).

Genetic characterization of the mid-Hood Canal stocks has, to date, been limited to comparison of adults returning to the Hamma Hamma River in 1999 with other Hood Canal and Puget Sound populations. These studies, although not conclusive, suggest that Hamma Hamma returns are not genetically distinct from the Skokomish River returns, or recent George Adams and Hoodsport hatchery broodstock (A. Marshall, WDFW unpublished data). The reasons for this similarity are unclear, but straying of chinook that originate from streams further south in Hood Canal, and hatchery stocking, could be contributing causes. Analysis of GSI collections made during 2002 is pending.

Because there is no specific information on wild smolt temporal and spatial distribution in Hood Canal streams, the extent to which they might interact with released hatchery-reared steelhead is unknown. However, recent data obtained from acoustic telemetry studies indicates that hatchery-reared steelhead released into the Hamma Hamma River migrate quickly (within 1 to 3 days) into Hood Canal (B. Berejikian, unpublished data), and are therefore not likely to interact with Chinook salmon to a significant extent in the freshwater environment. Releasing steelhead at a natural size (approximately 150-200mm), within the estimated carrying capacity of the supplemented streams, and at a natural emigration time will further minimize any negative interactions with Chinook salmon.

Hood Canal Summer Chum:

The following is paraphrased from life history information for Hood Canal and Strait of Juan de Fuca summer chum presented in the Summer Chum Salmon Conservation Initiative (SCSCI) (WDFW et al., 2000):

Hood Canal and Strait of Juan de Fuca summer chum populations are one of three genetically distinct lineages of chum salmon in the Pacific Northwest region; and were designated as an evolutionary significant unit (ESU) based upon distinctive life history and genetic traits. The uniqueness of the summer chum life history is best characterized by their late summer entry into freshwater spawning areas, and their late winter/early spring arrival in the estuaries as seaward-migrating juveniles. A significantly different migration and escapement timing and geographic separation from other chum stocks have afforded reproductive isolation.

Summer chum spawning occurs from late August through late October. Eggs eye in redds after about 4 to 6 weeks incubation and hatch about 8 weeks after spawning. Fry emerge from redds, usually with darkness, between February and late May and immediately commence migration downstream to estuarine areas. Summer chum fry initially inhabit nearshore areas and occupy sub-littoral sea grass beds for about one week and are thought to be concentrated in the top few meters of the water column both day and night. Upon reaching a size of 45-50 millimeters (mm), fry move to deeper offshore areas. Migrating at a rate of 7-14 kilometers (km) per day, the southernmost out-migrating summer chum fry population in Hood Canal would exit the Canal 14 days after entering seawater (90% of population exits by April 28 each year, on average); and Strait of Juan de Fuca summer chum would exit the Discovery Bay area 13 days after entering seawater (90% completion by June 8 each year, on average).

In the Summer Chum Salmon Conservation Initiative (SCSCI) (WDFW and PNPTT 2000), the most recent information on historical and current summer chum salmon distribution and on the genetic profiles of the populations has been reviewed. This analysis has resulted in an updated list of 16 summer chum stocks, which form the basic population units used throughout the recovery plan. Six current summer chum stocks have been identified in Hood Canal: Quilcene, Dosewallips, Duckabush, Hamma Hamma, Lilliwaup, and Union. Six additional stocks are identified as recent extinctions: Skokomish, Finch, Tahuya, Dewatto, Anderson, and Big Beef. In the Strait of Juan de Fuca, three currently existing stocks have been identified: Snow/Salmon, Jimmycomelately, and Dungeness. Chimacum is noted as a recent stock extinction.

In Hood Canal streams, the continuous and cumulative reduction in habitat productivity and capacity has influenced summer chum salmon by lowering survival rates and population resiliency, and reducing potential population size. Net fisheries in Hood Canal, when combined with harvests in Puget Sound and the Strait of Juan de Fuca, began to catch a high percentage of returning summer chum salmon in 1980, contributing to low escapements through the 1980s. At the same time, oceanic climate changes influenced regional weather patterns, resulting in unfavorable stream flows during the winter egg incubation season. Fall spawning flows dropped substantially in 1986 (also likely climate related), contributing to the poor status of these stocks. The current low production of Hood Canal summer chum salmon appears to be the result of the combined effects of lower survivals caused by habitat degradation, climate change and increases in harvest. The SCSCI requires that no hatchery fish releases are to occur prior to April 1 as a protection measure during out-migration of listed Hood Canal summer chum.

The pattern of decline of summer chum salmon in Strait of Juan de Fuca streams is similar to the Hood Canal experience, however, the drop in escapements occurred ten years later, in 1989. The combined effects of reductions in habitat quality, stream flows, and fishery harvests have resulted in low summer chum salmon production in the Strait of Juan de Fuca region.

There have been a number of factors that are positive for summer chum salmon recovery. One is the successful reduction in harvests within Hood Canal fishing areas, averaging

less than 2% of the runs during the 1993-1997 seasons. Successful supplementation projects are increasing the numbers of returning summer chum adults to two streams, and are providing eggs for reintroducing summer chum to two other streams. There have also been meaningful changes in the production of hatchery fish in the region, designed to reduce negative interactions with summer chum juveniles. The combined effects of these changes have contributed to some higher summer chum escapements in recent years. However, additional measures, particularly with respect to habitat protection and restoration, are required for successful recovery of summer chum salmon.

The extent to which summer chum salmon might interact with released hatchery-reared steelhead is unknown. Hatchery-reared steelhead smolts will be released no earlier than late April, after the outmigration of summer chum salmon fry. Moreover, recent data obtained from acoustic telemetry studies indicates that hatchery-reared steelhead released into the Hamma Hamma River migrate quickly (within 1 to 3 days) into Hood Canal (B. Berejikian, unpublished data), and are therefore not likely to interact with summer chum salmon to a significant extent in the freshwater environment. Releasing steelhead at a natural size (approximately 150-200mm), within the estimated carrying capacity of the supplemented streams, and at a natural emigration time will further minimize any negative interactions with summer chum salmon.

Puget Sound Bull Trout (South Fork Skokomish stock (WDFW 1998)

There is little or no information on adult age class structure, sex ratio, juvenile life history strategy or smolt emigration timing. Hood Canal Ranger District (Olympic National Forest) staff recently conducted a radio-tagging study of (presumed) bull trout in the South Fork Skokomish River (Ogg and Taiber 1999). The objectives of the study were to examine seasonal migration patterns and to identify spawning grounds and spawning times. In addition, Forest Service staffs have been conducting trapping, snorkeling and electrofishing surveys for bull trout in the South Fork. They believe that fluvial and resident life history forms are present. There is no evidence from their work of an anadromous life history form, though anadromous fish may be present. Sexually mature fluvial fish range from 38 to 59 cm. During the course of the telemetry study, spawning migration activity in fluvial fish began in late October when the water temperature dropped below 7□C and river flow increased. Spawning time appears to be from late October through late November. Spawning grounds have tentatively been identified in the mainstem South Fork from RM 18 through RM 23.5 and in Church, LeBar and Brown Creeks. Juvenile rearing areas include, but should not be considered restricted to, RM 19 through RM 23.5.

Hatchery-reared steelhead smolts will be released below the Gorge of the South Fork beginning at RM 7 to minimize interactions with bull trout.

2.2.2) <u>Status of NMFS ESA-listed salmonid population(s) affected by the program.</u>

- **Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds** (*see definitions in "Attachment 1").*

This section refers specifically to annual abundance levels for each of the natural management units, without regard to genetic diversity and distribution. The viable threshold, as defined by NMFS, is the level of abundance and function at which the population has a negligible risk of extinction over both the short (e.g., 3 generations) and long (100 years) term. The critical threshold is the level of abundance and function at which the population is at high risk of extinction over a short time period.

The present threshold estimates are subject to change.

Puget Sound Steelhead**:** The program intends to collect embryos from three Hood Canal steelhead populations (Dewatto, Duckabush and S. Fork Skokomish), rear them to the smolt and adult stages and release them into their natal rivers. Four additional populations (Hamma Hamma, Little Quilcene, Tahuya and Big Beef Creek) will be monitored as part of the research program associated with the hatchery program. The following table represents the status of the various Hood Canal populations as reported in the Draft WDFW Steelhead Management Report (2006). These are the best data available to describe the status of the various populations. Data collected under this project will add substantially to an understanding of the status of the various stocks.

Table 1. Status of Hood Canal winter steelhead populations

Population	Run timing	1994-1998 escapement	1999-2004 escapement	Percent change	Status
Dewatto	Winter	24	24	0	Depressed
Tahuya	Winter	103	164	58%	Depressed
Skokomish	Summer1	Unknown			
Skokomish	Winter	415	273	-34%	Depressed
Hamma	Winter	19	81	340%	Depressed
Duckabush	Summer1	Unknown			
Duckabush	Winter1,4	Depressed			
Dosewallips	Summer1	Unknown			
Dosewallips	Winter	61	83	36%	Depressed

Puget Sound Chinook: The Co-managers (Puget Sound) Technical Review Team (PSTRT) has identified minimum abundance levels and recovery exploitation rates in the Harvest Management Component of the Puget Sound Comprehensive Chinook Management Plan. These recovery exploitation rates were established based on current estimated survival and productivity rates with adjustments to account for data uncertainty and management imprecision. The basic strategy is to hold harvest impacts neutral and to turn short-term increases in productivity into additional fish on the spawning grounds. However, it should be stated that data quality in many cases is limited that these

exploitation rates should be periodically reviewed to assure that they are representative of critical thresholds.

Within Hood Canal, there are two chinook management units (MUs): Skokomish River and Mid-Hood Canal. The immediate and short-term objective for Skokomish River MU is to manage chinook as a composite population (including naturally and artificially produced chinook). The composite population will be managed, in part, to achieve a suitable level of natural escapement; and to continue hatchery mitigation for the effects of habitat loss; and to provide to the Skokomish Tribe partial mitigation for its lost treaty fishing opportunity. Habitat recovery and protection measures will be sought to improve natural production. The Mid-Hood Canal MU is comprised of chinook populations of the Dosewallips, Duckabush, and Hamma Hamma watersheds. The management objective is to maintain and restore sustainable, locally adapted, natural-origin chinook. Management efforts will focus on increasing natural population numbers and meeting specified minimum escapement rates or numbers.

For the Skokomish chinook MU, during the recovery period, pre-terminal southern U.S. are managed to achieve a total rate of exploitation of 15% or less as estimated by the FRAM model. This can be considered the critical exploitation rate threshold for the MU. A low abundance threshold escapement of 1300 chinook (comprised of 800 natural spawners and 500 adults returning to the hatchery rack) and can be considered the critical abundance threshold. The natural escapement component threshold is set at approximately 50% of the current MSY estimate and represents a level necessary to ensure in-system diversity and spatial distribution. During the 1996-2000 period, the composite low threshold was exceeded in all years for the Skokomish MU and in four of the five years for natural escapement. An escapement goal of 3,150 chinook (comprised of 1650 in-stream spawners and 1500 spawners required for the maintenance of hatchery production) is set and is intended to maintain full hatchery mitigation and meet current estimates of MSY escapement to natural production areas under current habitat conditions; this can be considered the viable threshold. During the 1996-2000 periods, composite escapement exceeded the goal of 3150 in 4 of 5 years, natural escapement has exceeded 1650 chinook in 2 of 5 years, and hatchery escapement has exceeded 1500 chinook in all 5 years (in 2003, the PSTRT revised the Skokomish River viable chinook population threshold to 3,650 (1,650 natural and 2000 hatchery)).

For the Mid-Hood Canal chinook MU, during the recovery period, pre-terminal southern U.S. are managed to achieve a total rate of exploitation of 15% or less as estimated by the FRAM model. This is considered the critical exploitation rate threshold for the MU. A low abundance threshold escapement of 400 chinook is considered the critical abundance threshold, which is approximately 50% of the current MSY estimate and represents a level necessary to ensure in-system diversity and spatial distribution. During the 1996-2000 period, the low threshold was exceeded in 2 of 5 years for the Mid-Hood Canal MU. An escapement goal of 750 chinook is set and represents current estimates of MSY escapement to natural production areas; this can be considered the viable threshold. During the 1996-2000 period, escapement exceeded the 750 goal in 1 of 5 years.

WDFW SaSI document (draft 2002) lists the following:

Summer/Fall chinook stock in the Skokomish is *depressed.* The mid-Hood Canal stock status is *critical.*

Hood Canal summer chum stocks (WDFW and PNPTC, 2000):

1. Union River is *healthy*
2. Lilliwaup and Jimmycomelately Creeks are *critical*
3. Hamma Hamma, Duckabush, Dosewallips, Big/Little Quilcene, and Salmon/Snow Creek, *depressed*.

Puget Sound bull trout in Hood Canal are *viable.*

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.

No reliable estimates of productivity are available for Puget Sound steelhead, chinook or for Puget Sound bull trout in the Hood Canal region. Productivity is a measurement of the number of adult salmon that are ultimately produced by each year's spawning escapement. Since the summer chum salmon from a given year's spawner population (brood year) return as 2-, 3-, 4-, and 5-year old fish, it is necessary to have reliable age composition data for each annual return. The total return for each brood year is divided by the number of parent spawners to arrive at the brood year production rate, typically expressed as recruits per spawner (R/S). The SCSCI performance standards included a minimum value for mean R/S rates that would contribute to stability and recovery of summer chum, and the SCSCI interim recovery goals included a R/S threshold that would represent recovery.

Although reports in the SCSCI series recognized the importance of R/S rates as an indicator of stock performance, attempts to address brood productivity were not made, as age composition data were insufficient for estimating recruits by brood year. Increased scale and otolith data collection in recent years have made it possible to begin estimating productivity for a limited number of broods. Productivity estimates are not available prior to the 1996 brood in either of the Hood Canal or Strait of Juan de Fuca regions due to insufficient age data collected prior to the 1999 return year.

Productivity estimates are available for the Hood Canal and Strait of Juan de Fuca regions, and for the Hood Canal summer chum ESU, ESU productivity estimates are 0.88, 1.11, 3.90, and 10.08 R/S for the 1997, 1998, 1999, and 2000 brood years, respectively (pers. comm.., T.H. Johnson, WDFW; from draft SCSCI 5-year review)

- **Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.** *(Include estimates of juvenile habitat seeding relative to capacity or natural fish densities, if available).*

Table 2. 1988-2005 spawner abundance data for Hood Canal fall chinook, Hood Canal region summer chum and Lake Cushman Bull Trout/Dolly Varden. Chinook data are from WDFW chinook run reconstruction through 2002 and WDFW files (T. Johnson, personal comm.). Summer chum data are from WDFW and PNPTT (2003) and annual progress reports to NOAA-Fisheries for 2003, 2004, and 2005. Bull trout data are from WDFW (1998) through 1996 and from D.Collins (WDFW, personnel communication) thereafter.

Year	Fall Chinook	Summer Chum	Bull Trout/Dolly Varden
1988	2,853	2,967	152
1989	1,425	598	174
1990	724	429	299
1991	1,858	747	299
1992	940	2,377	285
1993	1,172	756	412
1994	1,072	2,429	281
1995	1,999	9,462	250
1996	1,028	20,490	292
1997	492	8,972	No data collected
1998	1,803	4,001	119[1]
1999	3,020	4,114	90[0]
2000	1,690	8,649	93
2001	2,883	12,044	87
2002	1,725	11,454	93
2003	1,512	35,696	
2004	3,663	69,995	
2005	2,776	15,757	

[1] Counts were incomplete due to high water (D.Collins, personal communication, February, 2000)

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Table 3. Spawner abundance estimates for Hood Canal steelhead populations based on redd surveys. Cells with '—' indicate data were insufficient to estimate run size. Increases in the Hamma Hamma population are a result of the conservation hatchery program currently operating in that system. Data are from the SaSI database (T. Johnson, WDFW, pers. Commun.)

Year	Dose	Duck	Hamma	Skokomish	Tahuya	Dewatto	Big Beef Creek
1995	79	--	13	398	78	22	--
1996	55	--	8	--	92	39	--
1997	60	19	35	--	144	11	--
1998	49	6	18	373	126	28	--
1999	99	29	21	311	340	15	--
2000	78	36	19	261	191	23	--
2001	89	13	3	286	133	19	--
2002	52	16	260	156	97	30	--
2003	96	8	133	132	53	18	--
2004	--	29	214	233	168	39	--
2005	--	10	123	--	91	23	--
2006	--	21	73+	200	183	53	--

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

Steelhead-The number of hatchery-reared steelhead on the spawning grounds of Hood Canal streams has been large unknown over the past 12 years, but proportion is believed to be low based on the very poor marine survival of hatchery-origin fish (indicated by low catch numbers). The exception is the Hamma Hamma River. Preliminary estimates (Berejikian et al. unpublished data) suggest that approximately 20% to 75% of the redds constructed in the Hamma Hamma River between 2002 and 2006 were from hatchery-origin spawners (Berejikian et al. manuscript in review).

Chinook-Until all hatchery chinook are mass marked, it is not known what the annual proportions of hatchery-origin Chinook and natural-origin Chinook are on the spawning grounds. Preliminary estimates range from about 60% to 80% natural-origin fish in the Skokomish River (pers. comm., T.H. Johnson, WDFW).

Summer chum-For the summer chum ESU, spawner escapement was comprised of 54%, 60%, 74%, and 83% natural-origin fish during 2001 through 2004 (pers. comm.., T.H. Johnson, WDFW; from draft SCSCI 5-year review).

2.2.3) <u>Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of NMFS listed fish in the target area, and provide estimated annual levels of take</u> *(see "Attachment 1"*

*for definition of "take")***.**

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.
(*e.g. "Broodstock collection directed at sockeye salmon has a "high" potential to take listed spring chinook salmon, through migrational delay, capture, handling, and upstream release, during trap operation at Tumwater Falls Dam between July 1 and October 15. Trapping and handling devices and methods may lead to injury to listed fish through descaling, delayed migration and spawning, or delayed mortality as a result of injury or increased susceptibility to predation*").

Redd surveys
The abundance of redds in supplemented and non-supplemented rivers will be recorded during the spawning season (last week of February through the first week of June) each year. We expect to be able to foot survey the Duckabush, Dewatto, Hamma Hamma,Little Quilcene and Tahuya Rivers weekly. The Skokomish River will be surveyed every two weeks because the river is large in size and have limited accessibility, requiring a combination of aerial and raft surveys.

Survey biologists for all streams will number and mark each redd observed. In supplementation streams, the upstream (top) and downstream (bottom) end of each redd will be measured from three locations along the riverbank to triangulate the exact locations. Additionally, the GPS coordinates for the redd will be plotted or an estimate of the distance from the redd to an existing reach marker will be recorded. Widths will be measured at the ¼, ½, and ¾ points of the redd, with length measured as the total extent of the redd (the redd's boundaries are defined by the area of cleaned and excavated gravel). The visibility of each redd will be recorded as well (i.e., visible, moderately visible, not visible), for new as well as previously recorded redds. Once the location, size and visibility are recorded, the downstream end of the redd will be marked with a flagged rock that includes the redd number and date of observation.

Basis for take estimate (Observe or harass adult steelhead)--Experience from redd surveys in Hood Canal by WDFW biologists (D. Collins and T. Johnson, WDFW, pers. Commun.) is that one might reasonably expect to encounter approximately one adult steelhead for every 20 redds observed (5%). In most cases, the adult steelhead will be temporarily frightened and leave the redd area. Observations conducted in a controlled flow spawning channel indicate that the steelhead quickly return to their redds and resume spawning activity (B. Berejikian, pers. observation)

Adult sampling
Up to 10 wild adult steelhead (beginning in 2007) and up to 30 hatchery-reared adult steelhead (Beginning in 2011) will be sampled from each of the monitored streams by hook-and-line. The purpose of the sampling is to obtain life history information (size-at-age, freshwater and seawater ages and to quantify the success of females in depositing eggs (as determined by absence of eggs in the body cavity and condition). A small 5 mm^2 piece of fin tissue will be removed from the pelvic fin of each fish. 10 scales will be collected. The fish will be measured and returned to the river. In Big Beef Creek, all upmigrating steelhead will be captured and sampled as described

above. These fish will also receive a PIT tag for later identification as they pass downstream. The number of fish handled in Big Beef Creek will depend upon the annual run size.

Basis for take estimate (Unintentional lethal take of adult steelhead)-- Hook-and-line sampling of over 100 adult steelhead (both hatchery and wild) in the Hamma Hamma River since 2002 has resulted in no mortality. All fish collected and handled in the manner described above appeared to fully recover prior to release. However, it is possible that mortality could occur.

Embryo collections

Collection of embryos from redds constructed by natural steelhead will occur for two steelhead generations (eight years based on a typical 4-year life history). Embryos will be reared in captivity and released at two life-history stages: smolt and mature adult. **No adult broodstock will be collected and no adult steelhead will be artificially spawned at any point during the operation of the hatchery program**. Embryos will be collected from each of the three supplemented streams for the first eight years (2007-2014) of the project.

All fish reared in the respective hatcheries will be collected as eyed embryos from redds produced by natural spawners. Redd surveys will be conducted approximately once per week when streamflow conditions permit. The number of new redds constructed will be recorded along with their location (river kilometer and right or left bank). Each redd will be measured. The length of the redd from the upstream- to downstream-most extremes, and three width measurements will be recorded. Each redd will be given a unique number and marked by triangulating the upstream and downstream positions of the redds to two points on shore. The locations of the redds will be recorded and referenced for future hydraulic sampling to obtain eyed embryos. Water temperature probes will be placed in accessible areas of each river and will be monitored bi-weekly once the first redd is observed and marked. A spreadsheet will be developed to calculate proposed hydraulic sampling dates based on accumulated temperature units. The goal will be to hydraulically sample the embryos at the eyed stage of development. Proposed sampling dates will be updated bi-weekly based on river temperatures.

An hydraulic egg sampler will be used to remove eyed eggs from the redds of natural steelhead. Egg collections will occur approximately once per week; however, timing will ultimately be determined by temperature monitoring. A metal 3.2 cm diameter hose connected to a hydraulic pipe will be inserted into the gravel, connected with a length of 3.8 cm-diameter hose to a hydraulic pump. The pump will draw water from the stream. Eggs will be flushed from the gravel into a bag seine connected to a wire-mesh cage. A back-up seine will be positioned downstream to ensure that all flushed eggs are retained. Eggs collected from each redd will be placed in a separate plastic bag. Each bag will be emptied onto a screened tray and washed to clean away debris. The eggs will be counted and identified as either: translucent, translucent eyed, dense opaque, and turning opaque. The number of eggs from each redd in each category will be recorded. All viable (translucent eyed) eggs from the Duckabush and Dewatto rivers will be transported to the USFWS Quilcene National Fish Hatchery QNFH for incubation and pathology screening. All viable eggs from the Skokomish River will be transported to McKernan Hatchery for incubation and pathology screening. The eggs will be disinfected with 100 ppm active iodine solution for not less than 10 minutes prior to entering the incubation unit.

Basis for take estimate (Removal for broodstock, embryo collections)--

The number of embryos to be removed from each stream was arrived at by the collaborative group of agencies and non-profits working on this project. The embryo collection goal was based on the estimated embryo- to- smolt and embryo-to-adult survival that may be achieved and the goal of releasing smolts and adults so as not to exceed the estimated carrying capacity of the rivers to be supplemented. The embryo collection approach, as opposed to adult broodstock collection, maximizes the genetic variability that can be brought into the hatchery with the minimum of demographic risk. For example, the 4,683 eggs collected in 1998 represented eight of 11 redds constructed in that year and were offspring of 5 different females and 16 different males (Kuligowski et al. 2005). Achieving that same level of genetic variability with an adult broodstock collection approach would have required the removal of approximately 15,000 to 20,000 eggs (3,000 to 4,000 eggs from each of 5 females) and 15 males from natural production.

Basis for take estimate (Observe or harass embryos)—The hydraulic sampling procedure may cause eggs that are not collected for broodstock to be dislodged from their nest and moved to other locations within the redd. We do not have estimates of the rate of embryo dislocation. Hydraulic sampling begins at the downstream end of each redd with the intent of collecting all of the eggs within an individual nest, before moving to the next upstream nest. This should minimize disturbance to non collected eggs. All available evidence from the Hamma Hamma steelhead supplementation project indicates that eyed embryos are not damaged by the hydraulic sampling process. Therefore, we estimate that harassment of non-collected embryos may occur at a rate of 10% of the number collected.

Genetic and life history sampling – parr collections

O. mykiss parr will be collected annually during mid to late summer from all seven rivers. Only parr greater than 120 mm will be sampled for analysis to help ensure that they are at least age-1 (which will be verified by scale analysis). Collecting age-1 and older parr increases the likelihood of obtaining a broader genetic representation of the population than collecting age-0 fry, which may be spatially clumped and associated with their natal nest site. Fish collected during the summer that are larger than 220 mm will be defined as resident (i.e., non-migratory) because their body size exceeds the size range of smolts collected during the smolt outmigration season). Lethal parr samples are required to obtain life history information (i.e., resident or anadromous origin) and to provide verification for age determinations based on scales. Details regarding rationale, sampling location, sample size, and protocols are provided in the Study Plan (Appendix 4)

Basis for take estimate (summer parr intentional lehal take)—Up to 30 parr collected from upper (n = 10), middle (n = 10), and lower reaches (n = 10) of each watershed (supplemented and non supplemented) will be collected by hook-and-line or seining. As the take number is approached, only hook-and-line will be used to ensure that samples are collected one by one and the number is not exceeded. An additional 60 parr (20 from each reach) will be collected from each watershed, sampled (fin clip and scale removal, length, weight), and released. To reduce the possibility of exceeding the lethal take limit, we will collect lethal samples last.

Freshwater productivity monitoring – Smolt collections

Smolts will be captured by screw traps on each of the streams, except Big Beef Creek, which will be monitored using the existing weir and trap. A screw trap already exists on the Hamma Hamma River. Take authorizations for the Big Beef Creek weir and Hamma Hamma screw trap for Chinook salmon, summer chum salmon, and steelhead not being tagged, marked and released are being covered under WDFW 4(d) permit requests. We plan to operate screw traps on the Duckabush and S. Fork Skokomish River, and Dewatto River, Little Quilcene and the Tahuya Rivers annually. Additionally, WDFW is planning to install and operate a screw trap on the Dosewallips River in 2009 as part of the Intensively Monitored Watershed Project.

Trapped fish will be removed at least once daily and anesthetized with MS-222. Each fish will be weighed and measured. A scale sample will be taken from the 'preferred area' and used for age analysis. All fish will be marked with either a numbered visual implant tag or a small elastomer tag and released approximately 1 km upstream of the screw traps to estimate trap efficiency. A portion of the smolts (50 smolts from each of 4 populations) will be surgically implanted with acoustic transmitters to estimate early marine survival, residence time in Hood Canal, and to estimate smolt to adult survival rates. At Big Beef Creek all smolts will be collected at the permanent weir. The WDFW will collect scale and genetic samples from a subsample of 100 smolts taken over the duration of the outmigration period. All collected smolts will be released below the weir. Estimated numbers of smolts to be collected in each of the streams is provided in the 'Take Table'.

Basis for take estimate (capture, handle, tag/mark, tissue sample, and release for parr and smolts)—These estimates include the 60 non-lethal parr per population that will be collected during the summer months and the smolts that will be collected each spring. The Hamma Hamma estimates are based on past collections (years 2000 – 2006). The Big Beef Creek estimate (100 fish) is based on the number of fish that will be sampled. The catchability of smolts in the other rivers (Tahuya, Dewatto, Skokomish, and Duckabush) is uncertain. Screw traps have not been operated in these streams in the past.

Basis for take estimate (unintentional lethal take for parr and smolts)—These estimates were calculated at 1% of the estimated number of parr and smolts to be captured. Screw trapping for steelhead in the Hamma Hamma River from 2000 – 2006 has resulted in zero mortality of steelhead. However, some mortality may occur due to trap failure, clogging etc. In addition, surgical implantation of acoustic transmitters into approximately 210 smolts in 2005 and 2006 has resulted in zero mortality for fish held between 1 day and 1 week post-tagging. Nevertheless, some mortality associated with handling and marking is possible.

- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

Six years of monitoring in the Hamma Hamma River has resulted in no observed unintentional mortality (i.e., mortality beyond planned numbers of lethal samples)

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).
*Complete the appended "take table" (**Table 1**) for this purpose. Provide a range of potential take numbers to account for alternate or "worst case" scenarios.*

See Take Table

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.
(*e.g. "The number of days that steelhead are trapped at Priest Rapids Dam will be reduced if the total mortality of handled fish is projected inseason to exceed the 1988-99 maximum observed level of 100 fish."*).

Embryo collections will not exceed the numbers described in the take table. Efforts will cease when the target number of embryos is approached.

Summer parr and smolt collections will not exceed the numbers described in the take table. Collection efforts will cease when the target number of parr is collected

Smolt trapping operations will be modified if in season collection rates indicate that the take limits described in the take table might be exceeded. The trapping effort will be either reduced or terminated to ensure that limits are not exceeded.
Adult trapping and collections will not exceed the numbers described in the take table. Once the planned number of steelhead has been collected, efforts will cease.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.
(e.g. "The hatchery program will be operated consistent with the ESU-wide plan, with the exception of age class at release. Fish will be released as yearlings rather than as sub-yearlings as specified in the ESU-wide plan, to maximize smolt-to-adult survival rates given extremely low run sizes the past four years.").

The Hood Canal winter steelhead supplementation program HGMP would be added to the existing 46 WDFW-managed plans under the co-managers' non-chinook Resource Management Plan (RMP) for Puget Sound region non-chinook salmon hatcheries. This HGMP would be in alignment with the RMP, which serves as the overarching comprehensive plan for state and tribal non-chinook salmon hatchery operations in the

region.

As affirmed in the co-manager's non-chinook RMP, WDFW hatchery programs in Puget Sound must adhere to a number of guidelines, policies and permit requirements in order to operate. These constraints are designed to limit adverse effects on cultured fish, wild fish and the environment that might result from hatchery practices. Following is a list of guidelines, policies and permit requirements that govern WDFW hatchery operations:

Genetic Manual and Guidelines for Pacific Salmon Hatcheries in Washington. These guidelines define practices that promote maintenance of genetic variability in propagated salmon (Hershberger and Iwamoto 1981).

Stock Transfer Guidelines. This document provides guidance in determining allowable stocks for release for each hatchery. It is designed to foster development of locally adapted broodstock and to minimize changes in stock characteristics brought on by transfer of non-local salmonids (WDFW 1991).

WDFW Steelhead Rearing Guidelines. Details rearing guidelines and parameters statewide (July 31, 2001).

Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State. This policy designates zones limiting the spread of fish pathogens between watersheds, thereby further limiting the transfer of eggs and fish in Puget Sound that are not indigenous to the regions (WDFW, NWIFC 1998).

National pollutant Discharge Elimination System Permit Requirements This permit sets forth allowable discharge criteria for hatchery effluent and defines acceptable practices for hatchery operations to ensure that the quality of receiving waters and ecosystems associated with those waters are not impaired. For the 2001-02 and 2002-03 seasons, the co-manager's prepared a Harvest Management Plan for Puget Sound Chinook Salmon. The Plan states specific objectives for harvest of the 15 Puget Sound management units, the technical bases for these objectives, and procedures for their implementation. The Plan assures that the survival and recovery of the Puget Sound ESU will not be impeded by fisheries-related mortality. The Plan was submitted and NMFS (NOAA Fisheries) reached a finding, based on the conditions stated in the 4(d) rule, that fisheries-related take in Washington waters is exempt from prohibition under Section 9 of the ESA. NOAA Fisheries reviewed and approved a five-year Plan submitted by the co-managers for the 2004-05 through 2008-09 seasons.

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates. *Indicate whether this HGMP is consistent with these plans and commitments, and explain any discrepancies.*

A draft research plan is being developed based on contributions from all collaborators

listed in section 1. This HGMP is consistent with that draft plan. No other agreements exist.

3.3) Relationship to harvest objectives.
Explain whether artificial production and harvest management have been integrated to provide as many benefits and as few biological risks as possible to the listed species. Reference any harvest plan that describes measures applied to integrate the program with harvest management.

There is no planned harvest of these steelhead other than incidental catch in marine areas outside of this jurisdiction.

3.3.1) Describe fisheries benefitting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.
Also provide estimated future harvest rates on fish propagated by the program, and on listed fish that may be taken while harvesting program fish .

There is no planned harvest for these fish at this time.

3.4) Relationship to habitat protection and recovery strategies.
Describe the major factors affecting natural production (if known). Describe any habitat protection efforts, and expected natural production benefits over the short- and long-term. For Columbia Basin programs, use NPPC document 99-15, section II.C. as guidance in indicating program linkage with assumptions regarding habitat conditions.

Limiting factors analyses has recently been completed for streams and nearshore areas in WRIA 16 (Skokomish, Dosewallips, Duckabush and Hamma Hamma rivers) and WRIA 17 by the Washington State Conservation Commission (2002-03); these reports will provide information useful for identifying factors limiting populations in Hood Canal. Gradients rapidly become steep with impassable waterfalls, so most of these rivers are not accessible to steelhead. All of these rivers have suffered damage from human activities (dam, roads, logging, diking, agriculture and development) that have exacerbated natural summer low flows, winter flooding and streambed scouring, and sediment deposition due to unstable soils and slopes. Large woody debris is lacking in most areas used as a result of forest practices. In the Skokomish, the Cushman hydropower project on the North Fork has reduced stream flows in the Skokomish by about 40% and has altered the normal pattern of sediment delivery to the estuary with the result that eelgrass has been lost (WDFW and WWTIT, 1994). Gravel aggradation and removal have been problems in the lower Big Quilcene.

3.5) Ecological interactions. [Please review Addendum A before completing this section. If it is necessary to complete Addendum A, then limit this section to NMFS jurisdictional species. Otherwise complete this section as is.]
Describe salmonid and non-salmonid fishes or other species that could (1) negatively impact program; (2) be negatively impacted by program; (3) positively impact program; and (4) be positively impacted by program. Give most attention to interactions between listed and "candidate" salmonids and program fish.

(1) Salmonid and non-salmonid fishes or other species that could negatively impact the program.

Negative impacts by fishes and other species on the Hood Canal steelhead supplementation program could occur directly through predation on program fish, or indirectly through food resource competition, genetic effects, or other ecological interactions. In particular, fishes and other species could negatively impact steelhead survival rates through predation on newly released, emigrating juvenile fish in the freshwater and marine areas. Certain avian and mammalian species may also prey on juvenile steelhead while the fish are rearing at the hatchery site, if these species are not excluded from the rearing areas. Species that could negatively impact juvenile steelhead through predation include the following:

- Avian predators, including mergansers, cormorants, belted kingfishers, great blue herons, and night herons
- Mammalian predators, including mink, river otters, harbor seals, and sea lions
- Cutthroat trout

Rearing and migrating adult steelhead originating through the program may also serve as prey for large, mammalian predators in marine areas, nearshore marine areas and in the Hood Canal watershed to the detriment of population abundance and the program's success in restoration. Species that may negatively impact program fish through predation may include:

- Orcas
- Sea lions
- Harbor seals
- River otters

(2) Salmonid and non-salmonid fishes or other species that could be negatively impacted by the program (focus is on listed and candidate salmonid species).

- Chinook salmon
- Summer chum
- Bull trout
- Steelhead (proposed)

(3) Salmonid and non-salmonid fishes or other species that could positively impact the program.

Fish species that could positively impact the program may include other salmonid species and trout present in the Hood Canal watershed through natural and hatchery production. Juvenile fish of these species may serve as prey items for the steelhead during their downstream migration in freshwater and into the marine area. Decaying carcasses of spawned adult fish may contribute nutrients that increase productivity in the watershed,

providing food resources for the emigrating listed chinook and other steelhead.

(4) Salmonid and non-salmonid fishes or other species that could be positively impacted by the program.

The steelhead program could positively impact freshwater and marine fish species that prey on juvenile fish. Nutrients provided by decaying steelhead carcasses may also benefit fish in freshwater. These species include:

- Northern pikeminnow
- Cutthroat trout
- Pacific staghorn sculpin
- Numerous marine pelagic fish species
- Chinook salmon

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.
For integrated programs, identify any differences between hatchery water and source, and "natal" water used by the naturally spawning population. Also, describe any methods applied in the hatchery that affect water temperature regimes or quality. Include information on water withdrawal permits, National Pollutant Discharge Elimination System (NPDES) permits, and compliance with NMFS screening criteria.

McKernan Hatchery
Water for the McKernan Hatchery is supplied from Weaver Creek and two wells. Well water is currently used for incubation and also for rearing any fish that require pathogen-free water. This generally means fish, which are transferred to McKernan for short-term rearing, then transferred out of the Fish Health Management Zone. McKernan Hatchery fall chum are reared on Weaver Creek water, which should minimize straying into other watersheds.

The water right for Weaver Creek is 12 cubic ft/second (cfs). Flow in Weaver Creek has diminished in recent years because of drought conditions and development in the watershed.

The water right for McKernan wells is 6.4 cfs. The wells are used only for incubation or in instances when pathogen-free water is required. Otherwise, they are not used in order to allow the aquifer to recharge.

Lilliwaup Hatchery - Lilliwaup Hatchery's water is gravity fed, originating from Beardsley Creek, a surface water tributary to Lilliwaup Creek. The water temperature

ranges from 44 ºF in January to 52 ºF in July. The water is fish-free and pathogen-free. The water right for Beardsley Creek is 2.5 cfs; however, flow is a constant 2 cfs. The hatchery also has water rights of 0.2 cfs to an adjacent, unnamed creek. This creek is used as backup water supply in conjunction with pumping water directly from Lilliwaup Creek. Intakes are screened, cleaned daily to minimize build-up and maximize flow.

Manchester Research Station - Smolts entering the research facility from Mckernan Hatchery will be acclimated for a two-week period at this facility with a mixture of fresh water and sea water. Following this acclimation period, fresh water flow will cease. The research station is supplied with approximately 60 gpm of pathogen free well water drawn from aquifers at the U.S Navy fuel depot in Manchester, Washington. Seawater is pumped to the station from an adjacent NOAA pier at a rate of 3 cfs. Approximately 1.2 cfs is available for rearing steelhead. Prior to entering rearing vessels the sea water passes through a series of sand filters and ultra-violet sterilization units to reduce the probability of pathogen introduction from Puget Sound. There are redundant pumps to protect water flows from pump failures and the electrical system is backed up with an automated generator capable of providing enough electricity to maintain flows.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.
(e.g. "Hatchery intake screens conform with NMFS screening guidelines to minimize the risk of entrainment of juvenile listed fish.").

McKernan Hatchery - As mentioned above, water for the McKernan Hatchery is supplied from Weaver Creek and two wells. The water right for Weaver Creek is 12 cfs and is covered under water right permit # S2-24595.

Intake screens conform to minimize the risk that wild juvenile salmonids could enter the fresh water intake. There are no wild chum or chinook above the Weaver Creek intake. There is no formal pollution abatement pond at McKernan. Hatchery effluent is discharged into an adjacent wetland at McKernan and does not violate the conditions of the NPDES permit (# WAG 13-1036). The Hatchery Division has proposed installation of a clarifier to treat effluent before routing it to the wetland.

Lilliwaup Hatchery - There are no fish in Beardsley Creek above the intake. However, the intake is screened. There is a settling pond between the hatchery and Lilliwaup Creek where all of the hatchery effluent is deposited.

Manchester Research Station - All effluent seawater and freshwater leaving the rearing vessels at the research station passes through an ozone depuration vault. This system is considered a complete quarantine facility and will greatly reduce the likelihood that any pathogens present on transferred fish would disperse into Puget Sound.

SECTION 5. FACILITIES

Provide descriptions of the hatchery facilities that are to be included in this plan (see "Guidelines for Providing Responses" Item E), including dimensions of trapping, holding incubation, and rearing facilities. Indicate the fish life stage held or reared in each. Also describe any instance where operation of the hatchery facilities, or new construction, results in destruction or adverse modification of critical habitat designated for listed salmonid species.

5.1) Broodstock collection facilities (or methods).

There will be no adult broodstock collection (see 7.2 for details)

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

Eyed embryos will be transported to the Quilcene National Fish Hatchery in coolers containing ice. Embryos will be placed in wet mesh bags set on top of layers of moistened paper towels in the cooler.

5.3) Broodstock holding and spawning facilities.

N/A. No artificial spawning will occur at any point in this project

5.4) Incubation facilities.

All eggs collected from the Duckabush and Dewatto rivers will be transported to Quilcene National Fish Hatchery's egg isolation facility. The egg isolation building has its own pathogen-free water supply from a well equipped with two Jacuzzi submersible pumps. One pump alone is capable of over 60 gpm, both pumps together can provide just over 100 gpm (pipe diameters restrict the full flow from both pumps.), but the second pump would only be run if absolutely necessary, usually keeping one pump as a reserve. The temperature of the well water is a constant 10° C and is passed through an aspirated pipe and run through a packed column to remove excess nitrogen. Oxygen saturations at the outlet of the manifold pipe over the incubators is in the 10 to 12 ppm range. The effluent water passes through a chlorine exposure chamber and then passes through a dechlorination chamber (sodium thiosulfate) before emptying into the river. The building is equipped with multiple alarm systems to provide as much notice as possible of any water failure. It also has an enclosed formalin treatment system and chillers for otolith marking. All eggs collected from the Skokomish River will be transported to the McKernan Hatchery. The eggs will be maintained in isolation but no depuration of the effluent is required.

5.5) Rearing facilities.

McKernan Hatchery - Rearing facilities at McKernan Hatchery will consist of four 16 ft. X 5ft. deep self-cleaning circular ponds (1000 ft^3 each) and one concrete raceway 147' x 16' x 2.2'(5500 ft^3).

Lilliwaup Hatchery – There are a total of 44 circular rearing tanks at Lilliwaup Hatchery. Outside of the hatchery building sit sixteen 20 ft and twelve 10 ft tanks (when filled to ~4ft deep,

10ft = 294 ft^3. and 20ft = 1256 ft^3). Inside the lower floor of the hatchery are sixteen 4 ft starter tanks and two fiberglass raceways. Each tank is hooked up to the main water line, and has its own valve to regulate water flow. There is also a standpipe in the middle of each tank, and a standpipe next to the valve to regulate water level in the tanks. The two raceways are used to hold fish when sampling. The 20 ft and 10 ft tanks are used for rearing fish of all sizes. The 4 ft "starter" tanks are generally used for rearing fry, and a few for holding any age fish while sampling or counting. The 10 and 20 ft tanks are covered with netting and camouflage to deter predators and mimic the natural environment, respectively.

Manchester Research Station – Rearing at this facility will be from the smolt to adult stage. There are twelve 14 ft diameter by 4 ft deep (615 ft3) circular tanks available for rearing on a covered concrete pad. Each tank is fitted with its own set of fresh water and filtered/treated seawater pipes and valves. Supplemental oxygen is also supplied to each tank. The structure encompassing the pad is roofed but partially open on the sides to allow the admission of ambient light. The tanks are also each fitted with nets to contain fish and exclude predators. Shade covers are positioned over each tank to provide further protections.

5.6) Acclimation/release facilities.

Fish will be released directly into their natal streams. Final release locations have not yet been identified. However, it is expected that the smolts will be released into the lower to middle reaches of each watershed.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

McKernan Hatchery - At McKernan, there have been no major difficulties that have led to significant fish mortality.

Lilliwaup Hatchery - Lilliwaup Hatchery, experienced damage from flash flooding that occurred as a result of the storm that hit Western Washington in early December 2007. Landslides in Lilliwaup Creek and in Beardsley Creek, the main water supply for the hatchery, deposited three to four feet of sediment and rock in and around the facility, leaving the hatchery's main intake clogged with gravel. The water outlet and the adjacent settling pond were buried, preventing water from draining out of the tanks and the hatchery building once the floodwaters subsided. The walls to the hatchery building were damaged by the floodwaters and 2 to 4 inches of sediment was deposited in the nursery tank room. The floodwater also eroded the gravel base under several of the outdoor rearing tanks, threatening their integrity.

Nearly half of the yearling Chinook (25,000 of 50,000) and the Lilliwaup and Hamma summer chum (listed as threatened) being reared at the facility died when both the main water supply and backup pumps failed. **All 11,000+ steelhead (also listed as threatened), which were located in tanks linked to a separate gravity-fed back-up water supply, were not impacted and survived.** Summer chum being reared at a remote site on John's Creek (Hamma) also survived. The remaining Chinook were moved offsite since their tanks were damaged and their water supply could not easily be restored.

Since the flood, the area has been excavated (The intake was cleared, outlet and some of settling pond cleared, facility grounds leveled, and a temporary berm was created to slow flood flows directed at the hatchery building). We have also made some improvements to the facility building to better withstand floodwater. Additional repairs will occur in spring 2008, including lifting and resetting several of the outdoor tanks.

Manchester Research Station – Two brood cycles of steelhead have been reared to sexual maturity at the Manchester Research Station. Mortality from smolt to adult has not exceeded 5% (2.5% per year) for either of the groups. There has been no significant mortality associated with rearing steelhead at this facility.
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5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.
(e.g. "The hatchery will be staffed full-time, and equipped with a low-water alarm system to help prevent catastrophic fish loss resulting from water system failure.").

McKernan Hatchery - McKernan Hatchery is staffed full time with resident professional staff. The hatchery is equipped with alarm systems and backup generator to provide auxiliary power in the event of a power failure. There are provisions at McKernan Hatchery for switching to alternate water sources in the event of the loss of one water source. There is no alternate water source for the incubation room if either of the two production wells are lost.

Lilliwaup Hatchery - A flow alarm is installed on the main water line. Staff are able to respond to the alarm within 15 minutes. In the event of an expected freshet, hatchery personnel will remain overnight at the facility. The Lilliwaup facility has a hatchery water supply, a domestic water supply, and multiple backup hatchery water supply to be used in the event of emergency. Lilliwaup also has pumps to supplement the backup supply with water directly from Lilliwaup Creek. The pumps are now stored on higher grounds so that they will not be affected if another flash flood occurs like the one in December 2007. There is also support from Hoodsport and George Adams hatcheries, which can provide trash pumps to pump water from Lilliwaup Creek into fish holding tanks if necessary. Fish can also be transported off-station to either WDFW facility within 12 hours if necessary.

To prevent disease transmission and reduce the chance of water supply failure, each tank receives its water directly from the intake line (i.e. water is not recycled anywhere within the facility).

Due to the flood and consequent main and backup water system failures, Lilliwaup is revisiting their water supply and backup design. Modifications will be made in 2008 to reduce the chance of future failures.

Manchester Research Station. This facility is staffed with full-time professional fish-culturists and fisheries biologists. Alarms are in place to immediately notify personnel in the event of low flows, pump failures or high temperatures. As mentioned above, each tank used in rearing is fitted with supplemental oxygen. In the event of primary pump or primary sea water line failure, a backup pump will immediately activate and can send water through any of three auxiliary lines. There is also a back up generator to run the station should the grid fail.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to wild fish of the same species/population.

6.1) Source.

All fish for this program will be collected as eyed embryos from the Dewatto River, Duckabush River and Skokomish River. All embryos will be from naturally spawning, natural-origin steelhead adults, because no steelhead are currently being propagated and released in the Hood Canal Watershed aside from the Hamma Hamma River supplementation program which will be terminated (i.e., final release) in 2008.

6.2) Supporting information.

6.2.1) History.

Provide a brief narrative history of the broodstock sources. For listed natural populations, specify its status relative to critical and viable population thresholds (use section 2.2.2 if appropriate). For existing hatchery stocks, include information on how and when they were founded, sources of broodstock since founding, and any purposeful or inadvertent selection applied that changed characteristics of the founding broodstock.

See 6.1.

6.2.2) Annual size.

Provide estimates of the proportion of the natural population that will be collected for broodstock. Specify number of each sex, or total number and sex ratio, if known. For broodstocks originating from natural populations, explain how their use will affect their population status relative to critical and viable thresholds.

See section 7.4.1

6.2.3) Past and proposed level of natural fish in broodstock.

If using an existing hatchery stock, include specific information on how many natural fish were incorporated into the broodstock annually.

N/A – new program

6.2.4) Genetic or ecological differences.
Describe any known genotypic, phenotypic, or behavioral differences between current or proposed hatchery stocks and natural stocks in the target area.

N/A – this is a new program. Only redds constructed by wild winter-run steelhead will be collected. No artificial spawning will take place at any point in the program, so genetic divergence caused by broodstock management practices will be eliminated

6.2.5) Reasons for choosing.
Describe any special traits or characteristics for which broodstock was selected.

The stocks selected for supplementation as part of this program were based on geographic distribution throughout Hood Canal and the availability of suitable 'control' populations that will not be supplemented. For example, the supplemented populations represent the east side (Dewatto River), west side (Duckabush River) and southern extreme (Skokomish River) of Hood Canal. Control populations occur in all areas as well. All populations within Hood Canal are either listed as 'depressed' or 'status unknown' according to the WDFW 2002 Salmonid Stock Inventory (http://wdfw.wa.gov/fish/sasi/). The partners on this project have concluded that the three supplemented streams may be below current carrying capacity and natural productivity may benefit from the addition of natural-origin, hatchery-reared steelhead.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.
(e.g. "*The risk of among population genetic diversity loss will be reduced by selecting the indigenous chinook salmon population for use as broodstock in the supplementation program*.").

The risk of Ryman-Laikre effects (Ryman and Laikre 1991 and Waples and Do 1994) will be reduced by collecting eyed embryos from a larger number of families that would be possible if adults were to be collected and spawned artificially. For example, the Hamma Hamma River supplementation program collected 4,500 embryos from eight different redds in 1998. Those redds contained genetic contributions from at least 21 different parents (5 females and 16 males: Kuligowski et al. 2005), yet the removal of eggs equaled the fecundity of only a single female. A typical broodstock collection program would have required the use of only a single female to stay within the egg collection goal.

The risk of domestication selection will be lessened by rearing smolts to their natural age-at-smoltification (i.e., age-2). Juveniles will not be 'forced' to smolt at age-1, but will be released at age-1 if they reach a threshold size of 150 mm. The remaining fish will be held on a feeding schedule that will produce a natural mean size at age-2 release.

The risk of inbreeding over the course of this project is very low. No adult broodstock will be collected and spawned in captivity. Eggs will come from a large proportion of the redds and will broadly represent the genetics of the population. Siblings of the hatchery-reared groups will remain in the natural environment and contribute to natural productivity. Therefore, inbreeding

will not be exacerbated by mating of related individuals (because no spawning will occur in the hatchery) and sexual selection (which may include inbreeding avoidance mechanisms) will occur naturally in the wild.

The risk of competition will be minimized by rearing steelhead to a natural size at release, which will minimize any size-related advantages for hatchery fish during interference competition. Released hatchery smolts will have the potential to interact with natural origin smolts. However, recent data from acoustic telemetry monitoring indicates that hatchery-reared steelhead smolts released into the Hamma Hamma River quickly entered the estuary (within 1 to 3 days). Moreover, the number of smolts released has been scaled such that the total number of hatchery and natural-origin smolts should only marginally exceed the estimated carrying capacity of the rivers. Thus, the potential for significant effects from competition is low.

The risk of predation is minimized by the apparent rapid emigration of the hatchery reared smolts, the natural body size at release, and the conservative number of smolts planned for release. Recent data from acoustic telemetry monitoring in 2005 and 2006 (n = 83) indicates that hatchery-reared steelhead smolts released into the Hamma Hamma River quickly entered the estuary (within 1 to 3 days).

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Eyed embryos

7.2) Collection or sampling design.

Include information on the location, time, and method of capture (e.g. weir trap, beach seine, etc.) Describe capture efficiency and measures to reduce sources of bias that could lead to a non-representative sample of the desired broodstock source.

There will be no broodstock collection. All fish reared in the respective hatcheries will be collected as eyed embryos from redds produced by natural spawners. Redd surveys will be conducted approximately weekly when streamflow conditions permit. The number of new redds constructed will be recorded along with their location (river kilometer and right or left bank). Each redd will be measured. The length of the redd from the upstream- to downstream-most extremes, and three width measurements will be recorded. Each redd will be given a unique number and marked by triangulating the upstream and downstream positions of the redds to two points on shore. The locations of the redds will be recorded and referenced for future hydraulic sampling to obtain eyed embryos. Water temperature probes will be placed in accessible areas of each river and will be monitored bi-weekly once the first redd is observed and marked. A spreadsheet will be developed to calculate proposed hydraulic sampling dates based on accumulated temperature units. The goal will be to hydraulically sample the embryos at the eyed stage of development. Proposed sampling dates will be updated bi-weekly based on river temperatures.

An hydraulic egg sampler will be used to remove eyed eggs from the redds of natural steelhead. Egg collections will occur approximately weekly and will be determined by temperature monitoring. A metal 3.2 cm diameter hose connected to a hydraulic pipe will be inserted into the gravel, connected with a length of 3.8 cm-diameter hose to a hydraulic pump. The pump will draw water from the stream. Eggs will be flushed from the gravel into a bag seine connected to a wire-mesh cage. A back-up seine will be positioned downstream to ensure that all flushed eggs are retained. Eggs collected from each redd will be placed in a separate plastic bag. Each bag will be emptied onto a screened tray and washed to clean away debris. The eggs will be counted and identified as either: translucent, translucent eyed, dense opaque, and turning opaque. The number of eggs from each redd in each category will be recorded. All viable (translucent eyed) eggs will be transported to the USFWS Quilcene National Fish Hatchery and McKernan Hatchery for incubation and pathology screening.

7.3) Identity.

Describe method for identifying (a) target population if more than one population may be present; and (b) hatchery origin fish from naturally spawned fish.

All embryos will be collected from redds of naturally spawning steelhead in the target river-specific populations

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

Duckabush River =	8,620 eggs
Dewatto River =	9,566 eggs
Skokomish River =	44,616 eggs

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

N/A. This is a new program

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

Describe procedures for remaining within programmed broodstock collection or allowable upstream hatchery fish escapement levels, including culling.

No broodstock will be collected. Egg collections will stop once the target collection numbers have been reached.

7.6) Fish transportation and holding methods.

Describe procedures for the transportation (if necessary) and holding of fish, especially if captured unripe or as juveniles. Include length of time in transit and care before and during transit and holding, including application of anesthetics, salves, and antibiotics.

N/A. No broodstock will be transported

7.7) Describe fish health maintenance and sanitation procedures applied.

N/A No broodstock will be collected or held

7.8) Disposition of carcasses.
Include information for spawned and unspawned carcasses, sale or other disposal methods, and use for stream reseeding.

N/A. No broodstock will be collected, so no carcasses will be produced

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.
(e.g. "The risk of fish disease amplification will be minimized by following Co-manager Fish Health Policy sanitation and fish health maintenance and monitoring guidelines").

The risk of fish disease amplification will be minimized by following Co-manager Fish Health Policy sanitation and fish health maintenance and monitoring guidelines. Any deviation from the Fish Health Policy will be agreed to by the co-managers.

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.
Specify how spawners are chosen (e.g. randomly over whole run, randomly from ripe fish on a certain day, selectively chosen, or prioritized based on hatchery or natural origin).

N/A (see 7.2 for details)

8.2) Males.
Specify expected use of backup males, precocious males (jacks), and repeat spawners.

N/A (see 7.2 for details)

8.3) Fertilization.
Describe spawning protocols applied, including the fertilization scheme used (such as equal sex ratios and 1:1 individual matings; equal sex ratios and pooled gametes; or factorial matings). Explain any fish health and sanitation procedures used for disease prevention.
N/A (see 7.2 for details)

8.4) Cryopreserved gametes.

If used, describe number of donors, year of collection, number of times donors were used in the past, and expected and observed viability.

N/A (see 7.2 for details)

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

(*e.g. "A factorial mating scheme will be applied to reduce the risk of loss of within population genetic diversity for the small chum salmon population that is the subject of this supplementation program"*.).

N/A (see 7.2 for details)

SECTION 9. INCUBATION AND REARING -

Specify any management *goals* (e.g. "egg to smolt survival") that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1) Incubation:

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

Provide data for the most recent twelve years (1988-99), or for years dependable data are available.

Eyed eggs to fry survival rates by brood year for the Hamma Hamma winter steelhead were:

1998	76.06%
1999	88.87%
2000	82.49%
2001	-------
2003	76.49%

Eggs were collected at eyed egg stage by hydraulic sampling, and then transferred to remote site incubators (RSIs) until they hatched. Mortality could be attributed to egg viability at collection, collection methods and loss due to RSI failure. Loss due to RSI failure will be eliminated in the proposed Hood Canal Steelhead program as incubation will take place at the QNFH, and embryos will be incubated in Heath trays. Heath trays will provide a more consistent and reliable water supply to the embryos.

9.1.2) Cause for, and disposition of surplus egg takes.

Describe circumstances where extra eggs may be taken (e.g. as a safeguard against potential incubation losses), and the disposition of surplus fish safely carried through to the eyed eggs or fry stage to prevent exceeding of programmed levels.

No surplus eggs will be collected as described earlier

9.1.3) Loading densities applied during incubation.
Provide egg size data, standard incubator flows, standard loading per Heath tray (or other incubation density parameters).

Eggs will be placed in Marisource Heath-style incubators with Vexar mesh for substrate in numbers not to exceed 5,000 per tray. We do not know egg size at present. The eggs will be incubated in our egg isolation building. Flows will be set at 4 gallons per minute. The building is also equipped with chilling units to mark the otoliths of the fish if that is desired.

9.1.4) Incubation conditions.
Describe monitoring methods, temperature regimes, minimum dissolved oxygen criteria (influent/effluent), and silt management procedures (if applicable), and any other parameters monitored.

The egg isolation building has its own pathogen-free water supply from a well equipped with two Jacuzzi submersible pumps. One pump alone is capable of over 60 gpm, both pumps together can provide just over 100 gpm (pipe diameters restrict the full flow from both pumps.), but the second pump would only be run if absolutely necessary, usually keeping one pump as a reserve. The temperature of the well water is a constant 10° C and is passed through an aspirated pipe and then run through a packed column to remove excess nitrogen. Oxygen saturations at the outlet of the manifold pipe over the incubators is in the 10 to 12 ppm range. The effluent water passes through a chlorine exposure chamber and then passes through a dechlorination chamber (sodium thiosulfate) before emptying into the river. The building is equipped with multiple alarm systems to provide as much notice as possible of any water failure.

9.1.5) Ponding.
Describe degree of button up, cumulative temperature units, and mean length and weight (and distribution around the mean) at ponding. State dates of ponding, and whether swim up and ponding are volitional or forced.

The fish will be periodically inspected for the level of embryonic development, beginning approximately two weeks after hatch. Ponding will be forced when most of the fry in a tray are judged to be sufficiently developed (approximately 600 degree days C) and a commercial dry starter feed will offered to the fish. The fry will be fed and tanks cleaned for the period necessary to determine their viral status, usually 28 days. The fry will be kept in separate containers to maintain their discrete timing and family group relationship. When all of the fry have been ponded each stock will be sampled at the 2% APPL (150 fry) which will be evenly divided between all of the groups. The fry will then be transported to their assigned destination. The Skokomish River fry will be tested at the 5% APPL (60 fish) after ponding since they are remaining with watershed.

9.1.6) Fish health maintenance and monitoring.

Describe fungus control methods, disease monitoring and treatment procedures, incidence of yolk-sac malformation, and egg mortality removal methods.

Fish Health specialists from the USFWS Olympia Fish Health Center or WDFW will take samples of emergent fry to ascertain the presence of any regulated viruses which may not be endemic to the watershed where the fry are to be reared. If any regulated viral pathogens are detected the fry will need to be returned to their watershed of origin. In the course of this sampling, a general fish health inspection will be made and the subsequent samples obtained will be screened for the presence of bacterial pathogens.

The building is also equipped with a closed formalin delivery supply system for the control of fungus. During incubation, the eggs will be periodically inspected and any dead eggs or embryos will be removed.

The building is also equipped with a closed formalin delivery supply system for the control of fungus. During incubation, the eggs will be periodically inspected and any dead eggs or embryos will be removed.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation. (*e.g. "Eggs will be incubated using well water only to minimize the risk of catastrophic loss due to siltation.")*

Eggs will be incubated in and young fry will be supplied well water which will minimize the likelihood of loss caused by siltation or pathogens. The building is equipped with multiple alarm systems to provide as much notice as possible of any water failure. The effluent water is treated with chlorine, then the chlorine is neutralized with sodium thiosulfate before emptying into the river.

9.2) <u>Rearing</u>:

9.2.1) Provide survival rate data (*average program performance*) by hatchery life stage (fry to fingerling; fingerling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available.

The expected survival rate for the proposed program is about 80%. The following is the fry to smolt survival rate by brood year for the Hamma Hamma winter steelhead reared at the Lilliwaup Hatchery.

1998	90.82%
1999	78.35%
2000	81.39%
2001	72.70%
2003	59.94%

Data are from the Hamma Hamma River Steelhead Supplementation Project. Survival rates reflect approximately 20 months of rearing (fry to adult), which is longer than in

typical steelhead hatcheries. Some mortality was associated with lethal sampling for pathology and possibly some cannibalism. Fish are now sorted by size to reduce the potential for loss through cannabilism and asymmetric competition. No diseases have ever been detected in steelhead reared at the Lilliwaup Hatchery.

9.2.2) Density and loading criteria (goals and actual levels).
Include density targets (lbs fish/gpm, lbs fish/ft3 rearing volume, etc).

The fish will be reared at a maximum density index of 0.06 lbs/ft^3 per inch of fish length prior to release. Density index will not exceed 0.3 lbs/ft^3/in, or a maximum of 6.4 lbs/gpm at release and will not exceed 10 lbs/gpm in any rearing vessel at any given time. Flow Index will not exceed 1.4.

9.2.3) Fish rearing conditions
(Describe monitoring methods, temperature regimes, minimum dissolved oxygen, carbon dioxide, total gas pressure criteria (influent/effluent if available), and standard pond management procedures applied to rear fish).

McKernan Hatchery - Maximum and minimum temperatures of the Weaver Creek water source will be recorded daily. The ground well water source used for incubation and short-term rearing remains a constant temperature of 47 ºF. Dissolved oxygen levels will be monitored routinely and not allowed to fall below 5 ppm. Total settleable and suspended solids of the effluent are monitored as per National Pollution Discharge Elimination System requirements.

Lilliwaup Hatchery – Temperature and dissolved oxygen are monitored routinely. Water temperature ranges from 44 –52 ºF and dissolved oxygen levels do not fall below 8 ppm. The facility is rearing under the pound limit for the daily discharge requirements of larger hatcheries.

Manchester Research Station – Temperature data is recorded and monitored daily. Dissolved oxygen and ammonia-nitrogen levels are also routinely monitored. Average daily temperatures range from 44-55 ºF. This facility is also rearing under the pound limit for the daily discharge requirements of larger hatcheries.

9.2.4) Indicate biweekly or monthly fish growth information (*average program performance*), including length, weight, and condition factor data collected during rearing, if available.

This is a new program and new guidelines will be developed to produce a natural growth profile and a natural size at release. Rearing of Hamma Hamma River steelhead at the Lilliwaup Hatchery has been successful at producing smolts that match a natural growth template and size at release **(see Attachment 3)**. We will initially use the Snow Creek wild fish template until data on natural smolt size at outmigration can be collected from

the supplemented streams to provide a more directly relevant template. Feeding programs will be developed based on the water temperatures at each hatchery. In general, however, a sample of 100 fish per tank will be measured and weighed quarterly, and feeding rates will be adjusted to either increase or slow growth rates to match the wild template.

9.2.5) Indicate monthly fish growth rate and energy reserve data (*average program performance*), if available.

Contrast fall and spring growth rates for yearling smolt programs. If available, indicate hepatosomatic index (liver weight/body weight) and body moisture content as an estimate of body fat concentration data collected during rearing.

These data were not collected from the Lilliwaup Hatchery as part of the Hamma Hamma project.

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (*average program performance*).

Fish will be started on Bio-Oregon BioDiet starter feed, then switched to BioDiet Grower semi-moist feed as per manufacturers recommendations.. At approximately 100 FPP they will be switched to Skretting Fry dry diet. Fish will be fed by hand by hatchery staff. Amount fed will be based on body weight according to a pre-determined growth schedule. Feed rations will not exceed 3% BW daily. Maximum pounds of feed/gpm inflow will be 0.14 lbs. of feed/gpm.

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Fish health will be monitored on a routine basis by a WDFW Fish Health Specialist. Hatchery staff will observe fish behavior and request an examination by a WDFW Fish Health Specialist when necessary. Disease treatments will be carried out as prescribed by the Fish Health Specialist. Mortality will be removed and recorded on a daily basis. Eyed eggs will be disinfected with PVP iodine upon receipt from Quilcene National Fish Hatchery as per the Co-Manager's Fish Disease Control Policy guidelines. Separate fish handling utensils will be dedicated for handling and maintenance of these fish to avoid cross-contamination from other fish reared at the site. Fish handling utensils and staff's rain gear will be disinfected between uses. All mortalities will be disposed of in a landfill. The concrete raceway will be cleaned as needed and the circular ponds are self-cleaning.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

Body size will be used to determine which fish will be released at age-1 (those fish greater than 145 mm) and which fish will be held for an additional year and released at age-2 (those less than 145 mm). A subsample of fish from each release group and representing all size classes will be characterized by one of the following visual indices

of smolt development. **Class 1** (non-smolt): parr marks distinct, showing no signs of smolting characteristics as described in Class 3; **Class 2** (pre-smolt): parr marks becoming faint, smolting characteristics beginning to appear; **Class 3** (smolt): parr mark absent or clearly assuming smolting characteristics, such as silvery appearance, with black-banded tail, nose, or dorsal fin; loosening of scales.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.

The steelhead will be reared under feeding regimes to achieve body size characteristics similar to those of wild fish from a stream in the same region for which substantial seasonal size data is available (Snow Creek, Jefferson County, WA). To achieve these growth profiles, feed schedules will be developed based on water temperature, size-specific feed conversion rates. The fish are also reared in tanks that are covered with camouflage to mimic the natural environment.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation. (*e.g. "Fish will be reared to sub-yearling smolt size to mimic the natural fish emigration strategy and to minimize the risk of domestication effects that may be imparted through rearing to yearling size.")*

"Proposed Threatened" Puget Sound Winter Steelhead will be reared under feeding regimes to achieve body size characteristics similar to those of wild fish from a stream in the same region for which substantial seasonal size data is available (Snow Creek, Jefferson County, WA). To achieve these growth profiles, feed schedules will be developed based on water temperature, size-specific feed conversion rates.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program. *Specify any management goals (e.g. number, size or age at release, population uniformity, residualization controls) that the hatchery is operating under for the hatchery stock in the appropriate sections below.*

10.1) Proposed fish release levels. *(Use standardized life stage definitions by species presented in **Attachment 2**. "Location" is watershed planted (e.g. "Elwha River").)*

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry				
Fry				
Fingerling				

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Dewatto smolts	7,400	8	Apr 15 – May 15	Lower river
Duckabush smolts	6,667	8	Apr 15 – May 15	Lower river
Skokomish smolts	34,507	8	Apr 15 – May 15	Lower river
Dewatto adults	253	0.125	March 1	Throughout River
Duckabush adults	230	0.125	March 1	Throughout River
Skokomish adults	400	0.125	March 1	Throughout River

10.2) Specific location(s) of proposed release(s).
Stream, river, or watercourse: *(include name and watershed code (e.g. WRIA) number)*
Release points: (*river kilometer location, or latitude/longitude*)
Major watershed: S. Fork Skokomish, Duckabush, and Dewatto Rivers
Basin or Region: Hood Canal

10.3) Actual numbers and sizes of fish released by age class through the program.
For existing programs, provide fish release number and size data for the past three fish generations, or approximately the past 12 years, if available. Use standardized life stage definitions by species presented in ***Attachment 2****. Cite the data source for this information.*
Data source: (Link to appended Excel spreadsheet using this structure. Include hyperlink to main database)

N/A. This is a new project

10.4) Actual dates of release and description of release protocols.
Provide the recent five year release date ranges by life stage produced (mo/day/yr). Also indicate the rationale for choosing release dates, how fish are released (volitionally, forced, volitionally then forced) and any culling procedures applied for non-migrants.

Smolts will be released on or near May 1 of each year. Trapping of outmigrating smolts in the Hamma Hamma River over the past four years has indicated that early May represents the peak of the outmigration period. Fish will be transported by tank truck and released directly into their natal river.

Captively reared adult release timing will depend on final maturation timing. Beginning in late January, the captive adult populations will be checked for maturity bi-weekly. Once the first females have begun to ovulate, all of the adult fish for a given population will be released. For the Hamma Hamma Supplementation Project, this has typically been late February to early

March. Fish released at that time have shown strong site fidelity, often spawning very near the release site and have remained in the river for up to several months after release.

10.5) Fish transportation procedures, if applicable.

Describe fish transportation procedures for off-station release. Include length of time in transit, fish loading densities, and temperature control and oxygenation methods.

All juvenile and adult steelhead will be released off-site. Steelhead will be transported in fish transport tanks provided by either NOAA Fisheries or WDFW. Fish will not be held in transport tanks for more than 3 hours from the time they are loaded until the time of release. Transport tanks will be filled with pathogen free water (8 – 9º C) from the respective hatcheries (Lilliwaup or McKernan or Manchester). Streams temperatures at the time of release are expected to range between 6 and 8 ºC for the adult release groups (late February through early March) and 7 to 10 ºC for the smolt release groups (May). Fish densities will not exceed 0.5 lbs of fish per gallon of oxygenated water.

10.6) Acclimation procedures (*methods applied and length of time***).**

All hatchery-reared smolts and captively reared adults will be released directly into their natal rivers without acclimation.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

All hatchery-reared smolts will be marked by removing the adipose fin. All captively reared adults released as they mature will be marked with a uniquely numbered flow tag.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

No surplus fish will be produced

10.9) Fish health certification procedures applied pre-release.

Whenever abnormal behavior or mortality is observed, staff contacts the Area Fish Health Specialist. The fish health specialist examines affected fish, and recommends the appropriate treatment. Reporting and control of selected fish pathogens are done in accordance with the Co-managers Disease Control Policy (2006). All fish are examined for general condition and health within 1 to 3 weeks prior to release. If the fish are exposed to a non regulated pathogen-free water source during rearing they will need to be tested for regulated pathogens at the 5% APPL prior to transfer. A Fish Health Specialist prior to release checks fish as per the Co-managers Disease Control Policy.

10.10) Emergency release procedures in response to flooding or water system failure.

McKernan Hatchery

During a flood, drought or water system failure event, fish may be released early directly

into the adjoining water body to prevent possible fish loss.

Lilliwaup Hatchery
The Lilliwaup facility has a backup hatchery water supply to be used in the event of emergency. Lilliwaup also has pumps to supplement the backup supply with water directly from Lilliwaup Creek. The pumps are now stored on higher grounds so that they will not be affected if another flash flood occurs like the one in December 2007. There is also support from Hoodsport and George Adams hatcheries, which can provide trash pumps to pump water from Lilliwaup Creek into fish holding tanks if necessary. In 2008, the main and backup supply will be retrofitted to better withstand major flood incidents.

Fish can be transported off-station to either WDFW facility or released into their native watersheds within 12 hours if necessary. Fish would be transported in the local WDFW fish tanker truck, or using transport containers in the back of the hatchery pickup, depending upon the number that need to be moved and the availability of the tanker truck.

Manchester Research Station - There are backup systems in place to operate at this facility during emergencies. In the event of catastrophic failure tank trucks are available to immediately move the fish back to their natal stream or another designated site.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases. (*e.g. "All yearling coho salmon will be released in early June in the lower mainstem of the Green River to minimize the likelihood for interaction, and adverse ecological effects, to listed natural chinook salmon juveniles, which rear in up-river areas and migrate seaward as sub-yearling smolts predominately in May").*

The extent to which summer chum or Chinook salmon might interact with released hatchery-reared steelhead is unknown. Hatchery-reared steelhead smolts will be released no earlier than late April, after the outmigration of summer chum salmon fry. Moreover, recent data obtained from acoustic telemetry studies indicates that hatchery-reared steelhead released into the Hamma Hamma River migrate quickly (within 1 to 3 days) into Hood Canal (B. Berejikian, unpublished data), and are therefore not likely to interact with summer chum salmon to a significant extent in the freshwater environment. Releasing steelhead at a natural size (approximately 150-200mm), within the estimated carrying capacity of the supplemented streams, and at a natural emigration time will further minimize any negative interactions with summer chum and Chinook salmon.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

This section describes how "Performance Indicators" listed in Section 1.10 will be monitored. Results of "Performance Indicator" monitoring will be evaluated annually and used to adaptively manage the hatchery program, as needed, to meet "Performance Standards".

11.1) Monitoring and evaluation of "Performance Indicators" presented in Section 1.10.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program.

See Attachment 4

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

Funding to research the effects of steelhead supplementation in Hood Canal will be provided on an annual basis by NOAA Fisheries. Additional in kind contributions will be provided by collaborators to meet all necessary tasks.

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.
(*e.g. "The Wenatchee River smolt trap will be continuously monitored, and checked every eight hours, to minimize the duration of holding and risk of harm to listed spring chinook and steelhead that may be incidentally captured during the sockeye smolt emigration period.)"*

Basis for take levels and risk aversion measures are described in Section 2

SECTION 12. RESEARCH

Provide the following information for any research programs conducted in ***direct association with the hatchery program described in this HGMP. Provide sufficient detail to allow for the independent assessment of the effects of the research program on listed fish****. If applicable, correlate with research indicated as needed in any ESU hatchery plan approved by the co-managers and NMFS. Attach a copy of any formal research proposal addressing activities covered in this section. Include estimated take levels for the research program with take levels provided for the associated hatchery program in* ***Table 1****.*

12.1) Objective or purpose.
Indicate why the research is needed, its benefit or effect on listed natural fish populations, and broad significance of the proposed project.

Salmon and steelhead hatcheries in the Pacific Northwest primarily provide fish for harvest. In the past decade hatcheries have developed programs to aid in the conservation and rebuilding of depleted natural populations. The benefits and risks associated with hatcheries have been debated in public and scientific forums but remain unresolved due to the lack of controlled watershed-scale studies of populations influenced by hatchery operations. The recent 'Alsea Decision', and NOAA's Draft Hatchery Policy highlight the continuing uncertainty regarding the merits of hatcheries in an era in which over two dozen Evolutionarily Significant Units (ESUs)

have been listed as Threatened or Endangered under the Endangered Species Act (ESA). NOAA Fisheries has been petitioned to list the Puget Sound steelhead ESU as endangered under the ESA, and has conducted a status review of the Puget Sound steelhead ESU (including Hood Canal). This research proposal addresses a major question that is germane to steelhead populations throughout the Pacific Northwest: What are the demographic and genetic impacts of conservation hatchery programs on natural steelhead populations?

Our understanding of hatchery effects on natural populations has been greatly improved by substantial research efforts over the past several decades. However, studies of hatchery effectiveness have generally lacked two critical components critical that remove confounding influences on natural population status - replication and controls. Numerous studies have documented reduced relative reproductive fitness of hatchery steelhead populations, but these studies were conducted within single watersheds, and do not provide information on how hatchery fish may have reduced or contributed to the productivity of the natural populations (Berejikian and Ford 2004). The number of salmon smolts released from hatcheries producing fish for harvest has been negatively correlated with the productivity of natural populations (Nickelson 2003), but these data do not demonstrate causality, and the inferences are limited to large-scale production hatcheries. Numerous laboratory and a smaller number of field studies investigated ecological interactions between hatchery and natural salmonids and showed that hatchery fish clearly compete for resources with natural fish during several stages of their life histories (Weber and Fausch 2003). However, failure to replicate at the population level, lack of controls, and indirect speculation extrapolating the effects of hatchery fish on total population productivity has limited the usefulness of these studies.

The Northwest Fisheries Science Center's (NWFSC) Recovery Science Review Panel (RSRP) strongly advocated that NOAA Fisheries take the lead in initiating a large-scale hatchery experiment that incorporates treatment and control streams (RSRP Report, 21-23 July 2003). The Northwest Power Planning and Conservation Council's (NWPPC) Independent Science Advisory Board (ISAB 2003) questioned assertions by supplementation hatchery programs that the programs have aided natural populations, and concluded that the assertion remains untested and requires an experimental design with both supplemented treatment streams and control streams that exclude hatchery salmon and steelhead (ISAB 2003).

The Hood Canal presents an ideal situation to conduct this research for several reasons. First, a number of the major streams within the Canal received inputs of hatchery fish over the past several decades from the same domesticated, out-of-basin hatchery population (Bogachiel strain). This hatchery population featured early run timing and is not believed to have interbred to a large extent with the natural populations (Phelps et al 1994). With the exception of the Hamma Hamma River, which is currently undergoing an experimental supplementation evaluation, all stocking of domesticated steelhead was discontinued in 2002. Second, the lack of hatchery-dependent harvest in Hood Canal reduces the likelihood of significant harvest reduction issues that would occur in other regions of Puget Sound. Third, there is a broad range of habitat quality represented within the Hood Canal watershed. Finally, collaboration has been established between federal, state and tribal agencies and two major non-profit salmon restoration groups working in the Hood Canal watershed.

Results of the Hamma Hamma steelhead supplementation project suggest that the strategy of collecting natural origin embryos, rearing them to the smolt stage and the adult stage has resulted in dramatic increases in the number of naturally spawning steelhead in that river system. In particular, captively reared adults have demonstrated a high level of reproductive performance and this strategy requires fewer embryos to be collected from the wild, reducing the risk of 'mining' the natural population.

Benefits to fish populations

12.2) Cooperating and funding agencies.

Funding agency: NOAA, with in-kind contributions from cooperating entities

Cooperating agencies/groups: NOAA Fisheries (Northwest Fisheries Science Center), Washington Department of Fish and Wildlife, Skokomish Tribe, Long Live the Kings, Hood Canal Salmon Enhancement Group, US Fish and Wildlife Service

12.3) Principle investigator or project supervisor and staff.

Principal investigator: Barry Berejikian, NOAA Fisheries

12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.

Same as in Section 2

12.5) Techniques: include capture methods, drugs, samples collected, tags applied.

See Attachment 4 (Study Plan)

12.6) Dates or time period in which research activity occurs.

February 2007 through December 2022

12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.

Described in sections 4 – 10.

12.8) Expected type and effects of take and potential for injury or mortality.

All take is described in section 2.

12.9) Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached "take table" (Table 1).

See attached "take table"

12.10) Alternative methods to achieve project objectives.

The methods described in the study plan represent the collaborator's preferred approach to evaluating the effects of steelhead supplementation on a large scale. The study plan will be undergoing peer-review.

12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.

Steelhead are listed as Threatened. For threats to listed species – see Section 2

12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.
(*e.g. "Listed coastal cutthroat trout sampled for the predation study will be collected in compliance with NMFS Electrofishing Guidelines to minimize the risk of injury or immediate mortality.")*.

Risk aversion measures are covered under sections 2 – 9.

SECTION 13. ATTACHMENTS AND CITATIONS

Include all references cited in the HGMP. In particular, indicate hatchery databases used to provide data for each section. Include electronic links to the hatchery databases used (if feasible), or to the staff person responsible for maintaining the hatchery database referenced (indicate email address). Attach or cite (where commonly available) relevant reports that describe the hatchery operation and impacts on the listed species or its critical habitat. Include any EISs, EAs, Biological Assessments, benefit/risk assessments, or other analysis or plans that provide pertinent background information to facilitate evaluation of the HGMP.

References

Berejikian, B. A., and M. Ford. 2004. A review of the relative fitness of hatchery and natural salmon. U.S. Dept, Commer. NOAA Tech. Memo. NMFS-NWFSC-61, 28 p.

Berejikian, B., D. VanDoornik, J. Lee, A. LaRae, and E.P. Tezak. 2005. The effects of current velocity during culture on reproductive performance of captively reared steelhead. Trans. Am. Fish. Soc. 134:1236-1252.

Busby, P. J, T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Dep. Commer., NOAA Tech. Memo NMFS-NWFSC-27, 261 p. (Available online at: http://www.nwfsc.noaa.gov/publications/techmemos/tm27/tm27.htm).

Hershberger, W. K. and R.N. Iwamoto. 1981. Genetics Manual and Guidelines for the Pacific Salmon Hatcheries of Washington. University of Washington College of Fisheries. Seattle, WA. 83 pp.

Johnson, T. H. and R. Cooper. 1992. Snow Creek anadromous fish research: Annual Performance Report #92-5. 57 p. (Available from Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, WA, 98501.).

Kuligowski, D.R., M.J. Ford, and B.A. Berejikian. 2005. Fine-scale patterns of genetic relatedness in a population of steelhead (Oncorhynchus mykiss). Trans. Am. Fish. Soc. 134:1202-1212

Nickelson, T. 2003. The influence of hatchery coho salmon (*Oncorhynchus kisutch*) on the productivity of wild coho salmon populations in Oregon coastal basins Can. J. Fish. Aquat. Sci. 60: 1050–1056.

Ogg, L.W. and A.T. Taiber. 1999. South Fork Skokomish bull trout (*Salvelinus confluentus*) research project, summary report, 1999. U.S.D.A. Forest Service, Olympic National Forest, Hood Canal Ranger District, N 150 Lake Cushman Road, Hoodsport, WA 98548.

Phelps, S.R., B.M. Baker, P.L. Hulett, and S.A. Leider. 1994. Genetic analysis of Washington steelhead: Initial electrophoretic analysis of wild and hatchery steelhead and rainbow trout. Washington Department of Fish and Wildlife. Fisheries Management Program Rep., 94-9.

Ryman, N. and L. Laikre. 1991. Effects of supportive breeding on the genetically effective population size. Conservation Biology 5:325-329.

Salmon and Steelhead Inventory (SaSI). 2002. Salmon and steelhead inventory - 2002. Introduction, Summary Tables, and North Puget Sound, South Puget Sound, Hood Canal and Strait of Juan de Fuca volumes. Fish Program, Science Division. Washington Department of Fish and Wildlife. Olympia, WA.

Waples, R. S.//Do, C. 1994 Genetic risk associated with supplementation of Pacific salmonids - captive broodstock programs Canadian Journal of Fisheries and Aquatic Sciences 51 310-329.

Washington Department of Fish and Wildlife and Point No Point Treaty Tribes. 2000. Summer Chum Salmon Conservation Initiative: An Implementation Plan to Recover Summer Chum Salmon in the Hood Canal and Strait of Juan de Fuca Region. Jim Ames, Gary Graves, and Chris Weller, editors. Fish Program, Washington Department of Fish and Wildlife, Olympia. 423 pp. + app.

Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes. 1998. Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State. Washington Department of Fish and Wildlife. Olympia, WA.

Washington Department of Fish and Wildlife. 2001. Steelhead rearing guidelines. Fish Program, Science Division, Washington Department of Fish and Wildlife. Olympia, WA.

WDFW and WWTIT. 1994. 1992 Washington State salmon and steelhead stock inventory - Appendix One - Puget Sound stocks - Hood Canal and Strait of Juan de Fuca volume. Wash. Dept. of Fish and Wild., Olympia, WA. 424 p.

Washington Department of Fisheries, Washington Department of Wildlife and Western Washington Treaty Indian Tribes. 1992. Washington State Salmon and Steelhead Stock Inventory. Olympia, WA.

Washington Department of Fisheries. 1991. Stock Transfer Guidelines. Hatcheries Program, Washington Department of Fisheries. Olympia, WA.

Weber, E.D. and K.D. Fausch. 2003. Interactions between hatchery and wild salmonids in streams: differences in biology and evidence for competition. Can. J. Fish. Aquat. Sci. 60:1018-1036.

SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the information provided is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by_____ Date:_____

Table 1. Estimated listed steelhead and salmon take levels for hatchery and research and monitoring activities. One table is provided for each species. Justification for take estimates are provided in Section 2

Listed species affected: _*Oncorhynchus mykiss* ESU/Population:___ Puget Sound Steelhead_(Hood Canal)__ Activity:_Hatchery supplementation, research, monitoring and evaluation in Hood Canal				
Location of hatchery activity:_Hood Canal_____ Dates of activity:___February 1, 2007 through August 30, 2022_____ Principle Investigator: Barry Berejikian_____				
	Annual Take of Listed Fish By Life Stage *(Number of Fish)*			
Type of Take	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)	*Embryos:* Dewatto (1,000) Duckabush (1,000) Skokomish (4,000) **Total: 5,000**		*Redd surveys*: Adults observed = 0.05 x number of redds observed	0
Collect for transport b)	0	0	0	0
Capture, handle, and release c)	0	***Hatcher-reared smolts*** Duckabush (1,500) Dewatto (1,500) Skokomish (6,000) **Total: 9,000**	***Hatchery adults:*** Dewatto (30) Duckabush (30) Hamma Hamma (30) Skokomish (30) **Total: 120**	0
Capture, handle, tag/mark/tissue sample, and release d)	0	***Natural parr & smolts (spring migrants):*** Hamma Hamma (500)[1] Duckabush (1,000) Dewatto (1,500) Tahuya (2,000) Big Beef Creek (80)[1] Skokomish (2,500)[2] Little Quilcene (500) **Total: 8,550** ***Natural parr (summer):*** Hamma Hamma (90) Little Quilcene (90) Duckabush (90) Dewatto (90) Tahuya (90) Big Beef Creek (90) Skokomish (90) **Total: 2,700**	***Natural adults:*** Hamma Hamma (6) Dosewallips (6) Duckabush (6) Dewatto (6) Tahuya (6) Skokomish (10) Little Quilcene (6) **Total: 40**	0

Listed species affected: _*Oncorhynchus mykiss* ESU/Population:___ Puget Sound Steelhead_(Hood Canal)__ Activity:_Hatchery supplementation, research, monitoring and evaluation in Hood Canal				
Location of hatchery activity:_Hood Canal_____ Dates of activity:___February 1, 2007 through August 30, 2022_____ Principle Investigator: Barry Berejikian_____				
Removal (e.g. broodstock) e)	***Embryo Collections***: Dewatto (9,566) Duckabush (8,620) Skokomish (44,616) **Total: 62,802**		0	0
Intentional lethal take f)	0	***Summer parr*** Little Quilcene (30)[2] Hamma Hamma R (30) **Total = 60**[(2)] ***Smolts:*** Hamma Hamma R. (15) Little Quilcene (15) Duckabush (15) Skokomish (15) Dosewallips (15) **Total = 75**	0	0
Unintentional lethal take g)		***Parr & Smolts:*** Hamma Hamma (5) Little Quilcene (6) Duckabush (6) Dewatto (6) Tahuya (6) Big Beef Creek (2)[1] Skokomish (16) **Total = 40**	Hamma Hamma (1) Little Quilcene (1) Duckabush (1) Dewatto (1) Tahuya (1) Big Beef Creek (1)[1] Skokomish (1) **Total = 7**	0
Other Take (specify) h)				

1/These take estimates are not additional to those listed in WDFW permits for operation of the Big Beef Creek weir.
2/ Lethal parr samples for Little Quilcene are for summer 2010 only.

Listed species affected: _*Oncorhynchus keta* ESU/Population:___ Hood Canal Summer Chum Salmon__ Activity:_ Steelhead smolt release and juvenile abundance monitoring				
Location of hatchery activity:_Hood Canal_____ Dates of activity:___February 1, 2007 through August 30, 2022_____ Principle Investigator: Barry Berejikian_____				
Type of Take	**Annual Take of Listed Fish By Life Stage (*Number of Fish*)**			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)	0	0	0	0
Collect for transport b)	0	0	0	0
Capture, handle, and release c) 1	0	0	0	0
Capture, handle, tag/mark/tissue sample, and release d)	0	0	0	0
Removal (e.g. broodstock) e)	0	0	0	0
Intentional lethal take f)	0	0	0	0
Unintentional lethal take g) 1	0	0	0	0
Other Take (specify) h)	0	0	0	0

1/ There is no anticipated take of listed summer chum salmon from this project. However, take Authorizations for take of chum salmon from screw trap or weir operations have been applied for by collaborating agencies to account for activities that may occur with the same equipment but at different times (e.g., smolt trapping efforts prior to April 1.).

Listed species affected: _*Oncorhynchus tshawytscha* ESU/Population:___ Puget Sound Chinook Salmon Activity:_ Steelhead smolt release and juvenile abundance monitoring				
Location of hatchery activity:_Hood Canal_____ Dates of activity:___February 1, 2007 through August 30, 2022_____ Principle Investigator: Barry Berejikian_____				
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)	0	0	0	0
Collect for transport b)	0	0	0	0
Capture, handle, and release c) 1	0	Duckabush (300) Tahuya (300) Dewatto (400) Little Quilcene (300) Skokomish (300)	0	0
Capture, handle, tag/mark/tissue sample, and release d)	0	0	0	0
Removal (e.g. broodstock) e)	0	0	0	0
Intentional lethal take f)	0	0	0	0
Unintentional lethal take g) 1	0	Duckabush (5) Tahuya (5) Dewatto (5) Little Quilcene (5) Skokomish (5)	0	0
Other Take (specify) h)				

Attachment 1. Definition of terms referenced in the HGMP template.

Augmentation - The use of artificial production to increase harvestable numbers of fish in areas where the natural freshwater production capacity is limited, but the capacity of other salmonid habitat areas will support increased production. Also referred to as "fishery enhancement".

Critical population threshold - An abundance level for an independent Pacific salmonid population below which: depensatory processes are likely to reduce it below replacement; short-term effects of inbreeding depression or loss of rare alleles cannot be avoided; and productivity variation due to demographic stochasticity becomes a substantial source of risk.

Direct take - The intentional take of a listed species. Direct takes may be authorized under the ESA for the purpose of propagation to enhance the species or research.

Evolutionarily Significant Unit (ESU) - NMFS definition of a distinct population segment (the smallest biological unit that will be considered to be a species under the Endangered Species Act). A population will be/is considered to be an ESU if 1) it is substantially reproductively isolated from other conspecific population units, and 2) it represents an important component in the evolutionary legacy of the species.

Harvest project - Projects designed for the production of fish that are primarily intended to be caught in fisheries.

Hatchery fish - A fish that has spent some part of its life-cycle in an artificial environment and whose parents were spawned in an artificial environment.

Hatchery population - A population that depends on spawning, incubation, hatching or rearing in a hatchery or other artificial propagation facility.

Hazard - Hazards are undesirable events that a hatchery program is attempting to avoid.

Incidental take - The unintentional take of a listed species as a result of the conduct of an otherwise lawful activity.

Integrated harvest program - Project in which artificially propagated fish produced primarily for harvest are intended to spawn in the wild and are fully reproductively integrated with a particular natural population.

Integrated recovery program - An artificial propagation project primarily designed to aid in the recovery, conservation or reintroduction of particular natural population(s), and fish produced are intended to spawn in the wild or be genetically integrated with the targeted natural population(s). Sometimes referred to as "supplementation".

Isolated harvest program - Project in which artificially propagated fish produced primarily for harvest are not intended to spawn in the wild or be genetically integrated with any specific natural population.

Isolated recovery program - An artificial propagation project primarily designed to aid in the recovery, conservation or reintroduction of particular natural population(s), but the fish produced are not intended to spawn in the wild or be genetically integrated with any specific natural population.

Mitigation - The use of artificial propagation to produce fish to replace or compensate for loss of fish or fish production capacity resulting from the permanent blockage or alteration of habitat by human activities.

Natural fish - A fish that has spent essentially all of its life-cycle in the wild and whose parents spawned in the wild. Synonymous with *natural origin recruit (NOR).*

Natural origin recruit (NOR) - See *natural fish* .

Natural population - A population that is sustained by natural spawning and rearing in the natural habitat.

Population - A group of historically interbreeding salmonids of the same species of hatchery, natural, or unknown parentage that have developed a unique gene pool, that breed in approximately the same place and time, and whose progeny tend to return and breed in approximately the same place and time. They often, but not always, can be separated from another population by genotypic or demographic characteristics. This term is synonymous with stock.

Preservation (Conservation) - The use of artificial propagation to conserve genetic resources of a fish population at extremely low population abundance, and potential for extinction, using methods such as captive propagation and cryopreservation.

Research - The study of critical uncertainties regarding the application and effectiveness of artificial propagation for augmentation, mitigation, conservation, and restoration purposes, and identification of how to effectively use artificial propagation to address those purposes.

Restoration - The use of artificial propagation to hasten rebuilding or reintroduction of a fish population to harvestable levels in areas where there is low, or no natural production, but potential for increase or reintroduction exists because sufficient habitat for sustainable natural production exists or is being restored.

Stock - (see “Population”).

Take - To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

Viable population threshold - An abundance level above which an independent Pacific salmonid population has a negligible risk of extinction due to threats from demographic variation (random

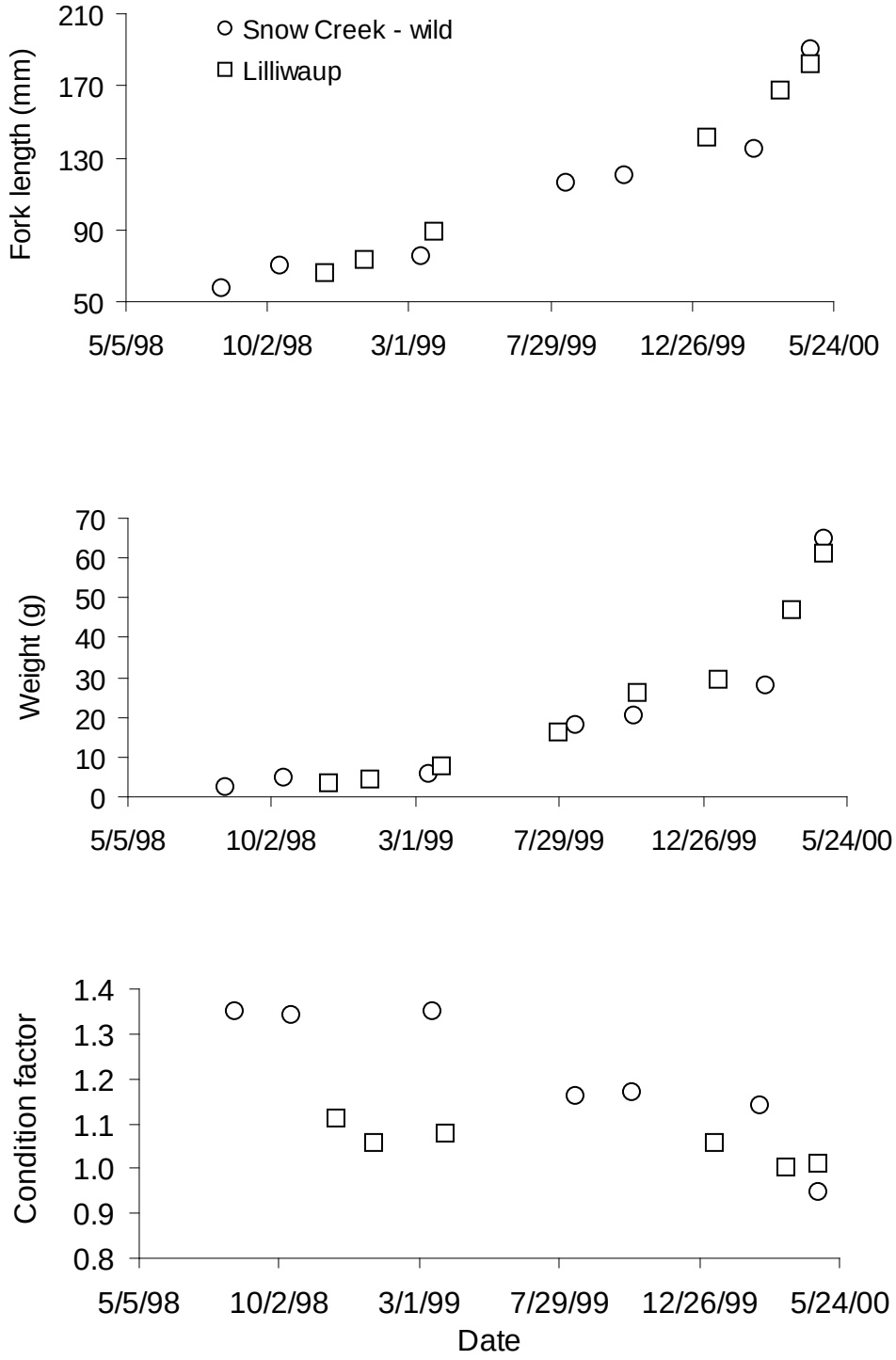
or directional), local environmental variation, and genetic diversity changes (random or directional) over a 100-year time frame.

Attachment 2. Age class designations by fish size and species for salmonids released from hatchery facilities. (generally from Washington Department of Fish and Wildlife, November, 1999).

SPECIES/AGE CLASS	SIZE CRITERIA Number of fish/pound	SIZE CRITERIA Grams/fish
• **Chinook Yearling**	**<=20**	**>=23**
• **Chinook (Zero) Fingerling**	**>20 to 150**	**3 to <23**
• **Chinook Fry**	**>150 to 900**	**0.5 to <3**
• **Chinook Unfed Fry**	**>900**	**<0.5**
• **Coho Yearling 1/**	**<20**	**>=23**
• **Coho Fingerling**	**>20 to 200**	**2.3 to <23**
• **Coho Fry**	**>200 to 900**	**0.5 to <2.3**
• **Coho Unfed Fry**	**>900**	**<0.5**
• **Chum Fed Fry**	**<=1000**	**>=0.45**
• **Chum Unfed Fry**	**>1000**	**<0.45**
• **Sockeye Yearling 2/**	**<=20**	**>=23**
• **Sockeye Fingerling**	**>20 to 800**	**0.6 to <23**
• **Sockeye Fall Releases**	**<150**	**>2.9**
• **Sockeye Fry**	**> 800 to 1500**	**0.3 to <0.6**
• **Sockeye Unfed Fry**	**>1500**	**<0.3**
• **Pink Fed Fry**	**<=1000**	**>=0.45**
• **Pink Unfed Fry**	**>1000**	**<0.45**
• **Steelhead Smolt**	**<=10**	**>=45**
• **Steelhead Yearling**	**<=20**	**>=23**
• **Steelhead Fingerling**	**>20 to 150**	**3 to <23**
• **Steelhead Fry**	**>150**	**<3**
• **Cutthroat Trout Yearling**	**<=20**	**>=23**
• **Cutthroat Trout Fingerling**	**>20 to 150**	**3 to <23**
• **Cutthroat Trout Fry**	**>150**	**<3**
• **Trout Legals**	**<=10**	**>=45**
• **Trout Fry**	**>10**	**<45**

1/ Coho yearlings defined as meeting size criteria and 1 year old at release, and released prior to June 1st.
2/ Sockeye yearlings defined as meeting size criteria and 1 year old.

ATTACHMENT 3. Figure shows the length, weight and condition factor of the BY 1998 smolt release group of steelhead from the Hamma Hamma River reared at Lilliwaup compared to wild Snow Creek steelhead. Snow Creek values are averages over 8 years. Smoltification occurs in April and May.



Attachment 4 – Hood Canal Steelhead Supplementation Project Study Plan (electronic file sent to Tim Tynan on 5 December 2006)