HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Barnaby Slough Winter Steelhead Program
Species or Hatchery Stock:	Winter Steelhead (*Onchorynchus mykiss*) Skagit River
Agency/Operator:	Washington Department of Fish and Wildlife
Watershed and Region:	Skagit River Puget Sound
Date Submitted:	March 17, 2003
Date Last Updated:	January 28, 2002

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Barnaby Slough Winter Steelhead Program

1.2) Species and population (or stock) under propagation, and ESA status.

Skagit River Winter Steelhead(*Oncorhynchus mykiss*) - not listed

1.3) Responsible organization and individuals

Name (and title):	Chuck Phillips, Region 4 Fish Program Manager Chuck Lavier, Skagit Complex Manager	
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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

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

Funding for this program is provided through the State Wildlife Fund.

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

Marblemount Hatchery:	Cascade River (04.1411) at RM 0.5 at confluence with Clark Creek (04.1421). The Cascade River is a tributary to the Skagit River (03.0176) at RM 78.
Barnaby Slough Pond:	Skagit River (03.0176) at RM 70.2.
Grandy Creek/Fabors Ferry:	Skagit River (03.0176) at RM 68.

1.6) Type of program.

Isolated harvest

1.7) Purpose (Goal) of program.

Augmentation

Provide steelhead for sport and tribal harvest opportunities (5,000 adults annually) and to have a self-sustaining hatchery run (400 adults).

1.8) Justification for the program.

This hatchery program will be operated to provide fish for harvest while minimizing adverse effects on listed fish. This will be accomplished in the following manner:

1. Hatchery fish will be released as smolts at a time to minimize or eliminate adverse interactions with listed fish.

2. Only appropriate stocks will be propagated.

3. Hatchery fish will be externally marked to distinguish them from wild fish.

4. Fish will be acclimated before release when possible.

5. Hatchery fish will be propagated using appropriate fish culture methods and consistent with the Co-Managers' Disease Policy, spawning and genetic guidelines and state and federal water quality standards.

6. These hatchery fish will be harvested at a rate that does not adversely effect wild fish.

1.9) List of program Performance Standards .

See section 1.10.

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

Performance Standards and Indicators for Puget Sound **Isolated Harvest** Steelhead programs.

Performance Standard	Performance Indicator	Monitoring and Evaluation Plan
Produce adult fish for harvest	Survival and contribution rates	Monitor catch
Meet hatchery production goals	Number of juvenile fish released - **200,000**	Future Brood Document (FBD) and hatchery records

Manage for adequate escapement where applicable	Hatchery return rates	Hatchery return records
Minimize interactions with listed fish through proper broodstock management and mass marking. Maximize hatchery adult capture effectiveness. Use only hatchery fish	Number of broodstock collected - **400 (total for both Marblemount & Barnaby Slough)**	Rack counts Spawning guidelines
	Stray Rates	Hatchery records
	Sex ratios	Hatchery records
	Age structure	Hatchery records
	Timing of adult collection/spawning - **December to March**	Hatchery records Spawning guidelines
	Total number of wild adults passed upstream - **All wild fish are released (non-adipose fin clipped).**	
	Adherence to spawning guidelines - **see section 8.3**	
Minimize interactions with listed fish through proper rearing and release strategies	Juveniles released as smolts	FBD and hatchery records
	Out-migration timing of listed fish / hatchery fish - **early May (chinook) /May (steelhead)**	FBD and historic natural outmigration times FBD and hatchery records
	Size and time of release - **6 fpp/May 1-15 release**	Hatchery records (marked vs unmarked)
	Hatchery stray rates	
Maintain stock integrity and genetic diversity	Effective population size	Spawning guidelines
	HOR spawners	Spawning ground surveys

Maximize in-hatchery survival of broodstock and their progeny; and Limit the impact of pathogens associated with hatchery stocks, on listed fish	Fish pathologists will monitor the health of hatchery stocks on a monthly basis and recommend preventative actions / strategies to maintain fish health	Co-Managers Disease Policy Fish health monitoring records
	Fish pathologists will diagnose fish health problems and minimize their impact	
	Vaccines will be administered when appropriate to protect fish health	
	A fish health database will be maintained to identify trends in fish health and disease and implement fish health management plans based on findings	
	Fish health staff will present workshops on fish health issues to provide continuing education to hatchery staff.	
Ensure hatchery operations comply with state and federal water quality standards through proper environmental monitoring	NPDES compliance	Monthly NPDES records

1.11) Expected size of program.

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

400 adults (approximate total needed for both programs: Marblemount & Barnaby Slough)

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location.

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling		
Yearling	Skagit River (03.0176)	*200,000

* - At Barnaby Slough up to 136,000 steelhead at 6 fpp are released from an earthen pond. No more than 51% of the fish are released above the Rockport Bridge. The remaining 64,000 are planted at sites below the Rockport Bridge. These will include the Grandy Creek and Fabors Ferry sites.

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

The tribal goal for hatchery winter steelhead is to harvest 5,000 adults commercially. This goal is not being achieved. The non-tribal goals are to have a self-sustaining hatchery run of 400 adults. This equates to a ~1% return on total smolt releases into watershed (534,000 smolts). During the return years from 1998 through 2001, the escapement levels have been 7,448, 7,870, 3,780 and 4,584, respectively.

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

Over 20 years.

1.14) Expected duration of program.

Ongoing

1.15) Watersheds targeted by program.

Skagit River (03.0176)

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

None

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS

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

None.

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

2.2.1) Description of ESA-listed salmonid population(s) affected by the program.

- Identify the ESA-listed population(s) that will be directly affected by the program.

-Identify the ESA-listed population(s) that may be incidentally affected by the program.

Lower Skagit/MS Trib Fall Chinook

One fall chinook stock exists in the Skagit, spawning in the lower mainstem and in Baker River, Finney Creek and Day Creek. Fall chinook spawning begins in the second week of September, peaks in early October, and continues through October

Escapement of Skagit Summer /Fall Chinook

YEAR	Low Sauk	Up Skgt	Low Skg	Total
1974	1082	8398	3116	12596
1975	964	7171	3185	11320
1976	1770	6760	5590	14120
1977	625	5807	2485	8917
1978	1640	8448	2987	13075
1979	1636	7841	3629	13106
1980	2738	12399	4921	20058
1981	1702	4233	2348	8283
1982	1433	6845	1932	10210
1983	375	5197	3151	8723
1984	680	9642	2306	12628
1985	515	13801	1686	16002
1986	1143	12181	4584	17908
1987	792	5982	2635	9409
1988	1052	8077	2339	11468
1989	449	4781	1454	6684
1990	1294	11793	3705	16792
1991	658	3658	1510	5826
1992	469	5548	1331	7348
1993	205	4654	942	5801
1994	100	4565	884	5549
1995	263	5948	866	7077
1996	1103	7989	1521	10613
1997	295	4168	409	4872
1998	460	11761	2388	14609
1999	295	3586	1043	4924

Source: WDFW data

Suiattle Spring Chinook, Upper Cascade Spring Chinook, Upper Sauk Spring Chinook, Lower Sauk Summer Chinook, Upper Skagit Summer Chinook, Bull Trout/Dolly Varden

2.2.2) <u>Status of 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

Critical and viable population thresholds under ESA have not been determined, however, the SASSI report (WDFW) determined this population (lower Skagit Fall Chinook) to be "depressed"

-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 tag returns at this time to assess survivals.

-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.

SKAGIT CHINOOK

Brood Year	Est. Females	Potential Eggs* (Millions)	Total Smolts	Survival to Migration
1989	3274	14.7	963,930	6.5%
1990	8468	38.1	233,603	0.6%
1991	2923	13.2	1,777,330	13.5%
1992	3598	16.2	2,142,078	13.2%
1993	2793	12.6	1,436,530	11.4%
1994	2847	12.8	1,310,448	10.2%
1995	3465	15.6	414,691	2.7%

* at 4,500/female

Range of Natural Origin Recruit per Spawner (1992 to 1999) = .356 to 2.619 : 1 Average is 1.132 spawner / recruit.

Source: WDFW trapping data

-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.

Upper Skagit summer chinook indicator adult returns (hatchery origin/acclimation pond release) through 2000 season have been less than 1% of total adult natural spawn for stock. Adult strays (carcass recoveries) from Skagit spring chinook indicator groups of 0-age and yearling releases from the Marblemount facility have been localized to one-mile radius of hatchery outlet.

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

-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.

The release of fish as described in this HGMP could potentially result in ecological interactions with listed species. These potential ecological interactions are discussed in Section 3.5, and risk control measures are discussed in Section 10.11. Implementation of the program modifications provided in this HGMP, and the actions previously taken by the comanagers, are anticipated to contribute to the continued improvement in the abundance of listed salmonids.

Collection of steelhead broodstock takes place between December and early March oustide the return time of the spring, summer and fall chinook runs. No likely effects to "take" of listed chinook.

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

Not known.

-**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).**

Unknown (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.

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.

This hatchery, as well as other WDFW hatcheries within the Puget Sound Chinook ESU, operates under U.S v Washington and the Puget Sound Salmon Management Plan. This co-management process requires that both the State of Washington and the relevant Puget Sound Tribe(s) develop *Equilibrium Broodstock Programs* and to enter into agreement the function, purpose and release strategies of all hatchery programs.

In addition, WDFW hatchery programs in Puget Sound must adhere to a number of guidelines, policies and pemit 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 propagrated salmon (Hershberger and Iwamoto 1981).

Spawning Guidelines for Washington Department of Fisheries Hatcheries. Assembled to complement the above genetics manual, these guidelines define spawning criteria to be use to maintain genetic variability within the hatchery populations (Seidel 1983).

Stock Transfer Guidelines. This document provides guidance in detemining 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).

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, WSFWS 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.

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

Annual Skagit Salmon Management M.O.U. between Skagit co-managers (S.S.C. & WDFW). Co-managers' Future Brood Document.

3.3) Relationship to harvest objectives.

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.

Skagit River and north Puget Sound saltwater (mainly west Whidbey Island) recreational and tribal commercial net fishery.

3.4) Relationship to habitat protection and recovery strategies.

The comanagers resource management plans for artificial production in Puget Sound are expected to be one component of a recovery plan for Puget Sound chinook under development through the Shared Strategy process. Several important analyses have been completed, including the identification of populations of Puget Sound chinook, but further development of the plan may result in an improved understanding of the habitat, harvest, and hatchery actions required for recovery of Puget Sound chinook.

3.5) Ecological interactions.

The program described in this HGMP interacts with the biotic and abiotic components of the freshwater, estuarine, and marine salmonid ecosystem through a complex web of short and longterm processes. The complexity of this web means that secondary or tertiary interactions (both positive and negative) with listed species could occur in multiple time periods, and that evaluation of the net effect can be difficult. WDFW is not aware of any studies that have directly evaluated the ecological effects of this program. Alternatively, we provide in this section a brief summary of empirical information and theoretical analyses of three types of ecological interactions, nutrient enhancement, predation, and competition, that may be relevant to this program. Recent reviews by Fresh (1997), Flagg et al. (2000), and Stockner (2003) can be consulted for additional information; NMFS (2002) provides an extensive review and application to ESA permitting of artificial production programs.

Nutrient Enhancement

Adults originating from this program that return to natural spawning areas may provide a source of nutrients in oligotrohic coastal river systems and stimulate stream productivity. Many watersheds in the Pacific Northwest appear to be nutrient-limited (Gregory et al. 1987; Kline et al. 1997) and salmonid carcasses can be an important source of marine derived nutrients (Levy 1997). Carcasses from returning adult salmon have been found to elevate stream productivity through several pathways, including:

1) the releases of nutrients from decaying carcasses has been observed to stimulate primary productivity (Wipfli et al. 1998); 2) the decaying carcasses have been found to enrich the food base of aquatic invertebrates (Mathisen et al. 1988); and 3) juvenile salmonids have been observed to feed directly on the carcasses (Bilby et al. 1996). Addition of nutrients has been observed to increase the production of salmonids (Slaney and Ward 1993; Slaney et al. 2003; Ward et al. 2003).

Predation Freshwater Environment

Coho and steelhead released from hatchery programs may prey upon listed species of salmonids, but the magnitude of predation will depend upon the characteristic of the listed population of salmonids, the habitat in which the population occurs, and the characteristics of the hatchery program (e.g., release time, release location, number released, and size of fish released). The site specific nature of predation, and the limited number of empirical studies that have been conducted, make it difficult to predict the predation effects of any specific hatchery program. WDFW is unaware of any studies that have empirically estimated the predation risks to listed species posed by the program described in this HGMP.

In the absence of site-specific empirical information, the identification of risk factors can be a useful tool for reviewing hatchery programs while monitoring and research programs are developed and implemented. Risk factors for evaluating the potential for significant predation include the following:

Environmental Characteristics. Water clarity and temperature, channel size and configuration, and river flow are among the environmental characteristics that can influence the likelihood that predation will occur (see SWIG (1984) for a review). The SIWG (1984) concluded that the potential for predation is greatest in small streams with flow and turbidity conditions conducive to high visibility.

Relative Body Size. The potential for predation is limited by the relative body size of fish released from the program and the size of prey. Generally, salmonid predators are thought to prey on fish approximately 1/3 or less their length (USFWS 1994), although coho salmon have been observed to consume juvenile chinook salmon of up to 46% of their total length (Pearsons et al. 1998). The lengths of juvenile migrant chinook salmon originating from natural production have been monitored in numerous watersheds throughout Puget Sound, including the Skagit River , Stillaguamish River, Bear Creek, Cedar River, Green River, Puyallup River, and Dungeness River. The average size of migrant chinook salmon is typically 40mm or less in February and March, but increases in the period from April through June as emergence is completed and growth commences (Table 3.5.1). Assuming that the prey item can be no greater than 1/3 the length of the predator, Table 3.5.1 can be used to determine the length of predator required to consume a chinook salmon of average length in each time period. The increasing length of natural origin juvenile chinook salmon from March through June indicates that delaying the release hatchery smolts of a fixed size will reduce the risks associated with predation.

Table 3.5.1. Average length by statistical week of natural origin juvenile chinook salmon migrants captured in traps in Puget Sound watersheds. The minimum predator length corresponding to the average length of chinook salmon migrants, assuming that the prey can be no greater than 1/3 the length of the predator, are provided in the final row of the table. (NS: not sampled.)

Watershed	Statistical Week										
	16	17	18	19	20	21	22	23	24	25	26
Skagit [1] 1997-2001	43.2	48.3	50.6	51.7	56.1	59.0	58.0	60.3	61.7	66.5	68.0
Stillaguamish [2] 2001-2002	51.4	53.5	55.7	57.8	60.0	62.1	64.2	66.4	68.5	70.6	72.8
Cedar [3] 1998-2000	54.9	64.2	66.5	70.2	75.3	77.5	80.7	85.5	89.7	99.0	113
Green [4] 2000	52.1	57.2	59.6	63.1	68.1	69.5	NS	79.0	82.4	79.4	76.3
Puyallup [5] 2002	NS	NS	NS	66.2	62.0	70.3	73.7	72.7	78.7	80.0	82.3
Dungeness [6] 1996-1997	NS	NS	NS	NS	NS	NS	NS	NS	77.9	78.8	81.8
All Systems Average Length	50.4	55.8	58.1	61.8	64.3	67.7	69.2	72.8	76.5	79.0	82.4
Minimum Predator Length	153	169	176	187	195	205	210	221	232	239	250

Sources:

[1] Data are from Seiler et al. (1998); Seiler et al. (1999); Seiler et al. (2000); Seiler et al. (2001), and Seiler et al. (2002)..

[2] Data are from regression models presented in Griffith et al. (2001) and Griffith et al. (2003).

[3] Data are from Seiler et al. (2003).

[4] Data are from Seiler et. (2002).

[5] Data are from Samarin and Sebastian (2002).

[6] Data are from Marlowe et al. (2001).

Date of Release. The release date of juvenile fish for the program can influence the likelihood that listed species are encountered or are of a size that is small enough to be consumed. The most extensive studies of the migration timing of naturally produced juvenile chinook salmon in the Puget Sound ESU have been conducted in the Skagit River, Bear Creek, Cedar River, and the Green River. Although distinct differences are evident in the timing of migration between watersheds, several general patterns are beginning to emerge:

1) Emigration occurs over a prolonged period, beginning soon after enough emergence (typically January) and continuing at least until July;
2) Two broad peaks in migration are often present during the January through July time period; an early season peak (typically in March) comprised of relatively small chinook salmon (40-45mm), and a second peak in mid-May to June comprised of larger chinook salmon;
3) On average, over 80% of the juvenile chinook have migrated past the trapping locations after statistical week 23 (usually occurring in the first week of June).

Table 3.5.2. Average cumulative proportion of the total number of natural origin juvenile chinook salmon migrants estimated to have migrated past traps in Puget Sound watersheds.

Watershed	Statistical Week										
	16	17	18	19	20	21	22	23	24	25	26
Skagit [1] 1997-2001	0.61	0.64	0.68	0.73	0.76	0.78	0.83	0.86	0.90	0.92	0.94
Bear [2] 1999-2000	0.26	0.27	0.28	0.32	0.41	0.52	0.73	0.84	0.92	0.96	0.97
Cedar [2] 1999-2000	0.76	0.76	.0.76	0.77	0.79	0.80	0.82	0.84	0.87	0.88	0.90
Green [3] 2000	0.63	0.63	0.64	0.69	0.77	0.79	0.84	0.86	0.88	0.98	1.00
All Systems Average	0.56	0.58	0.59	0.63	0.68	0.72	0.80	0.85	0.89	0.94	0.95

Sources:

[1] Data are from Seiler et al. (1998); Seiler et al. (1999); Seiler et al. (2000); Seiler et al. (2001), and Seiler et al. (2002)..

[2] Data are from Seiler et al. (2003).

[3] Data are from Seiler et. (2002).

Release Location and Release Type. The likelihood of predation may also be affected by the location and type of release. Other factors being equal, the risk of predation may increase with the length of time the fish released from the artificial production program are commingled with the listed species. In the freshwater environment, this is likely to be affected by distribution of the listed species in the watershed, the location of the release, and the speed at which fish released from the program migrate from the watershed.

Coho salmon and steelhead released from western Washington artificial production programs as smolts have typically been found to migrate rapidly downstream. Data from Seiler et al. (1997; 2000) indicate that coho smolts released from the Marblemount Hatchery on the Skagit River migrate approximately 11.2 river miles day. Steelhead smolts released onstation may travel even more rapidly migration rates of approximately 20 river miles per day have been observed in the Cowlitz River (Harza 1998). However, trucking fish to offstation release sites, particularly release sites located outside of the watershed in which the fish have been reared, may slow migrations speeds (Table 3.5.3).

Table 3.5.3. Summary of travel speeds for steelhead smolts for several types of release strategies.

Location	Release Type	Migration Speed (river miles per day)	Source
Cowlitz River	Smolts, onstation	21.3	Harza (1998)
Kalama River	Trucked from facility located within watershed in which fish were released.	4.4	Hulett (pers. comm.)
Bingham Creek	Trucked from facility located outside of watershed in which fish were released.	0.6	
Stevens Creek	Trucked from facility located outside of watershed in which fish were released.	0.5	
Snow Creek	Trucked from facility located outside of watershed in which fish were released.	0.4	

Number Released. Increasing the number of fish released from an artificial production program may increase the risk of predation, although competition between predators for prey may eventually limit the total consumption (Peterman and Gatto 1978).

Predation Marine Environment
WDFW is unaware of any studies that have empirically estimated the predation risks to listed species posed by the program described in this HGMP. NMFS (2002) reviewed existing information on the risks of predation in the marine environment posed by artificial production programs and concluded:

1) Predation by hatchery fish on natural-origin smolts or sub-adults is less likely to occur than predation on fry. Coho and chinook salmon, after entering the marine environment, generally prey upon fish one-half their length or less and consume, on average, fish prey that is less than one-fifth of their length (Brodeur 1991). During early marine life, predation on natural origin chinook, coho, and steelhead will likely be highest in situations where large, yearling-sized hatchery fish encounter sub-yearling fish or fry (SIWG 1984).

2) However, extensive stomach content analysis of coho salmon smolts collected through several studies in marine waters of Puget Sound, Washington do not substantiate any indication of significant predation upon juvenile salmonids (Simestad and Kinney 1978).

3) Likely reasons for apparent low predation rates on salmon juveniles, including chinook, by larger chinook and other marine predators are described by Cardwell and Fresh (1979). These reasons included: 1) due to rapid growth, fry are better able to elude predators and are accessible to a smaller proportion of predators due to size alone; 2) because fry have dispersed, they are present in low densities relative to other fish and invertebrate prey; and 3) there has either been learning or selection for some predator avoidance.

Competition
WDFW is unaware of any studies that have empirically estimated the competition risks to listed species posed by the program described in this HGMP. Studies conducted in other areas indicate that this program is likely to pose a minimal risk of competition:

1) As discussed above, coho salmon and steelhead released from hatchery programs as smolts typically migrate rapidly downstream. The SIWG (1984) concluded that migrant fish will likely be present for too short a period to compete with resident salmonids.
2) NMFS (2002) noted that ..where interspecific populations have evolved sympatrically, chinook salmon and steelhead have evolved slight differences in habitat use patterns that minimize their interactions with coho salmon (Nilsson 1967; Lister and Genoe 1970; Taylor 1991). Along with the habitat differences exhibited by coho and steelhead, they also show differences in foraging behavior. Peterson (1966) and Johnston (1967) reported that juvenile coho are surface oriented and feed primarily on drifting and flying insects, while steelhead are bottom oriented and feed largely on benthic invertebrates.

3) Flagg et al. (2000) concluded, By definition, hatchery and wild salmonids will not compete unless they require the same limiting resource. Thus, the modern enhancement strategy of releasing salmon and steelhead trout as smolts markedly reduces the potential for hatchery and wild fish to compete for resources in the freshwater rearing environment. Miller (1953), Hochachka (1961), and Reimers (1963), among others, have noted that this potential for competition is further reduced by the fact that many hatchery salmonids have developed different habitat and dietary behavior than wild salmonids. Flagg et al (2000) also stated It is unclear whether or not hatchery and wild chinook salmon utilize similar or different resources in the estuarine environment.
4) Fresh (1997) noted that Few studies have clearly established the role of competition and predation in anadromous population declines, especially in marine habitats. A major reason for the uncertainty in the available data is the complexity and dynamic nature of competition and predation; a small change in one variable (e.g., prey size) significantly changes outcomes of competition and predation. In addition, large data gaps exist in our understanding of these interactions. For instance, evaluating the impact of introduced fishes is impossible because we do not know which nonnative fishes occur in many salmon-producing watersheds. Most available information is circumstantial. While such information can identify where inter- or intra specific relationships may occur, it does not test mechanisms explaining why observed relations exist. Thus, competition and predation are usually one of several plausible hypotheses explaining observed results.

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.

Water for the Barnaby Slough rearing facility is provided by water from Barnaby Slough, Harrison Slough and from 5 wells. Barnaby Slough can provide 4,221 gallons per minute (gpm). The wells can provide 350 gpm and 3,000 gpm from Harrison.

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.

The hatchery intakes at the facility conform with NMFS screening guidelines to minimize the risk of entrainment of juvenile listed fish. There are no chinook passed above the Barnaby Slough intake.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Fish enter over a finger weir and enter into a 50' X 10' X 3' raceway.

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

NA

5.3) Broodstock holding and spawning facilities.

A 50' X 10' X 3' raceway.

5.4) Incubation facilities.

NA (at Marblemount Hatchery)

5.5) Rearing facilities.

A ~ 1 acre earthen pond and two 5' X 50' X 2.5' raceways.

5.6) Acclimation/release facilities.

At Barnaby Slough, fish are reared and acclimated in a ~ 1 acre earthen pond.

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

Flooding

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.

Hatchery crew is on stand-by at all times. All parts of the hatchery facility are equipped with low water alarms. All tools are disinfected between ponds. At acclimation site fish are held only 3-5 days.

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.

Fish returning to the trap at Barnaby Slough.

6.2) Supporting information.

6.2.1) History.

The stock is of locally adapted Chambers Creek stock and is segregated from the wild population genetically and temporally.

6.2.2) Annual size.

400 adults (approximate total needed for both programs: Marblemount & Barnaby Slough).

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

Past levels are unknown, but present levels are hatchery origin adults.

6.2.4) Genetic or ecological differences.

See 6.2.1

6.2.5) Reasons for choosing.

A locally adapted stock.

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.

NA

SECTION 7. BROODSTOCK COLLECTION

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

Adults

7.2) Collection or sampling design.

Adult steelhead are trapped volitionally, from December 1 to February 28th, in the adult trap located at the outlet of the large rearing pond. All fish are sampled for adipose clips and only these are used for broodstock.

7.3) Identity.

All adults returning to the trap are adipose-fin clipped.

7.4) Proposed number to be collected:

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

400 adults (200:200)

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

Year	Adults Females	Males	Jacks	Eggs	Juveniles
1988					
1989					
1990					
1991					
1992					
1993					
1994					
1995	227	265		689,800	
1996	173	108		532,980	
1997	162	153		770,500	
1998	49	49		245,000	
1999	39	39		194,000	
2000	15	11		49,950	
2001	39	39		182,200	

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

Fish are recycled to lower Skagit River. Fish are also given to local tribes.

7.6) Fish transportation and holding methods.

NA

7.7) Describe fish health maintenance and sanitation procedures applied.

Formalin drip at 1:10,000 is applied to the pond for treatment of fungus. All tools are disinfected between each use. Follow standard protocols as defined in the Co-Managers Fish Health Manual.

7.8) Disposition of carcasses.

Edible carcasses are distributed to approved charitable organizations. Non-edible carcasses are used for local stream nutrient enhancement.

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.

NA

SECTION 8. MATING

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

8.1) Selection method.

Broodstock are selected randomly throughout the total run. Adults may be spawned on the day of capture if ripe.

8.2) Males.

5 fish pools.

8.3) Fertilization.

Eggs are spawned in 5 fish pools (5 males to 5 females) and shipped, in bags on ice, to Marblemount Hatchery for fertilization.

8.4) Cryopreserved gametes.

NA

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.

NA

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.

NA

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

NA

9.1.3) Loading densities applied during incubation.

NA

9.1.4) Incubation conditions.

NA

9.1.5) Ponding.

NA

9.1.6) Fish health maintenance and monitoring.

NA

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.

NA

9.2) Rearing:

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..

Fingerling to smolt survival average is 96%.

9.2.2) Density and loading criteria (goals and actual levels).

Maintain a flow index of 2.1 or lower and a maximum density index of .20.

9.2.3) Fish rearing conditions

The rearing pond is supplied by a mix of spring and surface water.

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.

Not available

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

Not available

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*).

These fish are fed Moore-Clark Nutra Fry until about 100 fish per pound (fpp) then switched to Rangen's Steelhead dry pellet. Fish are started at about 4.3% B.W./day and finish up as smolts being fed about 1.2% B.W./day with an expected conversion rate of 80%.

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

All tools are disinfected between uses. All ponds are disinfected between uses. All loss is removed daily. Fish are checked every 3 weeks by fish pathologist. Treatments are made as prescribed by fish pathologist and the Co-Managers Fish Health Manual..

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

NA

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

Fish are reared in an semi-natural rearing pond.

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.

NA

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry				
Fry				
Fingerling				
Yearling	200,000	6	May 1-15	Skagit River

10.2) Specific location(s) of proposed release(s).

Stream, river, or watercourse: Skagit River
Release point: Barnaby Slough (RM 70.2), Grandy Creek/Fabors Ferry (RM 68)
Major watershed: Skagit River
Basin or Region: Puget Sound

10.3) Actual numbers and sizes of fish released by age class through the program.

Release year	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Yearling	Avg size
1988								
1989								
1990								
1991								
1992								
1993								
1994								
1995							224,900	6
1996							223,996	6
1997							190,000	7
1998							200,000	6
1999							184,000	6
2000							185,000	5
2001							195,000	6
Average							200,414	6

10.4) Actual dates of release and description of release protocols.

Fish are released between May 1 and May 15.

10.5) Fish transportation procedures, if applicable.

NA

10.6) Acclimation procedures

At Barnaby Slough, fish are reared and acclimated in a ~ 1 acre earthen pond.

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

Fish are 100% adipose clipped to allow differentiation with wild steelhead.

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

NA

10.9) Fish health certification procedures applied pre-release.

All fish are checked by the Fish Health Specialist prior to release.

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

NA

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.

To minimize the risk of residualization and impact upon natural fish, hatchery yearlings are released in May as smolts and only in the Skagit River watershed. All fish released are mass marked.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

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.

The comanagers conduct numerous ongoing monitor programs, including catch, escapement, marking, tagging, and fish health testing. The focus of enhanced monitoring and evaluation programs will be on the risks posed by ecological interactions with listed species. WDFW is proceeding on four tracks:

1) An ongoing research program conducted by Duffy et al. (2002) is assessing the nearshore distribution, size structure, and trophic interactions of juvenile salmon, and potential predators and competitors, in northern and southern Puget Sound. Funding is provided through the federal Hatchery Scientific Review Group.

2) A three year study of the estuarine and early marine use of Sinclair Inlet by juvenile salmonids is nearing completion. The project has four objectives:

a) Assess the spatial and temporal use of littoral habitats by juvenile chinook throughout the time these fish are available in the inlet;

b) Assess the use of offshore (i.e., non-littoral) habitats by juvenile chinook;

c) Determine how long cohorts of juvenile chinook salmon are present in Sinclair inlet;

d) Examine the trophic ecology of juvenile chinook in Sinclair Inlet. This will consist of evaluating the diets of wild chinook salmon and some of their potential predators and competitors. Funding is provided by the USDD-Navy.

3) WDFW is developing the design for a research project to assess the risks of predation on listed species by coho salmon and steelhead released from artificial production programs. Questions which this project will address include:

a) How does trucking and the source of fish (within watershed or out of watershed) affect the migration rate of juvenile steelhead?

b) How many juvenile chinook salmon of natural origin do coho salmon and steelhead consume?

c) What is the rate of residualism of steelhead in Puget Sound rivers?

Funding needs have not yet been quanitifed, but would likely be met through a combination of federal and state sources.

4) WDFW is assisting the Hatchery Scientific Review Group in the development of a template for a regional monitoring plan. The template will provide an integrated assessment of hatchery and wild populations.

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

See Section 11.1.1

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.

Risk aversion measures will be developed in conjunction with the monitoring and evaluation plans.

SECTION 12. RESEARCH

12.1) Objective or purpose.

12.2) Cooperating and funding agencies.

12.3) Principle investigator or project supervisor and staff.

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

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

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

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

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

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).

12.10) Alternative methods to achieve project objectives.

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

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.

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

I hereby certify that the foregoing information 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 salmonid take levels of by hatchery activity.

Listed species affected: Chinook ESU/Population: Puget Sound Activity: Barnaby Slough Rearing Pond				
Location of hatchery activity: Barnaby Slough Pond(Skagit R.) Dates of activity: December to May Hatchery program operator: WDFW				
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)				
Collect for transport b)				
Capture, handle, and release c)				
Capture, handle, tag/mark/tissue sample, and release d)				
Removal (e.g. broodstock) e)				
Intentional lethal take f)				
Unintentional lethal take g)		Unknown		
Other Take (specify) h)				

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.