HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

DRAFT

Hatchery Program	Washougal Hatchery Chum Salmon Program
Species or Hatchery Stock	Columbia River Chum Salmon Evolutionary Significant Unit (ESU) (*Oncorhynchus keta*)
Agency/Operator	Washington Department of Fish and Wildlife
Watershed and Region	Washougal and Lower Columbia River Gorge Population
Date Submitted	nya
Date Last Updated	August 13, 2004

Section 1: General Program Description

1.1 Name of hatchery or program.

Washougal Hatchery Chum Salmon Program

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

Onchorhynchus keta

ESA Status: Threatened

1.3 Responsible organization and individuals.

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

The Washington Department of Fish and Wildlife (WDFW) will provide general oversight, supervise brood stock collection, spawning, rearing, incubation and final report writing. The Pacific States Marine Fisheries Commission (PSMFC) will provide a biologist and technician for brood stock collection, spawning, incubating, rearing and data analyses. In addition, PSMFC will maintain and monitor the contract and budgets.

In the mainstem Columbia just below Bonneville Dam, several agencies under Bonneville Power Administration funding are evaluating the spawning success of chum salmon found there. Oregon and Washington departments of fish and Wildlife, USF&WS, U.S Geological Survey, and Pacific Northwest Battelle Laboratory have joined together to collect life history and habitat use data for fall chinook and chum salmon below the four lowermost Columbia River mainstem dams so the hydrosystem can be managed in a manner to protect and/or enhance these spawning populations.

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

Funding Sources
Bonneville Power Administration (BPA)

This HGMP is a combination of the Duncan Creek reintroduction program and salvage plan for the Washougal and Lower Gorge populations. The Bonneville Power Administration (BPA) funds this project. The overall contract is for $382,000 and includes 2.8 FTE's. The budget includes costs for the salvage and reintroduction efforts and supports hatchery program staff plus pays for feed costs. Approximately 1.3 FTEs are associated with the hatchery program. WDFW provides in-kind contributions that include space, power, incubation facilities and thermal marking equipment.

1.5 Location(s) of hatchery and associated facilities.

Broodstock source	Washougal/Duncan Creek Chum
Broodstock collection location (stream, RKm, subbasin)	Hardy Creek (WRIA 28.0302) which enters the Columbia River at River Mile RM 142, Hamilton Creek (WRIA 28.0303) which also enters the Columbia River at RM 142, Duncan Creek (WRIA 28.0296) which enters the Columbia River at RM 140.5, and areas in the mainstem Columbia River from Ives Island (RM 142) downstream to the I-205 Bridge at RM 112.
Adult holding location (stream, RKm, subbasin)	Washougal Hatchery/Washougal River/RKm 32.2/Washougal
Spawning location (stream, RKm, subbasin)	Washougal Hatchery/Washougal River/RKm 32.2/Washougal
Incubation location (facility name, stream, RKm, subbasin)	Washougal Hatchery/Washougal River/RKm 32.2/Washougal
Rearing location (facility name, stream, RKm, subbasin)	Washougal Hatchery/Washougal River/RKm 32.2/Washougal

1.6 Type of program.

Integrated Recovery program that utilizes supplementation and re-introduction strategies.

1.7 Purpose (Goal) of program.

This HGMP is a combination of the Duncan Creek reintroduction program and salvage plan for the Washougal and Lower Gorge populations. The goal of the Duncan Creek reintroduction program is to establish a self-sustaining population. This will be accomplished by a combination of juvenile supplementation and releases of wild chum salmon adults into renovated spawning habitat located in Duncan Creek. The goal of the salvage operation is to reduce the extinction risk of Lower Gorge and Washougal chum populations caused by hydropower operations. The approach used here is similar to that being employed at Duncan Creek. Wild adults will be captured and released into tributaries to spawn naturally in those years when the Columbia River flow forecast places this population at risk. Some adults will also be artificially spawned and their offspring will be reared and released back into the natural environment. Both programs have monitoring and evaluation components to evaluate the effectiveness of these strategies.

1.8 Justification for the program.

Duncan Creek was historically an important spawning area for chum salmon. In 1963, a dam and culvert were placed near the mouth of the creek. Chum returns rapidly declined and by 1969 no chum were found in the basin. The reintroduction program calls for eggs to be collected primarily from the Lower Gorge chum salmon population (e.g. Hardy and Hamilton Creeks, and the mainstem Columbia River), incubated at the Washougal Hatchery, and liberated into Duncan Creek after a short rearing period.

The reintroduction efforts into Duncan Creek will examine the utility of juvenile supplementation. All chum eggs imported into the system will be thermally marked making it possible to identify these fish at the adult stage. The number of adult chum salmon originating

from strays and from reared fry imported into Duncan Creek will be determined by examining otoliths collected from adult carcasses making it possible for us to evaluate the relative contribution rates of artificially introduced fish and natural strays returning to the Duncan Creek site. In addition, we will attempt to mark, via strontium immersion, the chum fry produced by the adults that were allowed to naturally spawn in Duncan Creek. Once they return, their contribution to the Duncan Creek population will also be determined. The newly established habitat and our reintroduction efforts will provide clear survival benefits to Columbia chum salmon returning to the Bonneville area. The results obtained from this project can also be used as a template for future chum salmon reintroduction and supplementation efforts in the Columbia Basin. Drought and hydro-system water management are the primary factors influencing chum salmon spawning and incubation success in the Lower Gorge and Washougal populations. The salvage plan is in place to preserve the genetic diversity of lower Columbia River chum salmon; specifically the Lower Gorge and Washougal populations. It achieves this objective by ensuring that adequate numbers of returning adults survive to spawn successfully, either naturally or artificially. The Lower Gorge population is most at risk because low water may create a complete barrier for fish passage into Hamilton and Hardy Creeks. Moreover, low water may eliminate or substantially reduce mainstem spawning in the Ives Island area, another important spawning location for this population. In some years it is uncertain if adequate mainstem Columbia River flows can be maintained throughout the entire incubation and emergence period. Without intervention, these populations will have access to a very restricted spawning area. Consequently, redd superimposition may occur due to overcrowding. In some years redds may also be dewatered which would lead to high pre-emergent mortality. Under extreme conditions these and related factors may cause brood year failures.

In order to minimize impact on listed fish by WDFW facilities operation and programs involved in the Columbia River Chum recovery program. The following Risk Aversion are included in this HGMP:

Table 1. Summary of risk aversion measures for the Lower Columbia River Chum recovery program

Potential Hazard	HGMP Reference	Risk Aversion Measures
Water Withdrawal	4.2	Washougal water rights are formalized thru trust water right S2-23896 from the Department of Ecology. Monitoring and measurement of water usage is reported in monthly NPDES reports.
Intake Screening	4.2	WDFW has requested funding for future scoping, design, and construction work of a new river intake system to meet NOAA compliance at Washougal (Mitchell Act Intake and Screening Assessment 2002).
Effluent Discharge	4.2	Washougal operates under the "Upland Fin-Fish Hatching and Rearing" National Pollution Discharge Elimination System (NPDES) administered by the Washington Department of Ecology (DOE) - WAG 13-1008.
Broodstock Collection & Adult Passage	7.9	1. Broodstock are collected per scientific protocols. 2. Collection is from the river and adults not affected disperse thru-out the system to spawn.
Disease Transmission	7.9, 10.11	*Fish Health Policy in the Columbia Basin*. Details hatchery practices and operations designed to stop the introduction and/or spread of any diseases within the Columbia Basin. Also, *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (Genetic Policy Chapter 5, IHOT 1995).
Competition & Predation	See also 2.2.3, 10.11	Current risk aversions and future considerations are being reviewed and evaluated for further minimizing impacts to listed fish.

1.9 List of program "Performance Standards".

(from NPPC *"Artificial Propagation Performance Standard and Indicators*)

1. Restore and Create Viable Natural Spawning Populations
2. Conservation of Genetic and Life History Diversity
    1. Genetic Characteristics
    2. Life History Characteristics
3. Research Activities
4. Operation of Artificial Production Facilities

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

Performance indicators addressing benefits

1. Program contributes to spawning populations
    - 1.1 The numbers of returning adults produced by the program will be documented and their relative contribution to the overall spawning population will be measured.
    - 1.2 Release groups will be 100% marked to assess impacts.
    - 1.3 Egg-to-fry and smolt-to-adult survival rates of the fish incubated and reared at the Washougal Hatchery will be significantly higher than those

experienced by fish produced from chum salmon spawning naturally in the Bonneville area.

1.4 Fecundity estimates by age will be generated and used to estimate the number of eggs deposited by naturally spawning chum salmon.

1.5 The re-introduction of chum salmon into Duncan Creek, including utilizing the newly restored channels, will be accelerated versus natural re-colonization.

Performance indicators addressing risks

1. Program contributes to spawning population
   - 1.1 Monitor escapement of non-supplemented populations to determine the level of straying of supplementation origin fish to other drainages.

2. Conservation of Genetic and Life History Diversity
   - 2.1 The minimum goal for spawning (30 pairs) protects genetic diversity
   - 2.2 Timing of broodstock collection is documented and compared to entire run
   - 2.3 Capturing brood stock throughout the entire run protects the genetic diversity and temporal integrity of the Lower Gorge chum population.
   - 2.4 A factorial mating scheme is being employed to minimize the effects of genetic drift and inbreeding depression.
   - 2.5 Baseline data collected on the genetic, phenotypic and ecological characteristics of population will be used to assess inadvertent domestication.
   - 2.6 Life history characteristics of both natural- and hatchery-origin adults will be documented and monitored for any changes in the genetic, phenotypic, or ecological characteristics of the populations (target and non-target) to evaluate the effects of the supplementation/reintroduction programs.
   - 2.7 Genetic material will be collected from broodstock and natural spawning adults to profile the population.
3. Research Activities
   - 3.1 Scientifically based evaluation and monitoring plan with measurable objectives and hypotheses has been developed and is being followed.
   - 3.2 The Monitoring and Evaluation plan includes timelines and guidelines for project completion.
   - 3.3 Annual and final reports are produced.
4. Operation of Artificial Production Facilities
   - 4.1 Artificial propagation facilities are operated in compliance with all applicable operational and fish health standards and protocols that are documented in annual reports.
   - 4.2 Discharge water complies with applicable water quality standards.
   - 4.3 Broodstock collection does not significantly impede passage or alter spatial/temporal distribution of natural population.
   - 4.4 Observations and mortality rates will be documented at weirs or traps to ensure that they do not cause any significant stress/injury/mortality to the natural population.
   - *4.5* Fry are monitored for disease prior to release to prevent introduction of pathogens into natural production areas.

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

For juvenile supplementation we expect that a minimum of 30 to a maximum of 150 adult pairs would be collected for reintroduction at Duncan Creek. For the salvage plan 30 to 150 pairs will be collected.

Both the reintroduction and salvage plans have an adult collection and release component. The recently renovated Duncan Creek channels can hold up to 360 adult pairs, which is the maximum number of fish that would be collected and released. Assuming half of these fish are females, approximately 1,080,000 eggs could be deposited. Egg-to-fry survival rates in spawning channels are typically at least two times higher than riverine sites. In 2003, the egg to fry survival was approximately 40%; this would result in 432,000 naturally produced fry.

If the salvage plan is implemented, it is likely that artificial production would be the common strategy because in the short-term it may be the most risk-averse strategy. However, there is at least one situation where the collection and release of adults for spawning may have a high level of success. This occurs when tributaries are forecast to have adequate spawning and incubation flows but access to them is restricted due to low flows in the Columbia River mainstem. We are not aware that this situation has occurred, but if it does we could potentially collect up to 1,000 adults. These fish would be distributed in such a manner that the carrying capacity of each tributary would not be exceeded.

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

The juvenile supplementation program calls for reintroduction releases of up to 405,000 (Table 1) and a salvage plan release of up to 324,000 (Table 2). It is likely that WDFW could not fully implement both programs simultaneously, because of limited resources for adult collection and rearing. Therefore, the maximum for the combined program is likely to be 405,000 juveniles.

Table 1. Estimated juvenile releases for the Duncan Creek reintroduction program.

Life Stage	Release Location	Annual Release Level
Fry	Duncan Creek	81,000 – 405,000

Table 2. Estimated juvenile releases for the salvage plan

Life Stage	Release Location	Annual Release Level
Fry	Hardy Creek Hamilton Creek Duncan Creek Mainstem Columbia near Ives Island	up to 81,000 up to 81,000 up to 81,000 up to 81,000

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

This is a new program. Thermally marking all the fry produced by the project will allow us to monitor their fry-to-adult survival and distribution patterns. The number and size of the fry released and the post-release environmental conditions the fish encounter will affect the number of adult fish produced. Unfed fry-to-adult survival rates in this species typically range from 0.3 to 3% (Salo 1991). Rearing the fish until they reach a gram or larger may significantly increase their survival by one percent or more (Fresh et al. 1980; Kaeriyama 1989; Salo 1991; Fuss and Hopley 1991).

We are unaware of any data that estimates the fry-to-adult survival rates of reared Lower Columbia River chum salmon. However, such data should be forthcoming as adult returns from reared fry are currently occurring in the Grays and Chinook Rivers. Such survival values are likely to be higher than that achieved by reared-chum released into Bonneville tributaries since the fish released into the Grays and Chinook Rivers are closer to the ocean and less exposed to Columbia River predators. If reared fry-to-adult survival rates equal 0.25%, then between 202 and 1,010 adults would return from the releases of reared chum fry made in the Bonneville region. In addition, we estimate that up to 808 chum salmon adults could be produced from a fully implemented salvage plan. Since resources are not available to fully implement both a re-introduction and salvage plan, we expect both programs to produce a combined maximum return of 1,010 adults.

Moreover, using the 0.25% fry-to-adult survival rate, up to 1,080 adults could be produced from naturally spawning fish released into the restored Duncan Creek channels if it was fully seeded.

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

This program was initiated in November 2001 and has operated for two years

1.14 Expected duration of program.

Re-introduction efforts into Duncan Creek will last for 12 years or for three complete generations, unless a self-sustaining population is established earlier. Salvage operations would only take place during those years when mainstem flows are low enough to prevent Lower Gorge chum from successfully utilizing traditional spawning sites or when flows have restricted the size of such areas to such an extent that overcrowding is expected to occur. An annual review of tributary and mainstem flows would occur to ascertain whether such a program should be instituted.

1.15 Watersheds targeted by program.

Duncan Creek (28.0296)
Hardy Creek (28.0302)
Hamilton Creek (28.0303)
Mainstem Columbia (28.0001)

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

<u>Duncan Creek reintroduction program</u>
We considered natural re-colonization, juvenile reintroduction, and adult reintroduction. Natural re-colonization of Duncan Creek is not a viable option. The abundance of chum salmon returning to spawn in Hamilton and Hardy Creeks is usually relatively small (often less than 400 adults per year). Natural re-colonization requires that some of these fish stray into the Duncan system and utilize it as a spawning site. Stream surveys made in this area from 1996 through 1999 indicated that one or no chum entered Duncan Creek during each of these years. For the past forty years a dam placed on Duncan Creek has prevented chum from using this stream as a spawning location. Prior to the placement of the dam, up to five hundred chum salmon spawned in seeps located in the Duncan drainage. Some of these seeps were renovated in 2001 and are now suitable spawning areas for chum salmon. The introduction of chum (either adults or fry) to these locations will expedite their use.

Since chum salmon in the Lower Columbia River ESU are listed as threatened under the ESA, extensive reintroduction and rebuilding programs need to be developed for tributaries to the Lower Columbia River. The monitoring and evaluation program for the Duncan Creek chum

salmon re-introduction effort will evaluate the success of both adult and juvenile release strategies and apply the results to other reintroduction programs. The current Duncan Creek program calls for releasing adults and hatchery reared juveniles in Duncan Creek. All hatchery juveniles are otolith marked. An adult sampling program will recover salmon carcasses and their otoliths. Since virtually no natural colonization has occurred, we expect that adults with unmarked otoliths will have originated from fish that were allowed to spawn in Duncan Creek. As mentioned above, however, plans are being developed, with help from the FDA/CVM, to allow us to mark all the naturally-produced fry originating from the renovated Duncan channel by using simple immersion in strontium chloride salts. When this occurs it will also be possible for us to document the fry-to-adult survival and distribution patterns of the chum salmon naturally produced in Duncan Creek in a more rigorous fashion.

Salvage Plan

If low flows continue to occur in the mainstem of the Columbia River the amount of useable spawning area for chum will decrease and overcrowding on the spawning grounds will occur. Two types of adult density occur on spawning grounds. One is referred to as instantaneous density and it equals the number of fish present at any given instant. High instantaneous densities ($\leq$1.5 m^2per female) cause high egg retentions and promote superimposition of redds (Schroder 1973); both significantly impair egg-to-fry survival rates. The other type of density is called overall density; and this is simply the total number of fish that utilize a particular location over the course of a single spawning season. When overall density is high, redd superimposition may occur and eggs can be destroyed by mechanical agitation or uplifted out of nests by the digging activities of later arriving females (Schroder 1977). The intent of the salvage operation described here is to allow chum to spawn at acceptable instantaneous and overall densities and thereby maximize the survival of naturally spawned eggs and also to maximize the survival of the eggs collected during the course of the brood stocking process. Finally, if droughts continue or hydro needs upstream supercede those for chum salmon below Bonneville Dam, there is a risk that incubation and rearing flows in the Columbia River and its tributaries may not be adequate in spawning areas that are traditionally used the Lower Gorge and Washougal chum salmon populations. The renovated habitat of Duncan Creek along with existing habitat in Hardy and Hamilton Creeks will provide an important refugia for these populations when such conditions occur. As with the reintroduction plan, we will evaluate both adult and juvenile release strategies.

Section 2: Program Effects on ESA-Listed Salmonid Populations

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

Permits for the operation of Washougal Hatchery were developed under the 1999 biological opinion on artificial propagation in the Columbia Basin. In response to low flow conditions in the fall of 2001, the Bonneville Power Administration (BPA), with the support of NMFS, requested that the Washington Department of Fish and Wildlife generate a chum salvage plan outlining potential options for emergency intervention. This resulted in a consultation re-initiation with the NMFS.

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

Chum salmon production in the Lower Columbia River has drastically declined over the past fifty years (WDF 1951; WDFW et al. 1993). Many lower Columbia River tributaries once produced chum. However, at present significant natural production appears to be limited to three areas: Grays River, the area just below Bonneville Dam (Hardy and Hamilton creeks and the area around Ives Island) and an area just upstream from the I-205 bridge (the Woods' and River Shore spawning areas). The Grays River population is considered depressed due to a long-term negative trend in spawning ground escapements (WDF et al. 1993) probably caused by dynamic stream flows that create unstable spawning and incubation habitats. Moreover, in 1999, a flood event in the Grays basin completely destroyed Gorley Springs; the one protected spawning location for chum salmon in the watershed. The loss of this important spawning and incubation refugia has decreased the capacity of this population to maintain itself.

Spawning ground counts made in Hardy and Hamilton creeks since the late 1950's indicate that they possess stable populations (WDF et. al. 1993). Chum salmon spawning in the mainstem Columbia River below Bonneville Dam were identified by Fulton (1968). These populations have not been monitored until recently and no historical data exist for them. Because of the generally low abundance of this species throughout the Columbia, NMFS listed Lower Columbia River chum as a "threatened" species under the auspices of the ESA in March of 1999.

The Duncan Creek subpopulation of the Lower Gorge population was extirpated by the late 1960's and this HGMP includes the Duncan Creek reintroduction program. The goal of this program is to re-establish a self-sustaining natural population in this watershed and to evaluate the effectiveness of adult and juvenile release strategies used in reintroduction.

Recent weather patterns created unusually low water levels in the Columbia River during the fall and winter periods of 2001-02 and similar low-flow episodes may occur in the future. These events may further threaten this species. Activities designed to alleviate the effects of low water flows on chum salmon are predicated on how much water may be available and when it will be released into the river. For example, as the fall season progresses and weather fronts move in, the potential water budget changes. Given this situation we developed an array of strategies that rely on current and forecasted water availability (Table 3). They have been arranged from the worst case (extremely low water) to the best possible case. It is likely too, that water levels in Hardy, Hamilton, Duncan creeks and the mainstem Columbia River may all differ and each stream will need to be evaluated individually. Below Table 3 is a more detailed summary of conditions.

reintroduction strategy, salvage strategy, and juvenile releases.

Table 3. Summary of strategies for Columbia River Chum Salmon salvage plan.

Case	Columbia River	Tributaries	Spawning Area	Strategy
1	low	low	low	Juvenile supplementation in the mainstem Columbia River and tributaries
2	low	low	adequate	Adult supplementation in tributaries and juvenile supplementation in the mainstem Columbia River
3	adequate	low	low	Juvenile supplementation in tributaries, and no action in the mainstem Columbia River
4	low	adequate	adequate	Juvenile supplementation in the mainstem Columbia River, and no action in tributaries
5	adequate	adequate	adequate	No intervention, rely on natural production, and monitor

Case 1

Conditions

Extreme low flows in the Mainstem Columbia River limit or prevent access to spawning areas near Ives Island. Flows in Hardy, Hamilton, and Duncan Creeks are very low, preventing access into the creeks themselves. Flows from springs/seeps are too low to support successful spawning. This is an extreme situation and artificial propagation is needed to minimize a brood year failure.

Re-Introduction Action:

Capture a total of 30 pairs of adult chum salmon for use in the Duncan Creek chum salmon re-introduction program. These fish may be collected from the mainstem Columbia River focusing on the Ives Island Area. Adults are taken to Washougal Hatchery for artificial spawning, incubation and rearing. Fed fry are released into Duncan Creek.

Salvage Action:

Capture a maximum of 120 adult pairs from the mainstem Columbia River focusing on the Ives Island Area. Transport adults to Washougal Hatchery for artificial spawning and rearing.

Juvenile Releases

Release fed fry into Hamilton, Hardy and Duncan creeks and near Ives Island in the mainstem Columbia. The capture of 150 females is expected to produce a take of 450,000 eggs. Eggs from each female will be divided into four treatment groups, allowing the progeny equivalent of 37 pairs to be replaced into each of the four release sites. Treatment groups will be differentially thermally marked for identification before release. We have taken this approach so that eggs from each of the females spawned will be incorporated into each release group thereby maximizing the genetic diversity of each release group.

Case 2

Conditions:

Extreme low flows in the Mainstem Columbia River limit or prevent access to spawning areas near Ives Island. Flows in Hardy, Hamilton, and Duncan Creeks are adequate to support successful spawning. However, Columbia River flows or low tributary flows prevent access to these tributaries. This is an extreme situation and artificial propagation is

needed to minimize the brood year failure.

Re-Introduction Action:
Capture a minimum of 60 pairs of adult chum salmon for use in Duncan Creek chum salmon re-introduction program. These fish may be collected from the mainstem Columbia River focusing on the Ives Island Area. A total of 30 adult pairs are taken to Washougal Hatchery for artificial spawning, incubation and rearing. Fed fry are released into Duncan Creek. The remaining adults are released above the Duncan Creek weirs for natural spawning

Salvage Actions:
Capture as many adult chum as possible that have entered the lower reaches of Hardy, Hamilton, and Duncan Creeks and possibly mainstem Columbia River and transport these fish across any existing anadromous barriers to spring/seep spawning areas, allowing them to spawn naturally. Adult densities in these tributaries would not exceed their spawning capacity. Capture additional pairs (30) of adult chum salmon from the mainstem Columbia River. Transport these adults to the Washougal Hatchery for artificial spawning and rearing. Release fed fry into Duncan Creek and the Ives Island area.

Juvenile Releases
Release fed fry into Duncan Creek and near Ives Island in the mainstem Columbia. Eggs from each female will be divided into two treatment groups, allowing the progeny equivalent of 30 pairs to be replaced into each of the two release sites. Treatment groups will be differentially thermally marked for identification before release. We have taken this approach so that eggs from each of the females spawned will be incorporated into each release group, maximizing the genetic diversity of each release group.

Case 3
Conditions:
Adequate flows in the mainstem Columbia River allow access to spawning areas. Flows in Hardy, Hamilton, and Duncan Creeks are very low and prevent access into the creeks themselves. Flows from springs/seeps are too low to support successful spawning. This is an extreme situation and artificial propagation is needed to minimize the brood year failure in Columbia River tributaries.

Re-Introduction Action:
Capture a minimum of 30 pairs of adult chum salmon for use in the Duncan Creek chum salmon re-introduction program. These fish may be collected from the mainstem Columbia River focusing on the Ives Island Area. A total of 30 adult pairs will be taken to the Washougal Hatchery for artificial spawning, incubation and rearing. Fed fry are released into Duncan Creek.

Salvage Actions:
Capture a maximum of 120 adult pairs from the mainstem Columbia River focusing on the Ives Island Area. Transport adults to Washougal Hatchery for artificial spawning and rearing.

Juvenile Releases
Release fed fry into Hamilton, Hardy and Duncan creeks and near Ives Island in the mainstem Columbia. The capture of 150 females is expected to produce a take of 450,000 eggs. Eggs from each female will be divided into four treatment groups, allowing the progeny equivalent of 37 pairs to be replaced into each of the four release sites. Treatment groups will be differentially thermally marked for identification before release. We have taken this approach so that eggs from each of the females spawned will be incorporated into

each release group, maximizing the genetic diversity of each release group.

Case 4
Conditions:
Low flows in the Mainstem Columbia River limit or prevent access to spawning areas near Ives Island. Densities in mainstem spawning areas exceed capacity. Flows in Hardy, Hamilton, and Duncan Creeks are adequate to support successful spawning and access to these spawning areas. Artificial propagation is needed to minimize the brood year failure.

Re-Introduction Action:
Capture a minimum of 60 pairs of adult chum salmon for use in Duncan Creek chum salmon re-introduction program. These fish may be collected from the mainstem Columbia River focusing on the Ives Island Area. A total of 30 adult pairs will be taken to Washougal Hatchery for artificial spawning, incubation and rearing. Fed fry will be released into Duncan Creek. The remaining adults will be released above the Duncan Creek weirs for natural spawning.

Salvage Actions:
Capture up to 120 adult chum pairs from the mainstem Columbia River. Transport these adults to the Washougal Hatchery for artificial spawning and rearing. Release fed fry into Duncan Creek and the Ives Island area. If adult densities in tributaries are below their spawning capacity, some adults may be placed in these spawning areas.
Juvenile Releases
Release fed fry into Duncan Creeks and near Ives Island in the mainstem Columbia. Eggs from each female will be divided into two treatment groups, allowing the progeny equivalent of 30 pairs to be replaced into each of the two release sites. Treatment groups will be differentially thermally marked for identification before release. We have taken this approach so that eggs from each of the females spawned will be incorporated into each release group, maximizing the genetic diversity of each release group.

Case 5
Conditions:
Flows in the mainstem Columbia River allow access to spawning areas in the Columbia River. Flows in Hardy, Hamilton, and Duncan Creeks are adequate to support successful spawning. Under these conditions, natural spawners should be able to replace themselves and the primary action strategy is natural production.

Re-Introduction Action:
Capture a minimum of 60 pairs of adult chum salmon for use in Duncan Creek chum salmon re-introduction program. These fish may be collected from the mainstem Columbia River focusing on the Ives Island Area. A total of 30 adult pairs are taken to Washougal Hatchery for artificial spawning, incubation and rearing. Fed fry are released into Duncan Creek. The remaining adults are released above the Duncan Creek weirs for natural spawning

Salvage Action:
No action is anticipated except to monitor natural spawning populations.

Juvenile Releases
Release fed fry into Duncan Creek. Eggs will be thermally marked and represent one treatment group, allowing the progeny equivalent of 30 pairs to be released at the Duncan Creek sites. As in the other cases, naturally produced fry originating from the Duncan channels will be marked by using strontium immersion. The fish will be held in 1000-ppm solutions of Strontium Chloride hexahydrate for four hours. They will be liberated into Duncan Creek at darkness the same day they are marked.

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

Columbia River chum mature at ages 3, 4-, and 5 with a few maturing at age six; typically most return as 4-year olds. Usually Columbia River chum return to freshwater in late October and November and spawn in November and December. Chum salmon are primarily produced in the Grays River, in the Lower Gorge (Hardy and Hamilton Creeks and mainstem Columbia River from Bonneville Dam downstream to the mouth of the Washougal River), and the Washougal (Washougal River and mainstem Columbia between mouth of the Washougal and Lewis Rivers) (WDFW/ODFW 2000). Juvenile outmigration for chum salmon in Hardy, Hamilton, and Duncan Creeks commences in late February, peaks in March or April, and is completed in May.

Hatchery release strategies for the reintroduction and salvage plan are designed to minimize interactions with wild chum salmon. To achieve this WDFW has adopted a rearing strategy, where hatchery juveniles are reared to ~ 1 gram. This strategy produces large juveniles, which have optimum fry to adult survival. This strategy also limits ecological interactions with wild chum salmon since releases occur after the peak outmigration of wild juvenile chum salmon. Hatchery releases for the reintroduction program are made in the Columbia River at the mouth of Duncan Creek. Since this sub-population has been extirpated, there is little concern for ecological interactions.

2.2.2 Status of ESA-listed salmonid population(s) affected by the program.

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

Columbia River chum salmon *(Onchorhychus. ket*a) –
Mainstem Chum were listed as threatened under the ESA on March 25, 1999. The population affected by the program is the Columbia River Chum Salmon ESU. The stock affected by the reintroduction program is the Lower Gorge population. The two stocks that will be directly affected by the salvage plan are the Lower Gorge and Washougal Population.

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

All listed steelhead, chinook salmon, and chum salmon ESU in the Columbia River may be incidentally affected by the program. These include: Lower Columbia Steelhead, Lower Columbia chinook, Lower Columbia Chum, Mid Columbia Steelhead, Upper Columbia Steelhead, Upper Columbia Spring chinook, Snake River Sockeye, Snake River chinook, Snake River Steelhead, Willamette Steelhead and Willamette chinook.

Describe the status of the listed natural population (s) relative to "critical" and "viable" population thresholds.
Critical and viable population thresholds have not been established for the above ESU's and the populations within them. NMFS has formed a Lower Columbia River/Willamette River Technical Review Team to review population status within these ESU's and develop critical and viable population thresholds.

- 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.

Egg-to-fry and smolt-to-adult survival rates are not currently available for naturally produced chum salmon of the Bonneville population. The survival of Lower Columbia chum salmon artificially spawned and reared at the Grays River Hatchery, 1998-2002, and

those from the Bonneville population spawned and reared at the Washougal Hatchery in 2001 and 2002 are presented in the Tables 4-7 (Schroder unpublished data; Hillson 2002; Hillson unpublished data).

Table 4. Rates of Survival for Columbia River Chum Salmon spawned and reared at Grays River Hatchery.

Brood Year	Green Eggs Collected	No. Of Eyed Eggs Obtained	No. Of Fry Obtained	Egg to Eyed Egg Survival	Eyed Egg to Fry Survival	Overall Green Egg To Fry Survival
1998	121,060	112,355	110,114	92.6%	98.0%	91.0%
1999	216,775	201,744	199,407	93.1%	98.8%	92.0%
2000	298,428	286,811	282,029	96.1%	98.3%	94.5%
2001	437,432	413,918	406,117	94.8%	98.1%	92.8%
2002	437,517	414,308	407,006	94.7%	98.2%	93.0%

Table 5. Rates of Survival for Columbia River Chum Salmon spawned and reared at Washougal Hatchery.

Brood Year	Green Eggs Collected	No. Of Eyed Eggs Obtained	No. Of Fry Obtained	Egg to Eyed Egg Survival	Eyed Egg to Fry Survival	Overall Green Egg To Fry Survival
2001	65,922	61,009	54,345	92.5%	89.1%	82.4%
2002	244,156	225,791	223,209	92.5%	98.9%	91.4%

Table 6. Release Information (Location and Number Released) and Survival Rates from Ponding to Release, by Release year, for Chum Salmon reared at Grays River Hatchery.

Year Released	Location	Number of Fed Fry Released	Survival During Rearing Period
1999	West Fork Grays River	109,012	99.00%
2000	West Fork Grays River	135,678	99.60%
2000	Mouth Of Chinook River	62,820	99.43%
2001	West Fork Grays River	203,719	98.97%
2001	Mouth of Chinook River	75,601	99.24%
2002	West Fork Grays River	303,413	99.33%
2002	Mouth of Chinook River	100,127	99.45%

Table 7. Release Information (Location and Number Released) and Survival Rates from Ponding to Release, by Release year, for Chum Salmon reared at Washougal Hatchery.

Year Released	Location	Number of Fed Fry Released	Survival During Rearing Period
2001	Mouth of Duncan Creek	45,046	98.1%
2002	Mouth of Duncan Creek	217,436	98.1%

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.

Formal population estimates for the tributaries are not currently available. However, peak live and dead fish counts are available for select areas. These peak counts are presented in the table below by location and year.

Table 8. Peak counts of adult chum salmon spawning Between Bonneville Dam and the I-205 Bridge.

Year	Hamilton Creek (Including Spring Channel)	Hardy Creek	Duncan Creek	Mainstem Columbia Ives Island Area	Mainstem Columbia Ives Island to I-205
2002	1,387	291	5 [1/]	1,471	732
2001	691	498	13 [1/]	256	546
2000	199	20	0	249	82
1999	182	157	1	41	12
1998	280	443	1	117	No Count
1997	145	105	1	15	No Count
1996	86	140	1	0	No Count
1995	20	130	0	7	No Count
1994	69	264	No Count	22	No Count
1993	20	324	No Count	39	No Count
1992	149	635	No Count	No Count	No Count
1991	19	125	0	No Count	No Count
1990	51	116	No Count	No Count	No Count
1989	25	9	No Count	No Count	No Count
1988	132	436	No Count	No Count	No Count

[1/] *Voluntary fish only. Does not include fish collected during re-introduction efforts and placed into the channels above the weirs.*

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.

Chum salmon returning to the Lower Gorge are assumed to be entirely from natural production as no hatchery fish are released into Hardy, Hamilton, Duncan creeks and the mainstem Columbia. The first year of returns from chum reared at Washougal Hatchery will occur in 2004. Eyed eggs of non-local origin were introduced into Spring Channel on Hamilton Creek several generations ago with no apparent increase in natural production.

2.2.3 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.

As was indicated above, the degree of intervention and levels of "take" will vary depending upon river flows. Consequently, in years with typical flow regimes "takes" will be less than in those with extreme low flows. Nonetheless, all "take" values here have been estimated based on a worst-case scenario of extremely low water and maximum broodstock collection effort.

First, in 2004, three years after the beginning of the re-introduction effort, project fish

(three-year-old males and females) are expected to return to the upper Bonneville area of the Columbia. Stream surveys in this area and down the length of the Columbia will be taking place with the intention of documenting the presence and abundance of chum salmon. Otoliths and genetic material will be collected from carcasses to determine if project fish are homing to release locations or straying into other sites. Several hundred samples from carcasses could be collected during each year.

Second, tangle nets and beach seines will be used to collect broodstock for artificial and natural spawning as part of the Duncan Creek re-introduction plan and possibly a salvage effort. Beach seines were successfully used to collect adult chum in the Grays River in 2000-02 and on the Columbia River in 2001-02. Males tend to be caught in such nets more readily than females because of their hooked kypes and prominent teeth. In addition, female chum that have already spawned (fully spent or partially spawned-out) are also caught by this gear. Such fish are territorial and are guarding their redd sites. Consequently, if the goal is to collect 150 pairs, up to 3,500 or so adults could be collected over the six week spawning period that would not be suitable or needed for broodstock (excess males and spent females). These fish would be quickly removed from the nets and either released or held for tagging. Adults not used for broodstock may be tagged and released. Tagging is necessary to produce population estimates so that percent contributions to adult returns of the artificially spawned and reared treatment groups can be determined. No immediate mortalities have been observed in either the Grays or mainstem Columbia rivers as a result of broodstock collection or tagging activities. It is difficult to measure the delayed effect of such handling since these fish are in the final stages of their life cycle; however, we estimate that mortality of pre-spawn adults as a result of these activities to be less than 1%.

Third, fish selected for broodstock will be immediately placed into holding tubes made of 10 inch (25 cm) in diameter PVC pipe that are 36 to 48 inches long (91 – 122 cm) perforated with numerous 1.5 inch (3.8 cm) holes. The fish's sex, date, and location of capture will be penciled in on the tube. The fish will be hauled to the Washougal Hatchery in their tubes and placed, still in the tube, in a holding pond until ripe. A similar procedure has been used successfully in the chum recovery project at Grays River. Fish mortality in the tubes has been less than 3% during the three years of the Grays River project. Modifications to the design of the fish holding tubes have been made and these improvements appear to have reduced mortality further. We anticipate that fewer than 2% of the broodstock will perish before they are used.

Fourth, broodstock will be killed when their gametes are taken (up to 300 fish).

Fifth, once eggs have been removed and fertilized, the offspring produced from each female will be incubated in its own Heath incubation tray. Egg-to-fry survival rates of Grays River chum at Grays River Hatchery have generally been greater than 90% (Schroder, unpublished data). Egg-to-fry survival rates of chum spawned and reared at Washougal Hatchery were 78.2% and 89.6%, 2001 and 2002 respectively (Hillson 2002; Hillson unpublished data). Some mortality will occur during the rearing period. Mortality rates of 1.9% were recorded during the rearing period at Washougal Hatchery, 2001 and 2002 (Hillson 2002; Hillson unpublished data). Finally, when juveniles are transported to release sites, some mortality will undoubtedly happen, a few individuals may be crushed or injured (expected to be less than 100 fry).

Sixth, part of the evaluation is to determine the egg to fry survival of natural spawning chum salmon. To estimate this fence traps are installed from mid-February through May. These traps count 100% of outmigrants. Therefore, catch and associated take are dependent on spawning escapement. Over the evaluation period we may achieve spawning

escapement that approaches the channel capacity (near 400). To determine estimates of smolt production we assumed the channel was seeded to capacity. If this occurs ~ 450,000 juveniles would emigrate from the channel. We assumed a 2% mortality to estimate unintentional lethal take.

Seventh, it should be noted that female carcasses in Duncan Creek are examined for egg retention to calculate actual egg deposition. This take is not explicitly listed in the take tables, since take from these females is already accounted for in the broodstock collection.

- 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.

Tangle nets and beach seines used to collect chum broodstock have a low potential to take listed chinook and steelhead. Any incidental catch will be returned alive to the river immediately. Adult fall chinook inadvertently captured during tangle net activities have totaled 63 and six, 2001 and 2002 respectively (Hillson 2002; Hillson unpublished data). No steelhead were captured either year.

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

A total of 234 and 2,950 adult chum were handled as part of our broodstock collection efforts in 2001 and 2002 respectively. The increase in numbers handled between the two years is a result of increased broodstock needs. Re-introduction and salvage efforts occurred in 2002, and the initiation of a tagging program to estimate adult chum population numbers. A total of 51and 182 adult chum were kill-spawned at Washougal Hatchery in 2001 and 2002 respectively. A total of four adults died prior to spawning in 2001 and 2002. The survival of Columbia River chum broodstock, eggs, alevins, and fry at both Grays River and Washougal hatcheries has been detailed in above paragraphs and tables. Overall survival at these facilities from the green egg stage to release as fed fry has consistently been around 90% or higher.

- 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).

Table 9 identifies eight separate types of takes. The range of values presented below have assumed that fish in a hatchery situation are not “observed or harassed” during typical operations, for example when eggs are shocked, picked, and fry are ponded. The same approach was taken for the other types of takes except for the unintentional lethal takes. Clearly, some mortalities will occur in hatchery operations that are above and beyond what might be expected, eggs inadvertently lost during spawning operations, fry accidentally killed during transport and so forth. These takes are estimated below. Finally, the ranges shown below primarily represent different levels of intervention. The lowest values would be those we anticipate occurring when only 30 pairs of chum salmon are collected from below Bonneville Dam and the highest represent those expected to occur when 120 pairs are collected for artificial spawning. In addition, up to 400 fish may be collected to spawn naturally in the newly restored Duncan Creek channels. In the table below the range of takes estimated to occur by life-history stage are shown with a brief explanation of the origin of the take.

Table 9. Projected Annual Take Levels for Listed Fish by Life Stage

Type of Take	Description and Range of Takes per Year
Observe or Harass:	No eggs, fry, or smolts will be subjected to this type of take. Stream surveys will take place and when adults produced from the project return to spawn, otoliths will be collected from recovered carcasses. In addition, scales and genetic samples will be removed from each carcass. Take values could range from 0 (no carcasses observed up to 400 or more and obviously depend upon the number of carcasses seen). Because we want to determine if fish produced from this project home to release locations or show a proclivity to stray, extra efforts will be made to recover otoliths from carcasses. Stream surveys will be conducted to determine the abundance of chum and also to seek carcasses that can be sampled. Again the extreme ranges of take for this activity are expected to range between 0 (no fish seen) up to several thousand (dependent on run size of adults spawning in the Bonneville area). Such surveys will occur annually and continue throughout the project.
Collect for Transport:	Up to 480 individuals may be needed for activities relating to the re-introduction program. In addition to that a salvage plan may need 820 adults collected and transported.

	been induced into these fish. Otoliths are extracted, photographed and used as "voucher" samples. A total of up to 100 such fish may be collected. Whenever possible we will use abnormal fish for such samples, i.e. those with obvious deformities (e.g. twisted spines, twins, albinos, and so on). Such fish would not normally survive upon release but their otoliths still reflect the artificial bar code patterns induced. Juvenile/Smolt: The re-introduction program calls for juveniles to be trapped as they out-migrate from the channels so that they can be marked via strontium immersion which will allow them to be identified when they return as adults. Beginning in 2004 all fry trapped will be marked prior to release. If marking is done with strontium as planned voucher samples will need to be collected over the course of the out-migration. Up to 200 fry may be needed as voucher samples. Adult: From 60 to 300 adult fish may be sacrificed for artificial spawning.
Unintentional Lethal Take:	Egg/Fry: 0 to an estimated two hundred. During artificial spawning operations a eggs may be accidentally damaged. Juvenile/Smolt: Zero up to one hundred artificially produced fry. Fry will be transported to various release areas. Some may be injured or killed by dip nets, buckets etc. during this process. We estimate that this number should be less than 0.1% of any given years fry production total. Mortalities may occur as a result of fry trapping operations at the Duncan Creek channels. We would expect those to be less than 2% of the total out-migrating fry. Magnitude of this take depends on the number of naturally spawning chum salmon in Duncan Creek above the weir. Adults: three to twelve adults collected for broodstock may die prior to spawning. The collection and holding tubes used in this project have been employed in other recovery programs. Generally, mortality rates of fish held in such tubes are extremely low. However, inadvertent injuries caused by how a fish was captured or other stresses may cause adult fish to die while being held. The chum we collect are mature or very close to that stage, resulting in a holding period of only a few days. Such a short holding period will minimize pre-spawning mortality. Chum held in tubes at the Grays River Hatchery over the past three years have consistently had very low mortality rates, less than 2%.

- 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.

1) We plan to evaluate whether capture gear, tangle nets or beach seines have differing

mortality rates. If one type of gear appears to be more likely to stress or injure broodstock, its use will be limited.

2) This program is an attempt to protect extant chum stocks using spawning areas adjacent to the Bonneville Dam. In most years, it is likely that our artificial brood stocking goal will be 30 pairs as opposed to 120 pairs, the goal that would occur during extreme drought conditions. A 30 pair goal will significantly reduce the upper bound of the take levels described above.
3) Broodstock collection and tagging will be activities that will be reduced or curtailed if direct mortalities are observed in the field or pre-spawn mortality increases at the hatchery.
4) If mortality during rearing noticeably increases, a state fish pathologist will be called to evaluate the fry and recommend treatment actions.
5) The protocols used in this project have been tried and evaluated in numerous chum salmon recovery efforts. As this project proceeds, improvements to these techniques will be implemented on as needed basis.

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.

The hatchery program will be operated under the general procedures of the Summer Chum Salmon Conservation Initiative (WDFW and PNPTT 2000). This program is consistent with the Columbia Basin System Planning Salmon and Steelhead Production Plan for chum salmon in the lower Columbia Sub-basin. Planners recommended that a combination of natural and hatchery production would be the optimal way to produce the most rapid sustainable improvement in chum runs. It assumed the quickest way to rebuild the run would be to combine releases of an appropriate stock into improved habitat (WDF 1990). This approach is being applied in this program.

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

This HGMP is consistent with the Monitoring and Evaluation Plan for Duncan Creek developed by WDFW in 2001.

3.3 Relationship to harvest objectives.

The Columbia River historically contained large runs of chum salmon that supported a substantial commercial fishery in the first half of this century. These landings represented a harvest of half a million chum salmon in the Columbia River in some years (NMFS Status Review 1996). By 1955, harvest had diminished to 10,000 fish and by 1965, less than 2,000 fish per year were harvested. Presently, no Columbia River commercial fisheries target chum salmon. Chum landings occur incidentally to targeted coho seasons in the late fall gill net fishery (WDF, 1993).

Current commercial fisheries are expected to end prior to the primary migration time or are gear specific to minimize chum handling. Commercial harvest rates from 1993-1997 averaged less than 2% on the minimum chum run size (WDFW/ODFW 1999).

3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

At this time, no specific fisheries will benefit from this program. This is a new program; there are no historic harvest levels for program fish. Future commercial harvest rates are expected to be managed in the 5% or less impact level (WDFW/ODFW 1999). The Columbia River system is currently closed to recreational harvest of chum salmon. Angling for and retaining chum has been closed on the Oregon side of the Columbia River since 1992 and on the Washington side since 1995. Hardy, Hamilton, and Duncan creeks are closed to fishing for salmon under permanent regulations. If the Lower Gorge population reaches a sustainable level, then harvest benefits may occur to both sport and commercial fishers.

3.4 Relationship to habitat protection and recovery strategies.

The lack of stable spawning habitat is considered the primary physical limitation on Columbia River chum production today (NWPPC 1990). Natural habitat limiters for the Hamilton Creek stock include gravel quality and stability and availability of good quality near-shore mainstem freshwater and marine habitat (WDF, 1993). Formal recovery plans for Columbia River chum have not been made but efforts are underway. However, the Columbia Basin System Planning Production Plan addresses habitat protection and recovery for the Lower Gorge population.

The Re-Introduction of Lower Columbia River Chum Salmon into Duncan Creek Project responds to Action 157 in the December 2000 FCRPS Biological Opinion. That action requires BPA to fund projects that improve and restore tributary and mainstem habitat for Columbia River chum salmon in the reach between The Dalles Dam and the mouth of the Columbia River to compensate for effects of water management operations in the Ives Island area. The Biological Opinion also states the Action Agencies shall operate the FCRPS to provide flows to support chum salmon spawning in the Ives Island area below Bonneville Dam.

A three-pronged approach is being used to once again produce a self-sustaining chum salmon population in Duncan Creek. This approach includes modifying the dam to provide adult fish passage, enhancing spawning habitat to allow successful incubation, and using local brood stock to re-introduce chum back into the basin. The first objective was accomplished in November 2000 when the dam was modified to allow free fish passage. The second objective was completed in 2002 under the Re-Introduction of Lower Columbia River Chum Salmon into Duncan Creek project. The third objective is covered in this HGMP.

Other attempts to improve habitat have occurred within the Bonneville Population area. The USFWS in cooperation with Burlington Northern Railroad and Washington Trout developed a controlled-flow spawning channel for Columbia River chum salmon in the Hardy Creek drainage. The Hamilton Spring spawning channel was renovated by WDFW in 1998. Efforts are underway to acquire or place conservation easements on the shoreline and upland areas at the Woods' Landing chum spawning area.

3.5 Ecological interactions.

(1) negatively impact program:

Because of their relatively small size, newly emerged and migrating chum fry are vulnerable to a large array of potential predators. For the Lower Gorge population, that would include juvenile wild and hatchery origin salmon including chinook, coho, steelhead, and cutthroat trout, along with northern pike minnow, cottids and warm water fishes (small and large mouth bass, yellow perch, crappie, blue gills, pumpkin seeds, catfishes, walleye) that have established themselves in addition to the salmonids. Avian predation from common merganser, double crested cormorant, and caspian tern, also poses a threat.

Fry released volitionally clear the river quickly, with only a small portion remaining for extended rearing. The rearing and release strategies developed for the chum salvage operation are designed to dampen predation. It's possible some fish may be reared until they reach 55 to 60 mm in length (fork) or 1 to 1.5 g in weight. This will make them large enough to escape some of their potential predators and shorten their dependence on shallow estuarine feeding areas thus reducing their exposure to aerial and bottom dwelling

predators.

In addition, the fish will be liberated during darkness on a falling tide in an effort to expedite emigration out of the Columbia River and reduce their visibility. Duncan Creek juveniles may be released directly into the mainstem
Columbia to minimize possible predation in backwater areas.

2) be negatively impacted by program:

No negative species interactions are expected to be produced by the chum salvage operation. Because of their small size and food habits, they are unlikely to directly compete with wild chum salmon fry or with other salmonids. In addition, the total number of fry that will be liberated into each area is relatively small (90 K) and early enough in the spring to limit behavioral effects on other wild salmonids (e.g. the inducement of premature out-migration) or ancillary predation (e.g. by the creation of numerical response in predators). If significant salvage operations occur then wild chum salmon could be impacted by the program. However, in this case salvage was initiated because of low abundance. Therefore, if impacts occur between juveniles, they are expected to be low because juvenile densities are likely to be below density dependent thresholds.

(3) positively impact program:

Limited positive interactions caused by other species are expected. The presence of adult chinook, coho, and other salmonid species may increase the amount of micro-nutrients present in Hardy, Hamilton, Duncan creek and the mainstem Columbia near Ives Island. However, only a small portion (<1%) of chum fry remain in freshwater to rear for short periods and hence they are unlikely to derive much benefit from carcasses of other salmonids.

(4) be positively impacted by program.

Many species including cutthroat trout, steelhead and rainbow, coho and chinook are known to prey on chum fry and consequently juveniles of these species may benefit from increased numbers of chum fry. Besides direct consumption, increased numbers of adult chum salmon carcasses into Hardy, Hamilton, Duncan creeks and the mainstem Columbia near Ives Island will add micro-nutrients into these streams which by direct or indirect routes would be available to salmonids and other species in the basin. In addition, the chum carcasses will provide possible a possible food source for eagles and other raptors. Released fed fry may buffer the effects of predation on wild chum salmon fry.

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.

The incubation and rearing water used at the Washougal Hatchery originates from Bob's Creek. This spring fed water supply delivers two to three cubic feet per second of gravity-fed water to the hatchery and has a relatively constant temperature that ranges between 48 and 49° F. Further details about this water source can be found in the HGMP that was developed for the chinook and coho program that takes place at the Washougal Hatchery. The water chemistry and temperature profile of Bob's Creek is believed to be similar to those found in Hardy, Hamilton, and Duncan creeks.

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.

As mentioned above, Bob's Creek will supply the water for this program. It enters the hatchery after traveling 1,500 feet with 900 feet of head. Intake screens at Bob's creek screens conform with NMFS screening guidelines to minimize the risk of entrainment of juvenile listed fish. The location of the spring also makes it highly unlikely that listed salmonids are present in the water supply.

Section 5. Facilities

5.1 Broodstock collection facilities (or methods).

Methods employed to capture adult chum will depend on water levels and fish location. Conditions will vary from shallow water areas in the lower reaches of tributaries to deeper areas in the mainstem Columbia River. Successful broodstock collection will require some experimentation and a combination of the following methods:

1) Beach Seining - Beach seining can be used in shallow to moderate depth and has been proven to be an effective means for capturing adult chum in the Grays River area. The beach seines will be 1.5-2" mesh of 1/8" ultragreen mono up to 200 feet long and 10 feet deep.

2) Tangle Netting - Tangle nets can be used in areas of moderate to greater depth. They have been utilized by the USFWS to capture Lower Gorge population chum for radio tagging. Tangle nets could be operated by commercial gill netters subcontracted to assist with the salvage operation.

3) Adjusted Flows - An experimental approach to capturing adult chum in the Ives Island area involves raising water levels over the Ives Island spawning grounds by increasing flows from Bonneville Dam for a limited period of time. It's assumed this will induce chum salmon to aggregate by the Ives Island area. Gradual flow reduction will decrease water levels allowing a beach seining crew to enter and capture fish.

4) Adult Traps - Collect possible brood stock from the adult traps on Hardy, Hamilton and Duncan Creeks.

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

Upon capture, a single fish will be placed into its own holding tube. The tubes will be 10" (25.4 cm) by 3 feet (91 cm) long PVC pipe, perforated with 1.5" (4 cm) in diameter holes and equipped with removable end pieces or caps.

After a collection episode has been completed, the tubes will be placed live in a tank truck and transported to Duncan Creek for natural spawning or Washougal Hatchery for artificial spawning. Three tanker trucks are available for use, capacities of 400, 1,500 or 2,000 gallons, and are equipped with an oxygen supply.

5.3 Broodstock holding and spawning facilities.

At Washougal Hatchery adults are held, still in the tube, in an asphalt-lined pond. Spawning occurs under cover, in the incubation room. All biological data collections, factorial matings, and PVP treatment will take place in the incubation room.

5.4 Incubation facilities.

The Washougal Hatchery has 1,152 individual vertical stack incubators (Heath trays). These will be used to individually incubate eggs collected during this program. This approach will allow us to evaluate the survival of offspring produced from each female used in the recovery program. Water chillers and flex hose have been installed at the hatchery making it possible to thermally mark fish while they incubate.

5.5 Rearing facilities.

The Washougal Hatchery has two concrete shallow troughs, four fiberglass troughs, and 24 concrete raceways. Twelve of the raceways are 80 feet long by 20 feet wide, and 3.1 feet deep

and have a unit volume of 5,000 cu feet. The other twelve are 135 long, 17.5 feet wide and 3.7 feet deep and hold 8,750 cubic feet of water. Additional details about the rearing facilities at the hatchery can be found in the HGMP developed for the coho and chinook programs located at the Washougal Hatchery. Chum fry are reared in fiberglass deep troughs having volumes of 600-700 gallons. These troughs are placed in one of the larger concrete raceways with the raceways water supply plumbed into a water manifold to provide flow to individual troughs.\

5.6 Acclimation/release facilities.

Two options exist for rearing and releasing fry artificially produced from either the re-introduction or the salvage programs. One is to rear fry to size at Washougal Hatchery and then transport them to the appropriate release site/sites for liberation. The other is to transport unfed or fed fry to rearing locations situated in Hardy, Hamilton, and Duncan creeks. In each of these locations, it may be possible construct facilities to hold and rear juveniles in seep areas. If this approach is used, bird netting will be stretched over rearing sites to help prevent losses from avian predators. Prior to fry introduction, the rearing areas will be seined and/or electroshocked to remove any potential predators. This option may increase homing fidelity since the fry will have additional time to imprint to their rearing locations.

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

No operational difficulties or disasters have lead to significant fish mortality.

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.

The hatchery is staffed full-time and equipped with a low-water alarm system to help prevent catastrophic fish losses resulting from water system failure. Because the water supply is a gravity fed system, the likelihood of a disruption in water service is very low. If that were to occur, several management steps will take place. First, if the fish are still in the egg stage, all water in the incubator trays will be drained off and the eggs will be kept moist for up to twenty-four hours or until the water supply is reconnected. If the water supply cannot be restored after twenty-four hours, the trays will receive re-circulated water that has been aerated and passed through a charcoal filter system until the eggs hatch, the water supply restored or stage of development allows for the eggs to be moved to another facility. Second, if water loss occurs after hatching then all the trays would be held in one of the hatchery's raceways until repairs are made. Third, if the water supply is interrupted during the rearing period, pumps would be installed to re-circulate raceway water and compressed air will be delivered to the raceways if necessary. This would continue until repairs were made, if repairs were impossible to make, fry would be moved off station to another facility or reared in seep areas located in Hardy, Hamilton, and Duncan creeks.

Section 6. Broodstock Origin and Identity

6.1 Source.

The source for all natural spawners is the mainstem Columbia River, from Bonneville Dam downstream to the I-205 Bridge, and fish returning to Duncan, Hardy and Hamilton Creeks. This population was listed as "threatened" in 1999. Annual broodstock collection totals will vary, dependent upon implementation and degree of a salvage plan. Estimated broodstock needs under different degrees of salvage plans were outline earlier in the document.

6.2.1 History.

It is believed that the Bonneville chum population originates entirely from natural production. Eyed eggs of non-local origin were introduced into the Hamilton Creek Spring Channel with no apparent increase in adult production. No non-local hatchery introductions have been made into Hardy and Duncan Creeks. Hardy Creek chum status was listed as healthy. Hamilton Creek chum status was considered depressed due to a long-term negative trend in a spawning ground escapement counts (WDF 1993).

6.2.2 Annual size.

Unexpanded, peak counts of live and dead fish in Hardy, Hamilton, Duncan creeks and the mainstem Columbia near Ives Island have averaged 451 chum from 1988 through 2001 though not all the areas were surveyed annually. Tagging studies done in Hardy and Hamilton creeks indicate that each observed carcass represents 1.22 (Hardy Creek) and 1.53 (Hamilton Creek) actual fish (Hymer 1994). In the mainstem it is estimated that each observed live or dead fish represents two individuals (Hymer personal communication). Using these expansion factors on count data collected in 1999-2001 (when efforts were made to survey all areas) it was found that on average 1,976 chum spawned in this area. If 120 pairs (240 fish) of chum are collected for broodstock under the most severe salvage effort, then approximately 12% of the population will be captured for broodstock needs. However, in 2002 it was estimated that 4,058 adult chum returned to the Ives Island area alone. The 2002 chum population estimates are unavailable at this time for Hamilton or Hardy creeks, but similar increases are expected to be seen in those groups. Returns of this size will greatly reduce impacts of broodstock collection activities.

Using chum salmon native to Bonneville for brood stock in Duncan Creek reduces the risk of catastrophic loss since the renovated spawning habitat in Duncan Creek will provide the fish with protected spawning areas. Moreover this tactic will help alleviate 1) high egg retention rates, 2) superimposition of redds and 3) pre-spawning mortality in low-flow years. In addition, it will protect this portion of the Lower Gorge chum population from destruction if natural spawning areas become completely dewatered due to weather conditions or flow manipulations. Finally, using the hatchery for spawning, incubation, and rearing should provide egg-to-smolt survival rates of 90% or higher.

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

The proposed level of natural fish in the broodstock is 100%. However, since returning adults are otolith marked and not mass-marked, the proportion will be unknown until after spawning.

6.2.4 Genetic or ecological differences.

There are no known genotypic, phenotypic, or behavioral differences between the natural spawning and fish collected for brood stock.

6.2.5 Reasons for choosing.

Chum salmon propagated through this program represent an indigenous Lower Gorge population that is the target of the chum salvage operation. This stock is one of two populations of Columbia River chum salmon that have persisted. Genetically, they are distinct from the Grays River Population. Based on recent genetic analysis, it appears the Washougal population (mainstem Columbia River spawners between Washougal and Lewis Rivers) is similar to the Lower Gorge population (Marshall 2000). Therefore, these stocks represent the best donor stock for Duncan Creek.

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.

Only local brood stock will be used. To preserve the temporal integrity of the run, broodstock collection will span the months of November and December. At a minimum, 30 pairs will be collected for each release site to maintain genetic diversity. When possible, fry will be acclimated at their release sites.

Section 7. Broodstock Collection

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

Adults

7.2 Collection or sampling design

Broodstock will be randomly collected throughout the entire run (early November through December) using any or all of the following methods: beach seines, tangle nets and adult traps on tributaries. Broodstock collection goals are set before the season begins. This total is then divided up into weekly goals using historical run timing information. For example, weekly collection goals for a season total of 100 pairs (200 adults) are provided in Table 10.

Table 10. Weekly Broodstock Collection Goals to Produce a Season Total of 100 Pairs.

Week	% of Season Total	# of Adults needed
1	5%	10
2	15%	30
3	30%	60
4	30%	60
5	15%	30
6	5%	10

This method insures that adults are collected over the entire run period and that the majority of adults are collected when the run is expected to be at its largest point.

7.3 Identity.

Lower Gorge and Washougal chum, are present when broodstock collection occurs. Both of these populations appear to be genetically similar based on electrophoretic analysis. Hatchery chum will not be present in the adult population until 2004. At this time, three-year old adults from the 2001 brood at Washougal Hatchery will be returning. While these fish are thermally marked for identification, this mark is cryptic and these fish cannot be distinguished in the field.

7.4 Proposed number to be collected:

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

Re-introduction program: up to 280 females and 280 males. Salvage Operation: up to 120 females and 120 males

7.4.2 Broodstock collection levels for the last twelve years (e.g. 1990-2001), or for most recent years available.

YEAR	Adults		Eggs	Juveniles
	Females	Males		
2001	24	27	65922	45046
2002	84	87	244156	218808
2003				
2004				

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

Excess adults captured during broodstock collection activities are tagged and released alive to spawn naturally. The tagging operation is essential to estimate the populations status and take.

7.6 Fish transportation and holding methods.

Selected fish will be held in perforated 25 cm in diameter x 122 cm long x 25 cm in diameter PVC holding tubes placed in a truck mounted tank and supplied with oxygen. The fish will then be hauled about 30 miles to the Washougal Hatchery where the tubes will be placed into an asphalt-lined adult holding ponds. The adult remains in the tube until it is spawned, generally within two days of capture. Adults collected to spawn naturally in the Duncan Creek channels are held and transported in a tube, then released into the channels above weirs.

7.7 Describe fish health maintenance and sanitation procedures applied.

At spawning, ovarian fluids (females) and kidney/spleen tissues (males and females) are collected and later assayed for viral pathogens. Whenever abnormal behavior or mortality is observed, a state fish health specialist will examine the affected fish, make a diagnosis and recommend the appropriate remedial or preventative measures.

For sanitation, all eggs brought to the facility are surface-disinfected with iodophor (as per disease policy). All equipment (nets, tanks, rain gear) will be disinfected with iodophor at the end of every spawning session. Eggs collected on each spawning day will be physically isolated from one another by separate incubation units. Incubation units are further isolated by plastic curtains. The intent of these activities is to prevent the horizontal spread of pathogens by splashing water.

Tanks used to transport adults and fry will be disinfected after each use. Footbaths containing iodophor will be strategically located on the hatchery grounds (i.e. entrance to the hatchery building) to prevent spread of pathogens.

7.8 Disposition of carcasses.

All carcasses (spawned and un-spawned) from the hatchery portions of either program from will either be given to a buyer or used for nutrient enhancement in the Washougal River watershed. In Duncan Creek, carcasses will be removed from the creek to reduce disease concerns. However, they will be left in the Duncan Creek riparian area for ecosystem benefits.

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.

The risk of fish disease amplification will be minimized by following Co-manager Fish Health Policy sanitation and fish health maintenance and monitoring guidelines. Genetic risks will be minimized by collecting and spawning over the entire run. The reintroduction program has a maximum duration of three generations (12 years). By making an effort to incorporate wild fish every year domestication selection should be minimized.

Section 8. Mating

8.1 Selection method.

Fish used for broodstock will be collected from the spawning grounds and at traps in a random fashion throughout the duration of the spawning run. Obviously, the number of fish spawned per day and whom they are mated with will depend upon which fish are ripe on a given spawning date. No effort is being made to cross fish with particular phenotypic attributes (e.g. size- and age-at-maturity) in any systematic fashion.

8.2 Males.

Backup males will be used to ensure that fertilization has been maximized. As will be discussed below, a factorial mating scheme, either 2 x 2 or more commonly 3 x 3 will be employed. In a 3 x 3 mating, nine separate egg lots are created, three from each female. Each male then fertilizes one egg lot from each female. Fertilization is achieved by adding milt from a male directly onto the eggs of a female. Water is then added and the gametes are gently stirred for 20 seconds. Milt from one of the other males is then added to the egg/water/milt mixture and the eggs are once again gently mixed. This addition of milt from a second male is done to ensure that high fertilization rates take place. For example, most fertilization occurs within seconds after water has been added to eggs and milt. On some occasions, milt quality may be low and fertilization consequently will be poor. Because of this potential risk, we routinely add milt to an egg batch 20 seconds after milt from a primary male has been added. This strategy simply provides any unfertilized eggs with a new batch of sperm and it also allows the first male an opportunity to fertilize 100% of the eggs within an egg lot if his milt has normal viability. Each male used in a 3 x 3 cross is used as a backup male for one of the other males. Typically male two will back up male one, male three will back up male two, and male one will back up male three.

Chum salmon do not produce precocious males and they are semelparous. Two-year-old males have been observed in some chum populations but they are very rare. In any case, broodstock males with different ages of maturity will be used in an equivalent fashion and in proportion to their occurrence in the population.

8.3 Fertilization.

As briefly described above, factorial mating schemes, either 2 x 2 or 3 x 3 are used whenever possible. To make these matings, the total weight of the eggs mass from each female is weighed and then divided into the number of aliquots necessary to make the cross, either two or three. Each aliquot is then fertilized by a different male and backup males are used as described above. All eggs are water hardened in an iodine solution before incubation begins.

8.4 Cryopreserved gametes.

No cryopreserved gametes will be used in this recovery/re-introduction program

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.

The factorial mating scheme described above allows each fish chosen as broodstock to make a genetic contribution and is being used to maintain genetic diversity.

Section 9. Incubation and Rearing.

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

The re-introduction to Duncan Creek and Bonneville chum salvage projects are relatively new. Numbers of eggs taken and related survival rates for the two years that spawning and rearing has occurred at Washougal; Hatchery were presented in Tables 5 and 7.

The renovated spawning channels at Duncan Creek should produce egg-to-fry survival rates of 30-50%. Minimum egg-to-fry survival rates for the two channels combined in 2001 and 2002 were 26% and 37%, respectively.

9.1.2 Cause for, and disposition of surplus egg takes.

There are no constraints, other than incubation space, on numbers to be released at this time. Therefore, all eggs taken for either program will be incubated, reared and released.

9.1.3 Loading densities applied during incubation.

Standard water flows, four to five gallons per minute (15 to 19 liters) will be provided to each incubator tray. The eggs from each female are incubated in their own Heath tray. Average fecundity is 3,000 resulting in loading densities well below than those recommended in Piper et al. (1982).

9.1.4 Incubation conditions.

All eggs incubated at the Washougal Hatchery will receive water from Bob's Creek. This spring-fed source of water has a temperature that ranges between 48 and 49° F. Standard low water level alarms are present in the hatchery and water temperatures will be recorded using Tidbit temperature loggers. No silt management is necessary, and influent and effluent gas concentrations, including dissolved oxygen are and will be within parameters optimal for salmonid egg and juvenile survival.

9.1.5 Ponding.

Chum salmon at Washougal Hatchery will be transferred into their rearing ponds after yolk absorption is almost complete. When only a small slit of yolk material is visible, individual weight and length samples on 10 to 20 fry per female will be taken to determine KD values. When these values average around 1.9, the fish will be ponded.

9.1.6 Fish health maintenance and monitoring.

A drip system will apply formalin to control fungus during incubation until hatching. At eyeing the eggs will be shocked and dead eggs removed by hand. The eyed eggs will then be placed into incubator trays supplied with folded Vexar. This rugose substrate reduces yolk sac deformations and maximizes yolk material utilization rates. Since each female's eggs will be incubated separately from one another, mortality data (from eyeing to ponding) for each female will be collected and recorded. At ponding, all mortalities and deformities are also removed by hand, counted, and described. Throughout the incubation period, fish health will be continuously monitored in compliance with Co-manager Fish Health Policy Standards (WDFW and WWTIT 1998).

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.

The factorial-mating scheme used ensures that each fish chosen as broodstock will have an almost equal opportunity to contribute genes into the next generation. Moreover, the incubation

conditions are designed to maximize egg-to-fry survival, for example, the water source is silt free and therefore catastrophic egg losses caused by siltation are not expected to occur. Egg loading densities in each tray are relatively low ensuring that adequate water exchange can occur. Additionally, the incorporation of a rugose substrate into the trays just prior to hatching will prevent yolk sac malformations. Moreover, fungal infestations on dead eggs will be controlled by routine Formalin drips. Heavy plastic curtains will be used to separate the trays holding chum eggs from the rest of the production trays in use at the hatchery. This practice should prevent any horizontal disease transfers from occurring. In combination, these measures should reduce genetic and ecological impacts on the fish during the incubation period

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 (1990-2001), or for years dependable data are available.

The objective at Washougal Hatchery is to achieve at least a 95% survival rate during the rearing period. Survival from ponding to release has been greater than 98%, Table 7, for the two years the programs have been in place.

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

The fish are reared using the loading densities recommend by Piper et al. 1982. The loading density for chum reared at Washougal Hatchery is less than one-half a pound of fish per gallon per minute during rearing.

9.2.3 Fish rearing conditions.

Four environmental parameters, flow rates, water temperatures, dissolved oxygen, and Total Settable Solids (TSS) will be monitored on a routine basis throughout the rearing period.

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.

Fork length and weight data is collected on random samples of 75 fry from each rearing vessel at least once per week. The data is used to adjust ration levels and food pellet sizes.

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

All fish are released as fry after a short rearing period. Growth rates, average size over time, can be seen in Table 11.

Table 11. Results of Weekly Fry Sampling, 2002.

Sample	Trough #1 Average		Trough #2 Average		Trough #3 Average		Trough #4 Average	
Date	Size (g)	# Fish/lb	Size (g)	# Fish/lb	Size (g)	# Fish/lb	Size (g)	# Fish/lb
18-Mar-02	0.272	1,668						
25-Mar-02	0.344	1,319						
1-Apr-02	0.484	937	0.320	1,417				
8-Apr-02	0.514	882	0.363	1,250	0.333	1,362		
15-Apr-02	0.665	682	0.544	834	0.363	1,250	0.423	1,072
22-Apr-02	0.786	577	0.635	714	0.454	999	0.454	999
29-Apr-02	0.847	536	0.907	500	0.514	882	0.635	714
6-May-02	1.150	394	1.210	375	0.786	577	0.816	556
13-May-02					1.090	416	1.090	416

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*).

Fry are fed Moore-Clark Nutra starter feeds and fed until liberation. Fish are fed at a rate of 3% body weight/day in six to eight feedings over the course of a day. While not calculated, expected fed conversion rates are $\geq$ 1.2.

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

Mortalities in each rearing vessel will be removed and enumerated daily. If a sharp increase in mortality occurs, the WDFW regional pathologist will be contacted for a diagnosis and possible treatment regime. The bottom of the troughs will be cleaned on a once-a-week basis with a vacuum or siphon. If necessary, the tank sidewalls will be cleaned with a stiff brush if algae growth starts to entrap food or feces. To prevent disease or pathogen transfer from one raceway to the next, the vacuum/siphon and any tools used are soaked in a PVP solution for several minutes before using it another trough.

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

At emergence, chum fry are physiologically able to move directly to seawater. No formal measurements on degree of smoltification will be conducted.

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

The most “natural” rearing method will be rearing chum fry in the restored Duncan Creek spawning channels. Here the fish will experience a natural substrate and will have opportunities to prey on live foods. So-called NATURES rearing systems have yet to be tried and evaluated for chum salmon. However, raceway coloration, overhead covers, and underwater feeders would be elements that could be used to pre-condition chum fry to natural conditions. If funding becomes available, such treatments will be instituted and evaluated because of their potential to increase post-release survival rates.

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.

Juvenile chum will be returned to appropriate release sites (e.g. Hardy, Hamilton, Duncan creeks and the mainstem Columbia near Ives Island) as soon as possible for imprinting. Another option is to rear the juveniles in the tributaries before release.

Section 10. Release

10.1 Proposed fish release levels.

Numbers reported in this table are to be considered maximums, in most years totals would be less.

Table 12. Maximum juvenile chum salmon releases from Washougal Hatchery.

Age Class	Maximum Number	Size	Release Date	Location
Fry	480,000	1 to 1.5 grams	mid-March through May	Hardy Creek Hamilton Creek Duncan Creek Mainstem Columbia near Ives Island

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

Stream, river, or watercourse: Hardy Creek (28.0302), Hamilton Creek (28.0303) Duncan Creek (28.0296) Mainstem Columbia near Ives Island (28.001)
Release point: same as above
Major watershed: same as above
Basin or Region: Lower Columbia River

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

Release year	Eggs/ Unfed Fry	Size	Fry	Size (grams)
2001			45,000	1.3-1.6
2002			218,000	1.1-1.6
2003				
2004				
Average			131,500	1.2-1.6

10.4 Actual dates of release and description of release protocols.

In 2001, fry were released in two groups, with released occurring on May 8 and 16. In 2002, fry will be released in three groups, with releases occurring on May 8, 19 and 22. Release is triggered on fish size, once the average weight of fry in a trough reaches 1.0-1.5 grams they may be released. Release is a forced type since fry are trucked from the hatchery and released in mass.

10.5 Fish transportation procedures, if applicable.

Dip nets are used to remove fry from the rearing troughs and place them in a truck bed mounted 400-gallon tank. Supplemental oxygen is used during transport. The fry are transport for approximately 30 minutes to release site/s. Fry are loaded to a maximum of one-half pound fish per gallon. Release from the tank is done via a section of flex hose to

accomplish a water-to-water transfer. Temperatures are measured to determine if any acclimation is needed before release, generally this does not occur because temperature differences have been less than 2-3 degree's F.

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

Currently, facilities do not exist to acclimate fry. These may be built if straying rates are determined to be unacceptable in the future.

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

All the chum fry released from Washougal Hatchery will have their otoliths thermally marked. Each release site will have a unique mark. Fry produced from naturally spawning adults in the restored Duncan Creek channels may be marked by placing the fish in a diluted strontium bath or using strontium enriched diets.

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

We anticipated collection of broodstock consistent with scope and magnitude of this program. Therefore, we will have no surplus fish.

10.9 Fish health certification procedures applied pre-release.

Prior to transfer and release, the juveniles will be given a health exam.

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

An alarm system and back-up water supply system are available at Washougal Hatchery.

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.

- The production and release of chum smolts through fish culture and volitional release practices fosters rapid seaward migration, limiting freshwater interactions with naturally produced Chinook and chum juveniles.
- The restoration program supplements productivity due to mainstem flow loss that prohibits access to historical habitat..
- Dispersal and emigration from multiple sites reduces competition in the area.
- All releases will occur after darkness has fallen and when possible on a falling tide in an effort to protect the fish from in-stream predation and expedite their movement toward the Columbia estuary.
- Returning fish from this program are not targeted for harvest.
- WDFW proposes to continue monitoring, research and reporting of chum restoration efforts performance behavior, and intra and interspecific interactions with wild fish to assess, and adjust if necessary, recovery re-introduction and release strategies to minimize effects on wild fish.
- WDFW fish health and operational concerns for the chum recovery programs are communicated to Region 5 staff for risk management or needed treatment. See also section 9.7.

Section 11. Monitoring and Evaluation of Performance Indicators

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

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

1. Restore a viable natural spawning population to Duncan Cr.

Contribution of juvenile hatchery releases to natural spawning

All hatchery releases are 100% otolith marked (thermal). Spawning ground surveys will be conducted to recover otoliths from percent (set bio-sample rate) of carcasses recovered. The WDFW otolith lab will process otoliths to determine percent hatchery origin. Total adult escapement will be calculated via a mark/re-capture program for an open population. Scales collected from sampled carcasses will be aged to assign recovered hatchery origin adults to hatchery release totals for a given brood year. Total contribution of any hatchery release can be determined by dividing the total adult escapement by the hatchery component (calculated using number of otolith sampled carcasses identified as hatchery by the bio-sample rate). This same procedure will be used to determine straying rates. Fry-to-adult survival rates can be calculated by dividing hatchery escapement by hatchery release totals for that brood year.

Contribution of wild adult releases in Duncan Creek to natural spawning.

Predictive regression formulas derived from phenotypic traits of females spawned at the hatchery can be used to estimate the fecundity (potential egg deposition-PED) of females allowed to naturally spawn in the Duncan Creek channels. Sampling of the females soon after death for retained and/or non-viable eggs allows for an estimate of actual egg deposition (AED). Using the sum of AED values for females that spawned naturally and total number of fry trapped as they emigrate from the channels a value of egg-to-fry survival will be calculated. All fry produced naturally from adults placed into the Duncan Creek spawning channels will be marked (strontium band on otolith) when captured in the downstream migrant traps. Spawning ground surveys will be conducted to recover otoliths from a consistent percentage (set bio-sample rate) of carcasses recovered. The WDFW otolith lab will process otoliths to determine the percentage of chum that originated from the Duncan Creek channels. Total adult escapement will be calculated via a mark/re-capture program for an open population. Scales collected from sampled carcasses will be aged to assign recovered Duncan Creek channel origin adults to outmigrant fry totals for a given brood year. Total contribution from the Duncan Creek channels can be determined by dividing the total adult escapement by the Duncan Creek channel component (calculated using number of otolith sampled carcasses identified as Duncan Creek channel origin by the bio-sample rate). This same procedure will be used to determine straying rates. Fry-to-adult survival rates can be calculated by dividing Duncan Creek channel escapement by outmigrant fry totals for a given brood year.

2. Conservation of Genetic and Life History Diversity.

   Timing of broodstock collection will be documented and compared to current and historical run timing. Capturing broodstock throughout the entire run protects the genetic diversity and temporal integrity of the Lower Gorge chum population. Employing a factorial mating scheme at the hatchery will minimize effects of genetic drift and inbreeding depression. Baseline data on phenotypic characteristics (fork length, mid-eye-to-hypural length, weight and fecundity) will be recorded for comparison to future brood years. Genetic material will be collected from hatchery broodstock and natural spawning adults to profile the population. Downstream migrant traps will be operated in the Duncan Creek channels to document the natural production of fry and document their migration timing. Hatchery produced fry are released as fed-fry after the peak of natural production to reduce ecological interactions.

3. Research Activities

   The Monitoring and evaluation plan was scientifically based and reviewed by an independent body of researchers (Independent Scientific Review Panel). The juvenile and adult supplementation program is set to last for 12 years. An annual report will document all research activities and make recommendations for modifications and/or additions to research activities.

4. Operation of Artificial Production Facilities

   Any direct or suspected delayed mortalities related to broodstock collection, either in tangle-net activities or at the adult collection weir located at Duncan Creek will be recorded and summarized in the annual report. Activities at Washougal Hatchery related to this HGMP will be documented in the Washougal Hatchery Annual Operations Plan report. Water quality measurements are routinely made at the hatchery and documented in the annual report. Any fish health concerns are reported to a state certified fish health specialist who will examine the suspected fish. The fish health specialist will provide a report of their findings and recommend treatment if necessary. All mortalities occurring in the incubation and rearing phases of the HGMP will be recorded and reported in our annual report to BPA.

   A more detailed summary of monitoring and evaluation activities can be found in the attached Monitoring and Evaluation Plan for the Duncan Creek Chum Salmon Reintroduction Program.

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, staffing and support logistics are in place to provide a brood stock collection crew 7days/ week throughout November and December. A full-time employee (in addition to normal hatchery personnel) is available to monitor operations at the Washougal Hatchery. This level of staffing will allow for the monitoring and evaluation of all activities from the beginning of brood stock collection through the subsequent release of thermally-marked fry. Funding for future stream surveying work to monitor and evaluate adult returns is currently being sought.

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 for brood stock collection, and egg/fry rearing and release have been described in previous sections. Future monitoring of returning adults will be accomplished through stream surveying and will include counts of live and dead adult chum, chum redd counts, and otolith sampling (for thermal mark identification) from chum carcasses. This type of surveying should have little or no effect on listed fish.

Section 12. Research

12.1 Objective or purpose.

Research programs associated with this HGMP are described in the monitoring and evaluation sections above and the Monitoring and Evaluation Plan for the Duncan Creek Chum Salmon Re-introduction Program. Research will be directed at determining whether this salvage/recovery/re-introduction program is successfully maintaining or increasing chum salmon abundance in the mainstem Columbia River, Hardy Creek, and Hamilton Creek, and introducing a new self-sustaining population of chum salmon into Duncan Creek**.**

12.2 Cooperating and funding agencies.

Washington Department of Fish and Wildlife

12.3 Principle investigator or project supervisor and staff.

The contact information for this data provided in this HGMP is Todd Hillson Hillsth@dfw.wa.gov.

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

NA

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

NA

12.6 Dates or time periods in which research activity occurs.

NA

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

NA

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

NA

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

NA

12.10 Alternative methods to achieve project objects.

NA

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

NA

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.

NA

Section 13. Attachments and Citations

13.1 Attachments and Citations

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Washington Department of Fisheries (WDF), Washington Department of Wildlife (WDW), and Western Washington Treaty Indian Tribes (WWTIT). 1992. 1992 Washington State salmon and steelhead stock inventory (SASSI). Washington Dept. Fish and Wildlife, 600 Capitol Way N, Olympia, WA. 98501-1091 . 212 pp.

Section 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

14.1 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:_____

Take Table 1. Estimated listed salmonid take levels by hatchery activity.

Chum Salmon

ESU/Population	Lower Columbia River Chum
Activity	Fall Chum Restoration Program
Location of hatchery activity	Grays River and Sea Resources Hatcheries
Dates of activity	Sept-April
Hatchery Program Operator	WDFW, Sea Resources

Type of Take	Annual Take of Listed Fish by life Stage (number of fish)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harrass (a)	nya	nya	nya	nya
Collect for transport (b)	nya	nya	nya	nya
Capture, handle, and release (c)				nya
Capture, handle, tag/mark/tissue sample, and release (d)	nya	nya	nya	nya
Removal (e.g., brookstock (e)	100,000 – 450,000	100,000 – 450,000	100- 400	nya
Intentional lethal take (f)	nya	nya	100-400	nya
Unintentional lethal take (g)	10,000 – 40,000	10,000 – 40,000		nya
Other take (specify) (h)	nya	nya	nya	nya

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.