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National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Fisheries Science Center
Fish Ecology Division
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MEMORANDUM FOR: F/NWR - William Stelle

THRU: F/NWC - Usha Varanasi

FROM: F/NWC3 - Michael H. Schiewe

SUBJECT: Evaluation of the Status of Chinook and Chum Salmon and Steelhead Hatchery Populations for ESUs Identified in Final Listing Determinations

The Conservation Biology Division staff, working with members of the Biological Review Teams (BRT) for chinook and chum salmon and steelhead, have completed their evaluation of the relationship of existing hatchery stocks to the listed evolutionarily significant units (ESUs). This evaluation is intended to provide Regional staff with the information needed to determine which hatchery stocks should be considered as part of the final listing determinations to be announced in March.

Attached is our report summarizing this evaluation. After a brief introduction, the report is composed of three sections-one for each of the species. For each species we provide descriptions of the hatchery populations under consideration (i.e., those populations containing fish that have not yet completed their life cycles, even if the hatchery programs were recently terminated). These descriptions are each followed by a table outlining the BRT's determinations on 1) whether the population is in (or out of) its associated ESU, 2) which hatchery population category (1, 2, or 3: the categorization attempts to define the relationship between the hatchery and natural fish in the ESU, and thereby the suitability of the hatchery fish for recovery) is characterizes the population in question, 3) and whether or not the population is essential for recovery of the ESU. Where available, recommendations from state or tribal comanagers for these determinations are included. An Appendix describes the criteria and procedures used to make the determinations.

Please contact either Jeff Hard or Robin Waples if you have any questions about this report.

Enclosure

cc: F/NWC - Waples
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Evaluation of the Status of Chinook and Chum Salmon and Steelhead Hatchery Populations for ESUs Identified in Final Listing Determinations

Prepared by the
Conservation Biology Division,
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4 March 1999

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[1]Conservation Biology Division staff who compiled this report include Peggy Busby, Michael Ford, Richard Gustafson, Jeffrey Hard, Orlay Johnson, James Myers, Robin Waples, and Laurie Weitkamp. The information provided is based on input from Biological Review Team members for chinook and chum salmon and steelhead (Busby et al. 1996, Johnson et al. 1997, and Myers et al. 1998 contain the lists of these members).

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INTRODUCTION

For any evolutionarily significant units (ESUs) of salmon or steelhead that are listed by NMFS as threatened or endangered "species" under the U.S. Endangered Species Act (ESA), legal protection is generally extended to all naturally spawning fish unless they or their ancestors are of non-ESU origin. Many listed ESUs also have hatchery populations associated with them, and in these cases it is necessary to evaluate the ESA status of hatchery populations as well. According to the NMFS interim policy on artificial propagation of Pacific salmon under the ESA (NMFS 1993, see also Hard et al. 1992), two key questions must be addressed for each hatchery stock associated with a listed species: 1) Is it part of the ESU? And, if so, 2) Should the hatchery population be listed? The focus of the evaluation should be on "existing hatchery fish," which are defined in the policy to include prespawning adults, eggs, or juveniles held in a facility, as well as fish that were released prior to the listing but have not yet completed their life cycle. It is important to note here that these evaluations apply to individual hatchery stocks or populations and not to facilities.

For each biological species, a NMFS Biological Review Team (BRT) reviews information for hatchery populations associated with listed ESUs and provides conclusions relevant to these two questions to the NMFS Northwest and Southwest Regional Offices. The first question–the ESU status of existing hatchery populations–is a biological one, and the guiding principle should be whether the hatchery population contains genetic resources that are representative of the evolutionary lineage that is the ESU. There are two general approaches to this issue. One is to make the ESU status of a hatchery population relative to the stock histories and evolutionary legacy of natural populations in the ESU. For example, a hatchery population recently derived from a native population probably would be considered in the ESU, while one of mixed origin located in a basin with a native wild population might be excluded. However, this mixed-origin stock might be considered to be in the ESU if the natural populations were also of mixed origin. The second approach is to make the ESU evaluations independent of the status of natural populations. One way to do this is to consider a hatchery population to be in the ESU if all (or nearly all) of the genetic contribution to the stock has come from populations within the ESU.

In ESA evaluations of hatchery populations from 1992 to 1998, BRTs used the first approach. One advantage to this approach is that it directs attention to hatchery populations that are most likely to be useful in recovery. However, this approach has some potential drawbacks. First, it is difficult to identify purely objective standards for the ESU evaluations when they are relative to characteristics of the natural populations. This makes it difficult to ensure consistency in application of the determinations across ESUs and across species. Second, because this approach can exclude a number of hatchery populations from listed ESUs, some have concluded that those stocks that are included are therefore always appropriate for general use in recovery within the ESU. This is not necessarily the case; the ESU determination for hatchery populations in no way supersedes sound principles of salmon biology, which generally dictate that a genetically similar stock should be used in supplementing a natural population. Third, this

approach may exclude some hatchery populations from an ESU even when the logical basis for doing so appears weak (e.g., when the stock origins are entirely from populations within the ESU). Such populations, even if substantially altered from their native progenitors, might play a role in recovery under certain circumstances.

In a recent review of these options, the consensus of the BRTs was that the second approach was preferable because it is more objective and repeatable across ESUs. It also eliminates the problem of excluding a hatchery population derived entirely from ESU fish. On the other hand, by expanding the scope of hatchery populations that are considered part of salmon and steelhead ESUs, this approach defers much of the control over appropriate use of artificial propagation in recovery to another process. For example, many populations that might be considered "in the ESU" by this criterion would not be suitable for use in recovery of most natural populations, based on well established principles of salmon and conservation biology. We have addressed this concern by adding another step to the evaluation process, which involves assigning each in-ESU hatchery population to one of three categories (1, 2, or 3; see the Appendix for detailed category descriptions). The categories are based on the degree to which the hatchery population contains genetic resources similar to a native, local population, and each category is characterized by a number of possible uses of the hatchery stock that are appropriate to consider for recovery.

The second question--Should an existing hatchery population that is in the ESU be listed?--is largely an administrative one. According to NMFS policy, existing fish would generally not be listed even if they are part of the ESU unless they are considered "essential" for recovery of the ESU. It is important to note that a determination that a stock is not "essential" for recovery does not preclude it from playing a role in recovery. Any hatchery population that is part of the ESU is available for use in recovery if conditions warrant. In this context, an "essential" hatchery population is one that is vital to the success of recovery efforts at the outset (for example, if the associated natural population(s) were already extinct or at high risk of extinction). Under these circumstances, NMFS would consider taking the administrative action of listing the existing hatchery population at the time of the final listing determination. In general, fish that are progeny of listed fish taken into a hatchery for broodstock automatically will be listed, so any hatchery population involved in formal recovery under the ESA eventually will be comprised of listed fish.

In the following sections, we summarize evaluations made by the Conservation Biology Division and BRT members of hatchery populations of chinook and chum salmon and steelhead in listed ESUs. These evaluations are organized into sections by biological species; each of these sections has two parts. The first part provides descriptions of the hatchery populations under consideration, excluding hatchery populations once associated with these ESUs but no longer propagated. The second part summarizes, in tabular form, determinations on 1) whether the population is in (or out of) its associated ESU, 2) which hatchery population category is appropriate for the population in question, 3) and whether or not the population is essential for

recovery of the ESU. Where available, recommendations from state or tribal comanagers for these determinations are included for comparative purposes.

CHINOOK SALMON

The chinook salmon Biological Review Team (BRT) considered the ESU status of 78 chinook salmon hatchery populations in the Puget Sound, Lower Columbia River, Upper Willamette River, and Upper Columbia River spring-run chinook salmon ESUs. Sixteen of the 78 stocks were not considered a part of the ESU into which they were released.

In evaluating the importance of hatchery stocks in the ESU for recovery, the BRT considered the relationship between the natural and hatchery populations and the degree of risk faced by the natural population(s). The BRT identified 12 hatchery populations in the Puget Sound, Lower Columbia River, and Upper Columbia River Spring-Run ESUs as essential for recovery.

Comments from WDFW

WDFW clarified the criteria used to establish whether or not a hatchery broodstock belonged in the ESU and whether or not it was essential for recovery (Crawford 1998). Because these criteria differed from that used by the BRT, excerpts from their cover letter are included below:

> Before I speak to the specific stocks, I would like to clarify the terms "part of the ESU" and "essential for recovery." The ESUs that NMFS has described within the status review encompass broad regional zones and a number of distinct and separate populations within the ESU. A population such as North Fork Nooksack [spring-run chinook salmon] is certainly representative of the ESU, but one that we would not necessarily transfer to watersheds that have no native populations. In these cases, we prefer to use the most local stock available and, in many instances, resort to using hatchery fish as a surrogate to recover wild spawners.
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> Thus, the definition of "part of the ESU" depends upon the presence or absence of a distinct native stock. If a native stock is present, then a hatchery stock would be considered part of the ESU only if it originated from the watershed in question and the hatchery stock maintains a close genetic alliance with the natural stock. If, however, no distinct native stock exists within the watershed, and natural spawning is the result of hatchery strays, then the hatchery stock may be used as a substitute for rebuilding natural spawning. Depending upon its ancestry and transfer history within the watershed, it may be considered as part of the ESU. How we address any rebuilding options where hatchery spawners predominate will require further discussion.

As for "essential for recovery," WDFW's interpretation would consist of four guidelines: 1) the hatchery stock in question would have genetic alliance with the wild stock, 2) the wild stock is in need of recovery, 3) the wild stock will not recover without the help of hatchery supplementation, and 4) genetic damage to the stock is likely to be greater if no action is taken. In systems where wild chinook no longer exist and we turn to the use of local hatchery stocks to enhance natural spawning, we would not identify that hatchery stock as essential for recovery. These guidelines apply to specific stocks and do not address the broader question of whether recovery of a particular stocks is essential to the recovery of the larger ESU or whether hatchery stocks should be listed.

This is consistent with our experience with upper Columbia steelhead (i.e., if a hatchery stock is considered "essential for recovery," it should not automatically be designated as a listed stock).

The criteria used by WDFW to define populations in or out of an ESU are similar to those used by the BRTs in their previous approach (see the Introduction), and they more restrictive in regard to the inclusion of hatchery stocks in the ESU than the new criteria outlined in this report. Generally, this difference concerns the ESU status of hatchery stocks that fall into Category 3. Comparisons between the conclusions of WDFW and the BRT regarding the ESU status of hatchery broodstocks should be made with an understanding of the underlying definitions used by each of these groups.

Hatchery Population Descriptions and Evaluations

Puget Sound Chinook Salmon ESU

Kendall Creek Spring Native (Spring-Run) Chinook Salmon Stock: Kendall Creek Hatchery is located in the Nooksack River Basin. There has been a hatchery program at the Kendall Creek site since 1899. Operations continued from 1899 to 1929, and from 1952 to the present. The current hatchery program objective for native [spring] chinook salmon is to increase the number of natural spawners through the use of acclimation ponds, which started in 1980. Because the spawning time of native spring-run and introduced fall-run chinook salmon overlaps, only returnees to the hatchery are propagated. Spawning protocols are designed to propagate the run throughout its return/spawning timing and maximize genetic representation. CWT and otoliths are utilized to distinguish the naturally-produced and hatchery-produced fish from each run time (WDF et al. 1993, Fuss and Ashbrook 1995). Genetically, the Kendall Creek stock of fish is one of the most distinct in the Puget Sound ESU (Marshall et al. 1995). The hatchery relies on adults returning to the hatchery for its broodstock. There is a naturally spawning population in the Nooksack Basin and it is probable that there is some genetic exchange between the hatchery and naturally-produced fish on the natural spawning grounds.

Comments: WDFW (Crawford 1998) emphasized that a number of strategies have been initiated to insure that the broodstock remains representative of the wild stock. The current program objective is the restoration of the naturally spawning native population through supplementation. WDFW considers this stock part of the ESU and essential for recovery.

ESU status: This broodstock is representative of the evolutionary legacy of the ESU, with only minimal influence from stocks outside the ESU. It is therefore considered part of the ESU. Because of the extended duration that this stock has been under artificial propagation, it is probable that there has been considerable opportunity for this stock to diverge from the historical population that existed in the North Fork Nooksack River Basin,therefore this broodstock is considered a Category 2 by the BRT. The majority of the BRT concluded this stock was essential for recovery. Those considering this stock essential cited the critically depressed status of the naturally-spawning population in the North Fork Nooksack (5-year geometric mean of 79). In any case, given the distinct genetic composition of this stock should not be used outside of its native basin.

Kendall Creek/Samish River Fall-Run Chinook Salmon Stock: The fall-run chinook salmon populations utilized at the Kendall Creek and Samish Hatcheries originated from the Soos Creek (Green River) Hatchery. Exchanges between the Kendall Creek and Samish Hatcheries are so common and in such quantity that these two hatchery populations are considered to be one stock by WDFW. Genetically, this stock closely resembles the Soos Creek Hatchery stock, and other Green River derivatives. A large number of fish are transferred to and released from the Lummi Tribal Hatchery and the Watcom Creek (Bellingham Maritime) hatchery.

Comments: WDFW (Crawford 1998) operates both the Kendall Creek and Samish Hatchery broodstock programs for fishery enhancement. Although there are some returns to the Kendall Creek facility, the majority of the stock is collected at the Samish Hatchery. Under the criteria put forward by WDFW, they do not considered the Kendall Creek fall-run broodstock as part of the ESU (given the significant genetic difference between the hatchery fall-run and native spring run); however, given that there are no wild fish in the vicinity of the Samish River hatchery the use of the fall-run broodstock here may be appropriate.

ESU status: This broodstock is considered part of the ESU, having been derived primarily from fish native to the Green River Basin. The contribution from sources outside the ESU has been minimal. The majority of transfers to the Samish River Hatchery originated directly or indirectly from the Soos Creek (Green River) Hatchery, which it still genetically resembles. This broodstock has been identified as a Category 3 because of the origins of this stock from outside of the basin which it is currently released. This broodstock is not considered essential for recovery because the naturally-spawning population with which they are most closely associated is not native the basin, and it is doubtful that this stock would be useful in the recovery of fall-

run chinook salmon in its native watershed (Green River) if the status of that stock should change.

Clark Creek Fall-Run Chinook Salmon Stock: This stock was reared at the Marblemount Hatchery (Skagit River Basin). It was originally founded using fish from Soos Creek Hatchery (Green River), but numerous transfers of fish from Samish, Kendall Creek, Issaquah, Minter, Willapa, and Humptulips Hatcheries were also received (the majority of these hatcheries all rear fish with Soos Creek origins) (WDF et al. 1993, Fuss and Ashbrook 1995). Returning adults were collected at a weir on Clark Creek. Due to straying by returning adults and the potential for Clark Creek fall-run chinook spawning with native Skagit River chinook the program was terminated. The last broodstock were collected in 1992, and some adults may return to the watershed this year. A number of the fish were transferred to cooperative rearing programs and tribal facilities.

Comments: WDFW (Crawford 1998) has actively terminated this program, killing any fall-run fish that have returned to the hatchery since 1993.

ESU status: The consensus of the BRT was that this is a Category 3 broodstock. Although primarily a Soos Creek derivative, eggs have been received from outside the ESU (especially the Washington Coast). Due to the termination of this project, there is no need to comment on the potential use of this broodstock.

Marblemount Summer-Run Chinook Salmon Stock (I): This stock was reared at the Marblemount Hatchery (Skagit River Basin). Wild adults were collected from the Upper Skagit River in 1975 to establish the hatchery broodstock. Adults were collected from the wild until sufficient broodstock returned to the hatchery. There appears to have been a significant overlap between the spawning time for Clark Creek fall-run chinook salmon and Marblemount summer-run chinook. As a result, allozyme analysis indicated that a significant amount of hybridization has occurred between the non-native Clark Creek stock and the summer run (Fuss and Ashbrook 1995, Marshall et al. 1995). The program was terminated in 1993, but some fish may still return to the Skagit River Basin this year.

ESU status: Although this broodstock may have been influenced by strays from another basin, within the ESU, it is still considered part of the ESU. The majority of the BRT considered this a Category 3 broodstock, because of the mixture of different stocks with different overall run timings. Genetic analysis indicates a significant divergence from naturally-spawning populations in the Skagit River Basin. Due to the relatively stable abundance of the naturally spawning spring-run chinook salmon stocks in the Skagit River Basin, this stock is not well suited for conservation use and is not considered essential for recovery.

Marblemount Summer-Run Chinook Salmon Stock (II): This stock was reared at the Marblemount Hatchery (Skagit River Basin). Wild adults were collected from the Upper Skagit

River in 1994. This program has been designed to help restore the native run in the Upper Skagit River. Juveniles are acclimated and released in the Upper Skagit River (rather than Clear Creek), and release timing is patterned after naturally-produced fish.

Comments: WDFW (Crawford 1998) considers this stock part of the ESU, but not essential for recovery. This broodstock is primarily maintained as an indicator stock.

ESU status: This stock was only recently founded from a population of spring-run chinook with little artificial propagation influence. The BRT classified this stock as a Category 1 broodstock. Unless the naturally-produced population from which it was founded goes into decline, this broodstock is not considered essential for recovery. Furthermore, it's use should be limited to the Skagit River Basin.

Marblemount Spring-Run Chinook Salmon Stock: This stock was originally founded by adult fish collected from Buck Creek (Suiattle River, Skagit River Basin) in 1976. Returning adults were also used beginning in 1981. Collection of adults from the Suiattle River ceased in 1988. Allozyme analysis of the hatchery spring run indicated that it had diverged from its founding Suiattle River population (Marshall et al. 1995). This is possibly due to hybridization with the summer and fall runs that were also being reared at the hatchery. Additionally, a spring-run chinook salmon stock (established from Cascade River (Skagit River Basin) spring-run chinook) was reared at the Marblemount Hatchery (ex-Skagit Hatchery) from the 1950s through 1972. It is not known if any fish from this program were incorporated in the present broodstock.

Comments: Genetic analyses indicate that, although this stock was founded by native spring-run chinook salmon, there has been moderate divergence between the hatchery broodstock and its native counterpart. Under the criteria utilized by WDFW (Crawford 1998) this broodstock is not considered part of the ESU, nor essential for recovery.

ESU status: This broodstock is considered part of the ESU, due to the absence of any transfers from outside the basin or ESU. It has genetically diverged from its founding stock, apparently due to artificial propagation effects rather than stock transfers. The BRT considered this stock a Category 2 broodstock. This stock is not presently considered essential for recovery. Additionally, the use of this broodstock should be limited to the Skagit River Basin, and only in instances where there is limited potential for interaction with naturally-spawning spring run.

North Fork Stillaguamish Summer-Run Chinook Salmon Stock: Broodstock for this stock is obtained from the naturally-spawning population in the North Fork Stillaguamish. Adults are taken over the course of the run from holding pools within the normal spawning area (RM 17.5-28). Adipose fin clipped fish are not incorporated into the broodstock. Broodstock adults are crossed in groups of five males and five females in matrix fashion to create 25 families. The program began in 1980. Eggs are incubated and reared at the Stillaguamish Tribal Harvey Creek Hatchery. Juveniles are acclimated at the WDFW Whitehorse Rearing Ponds on

the North Fork Stillaguamish (RKm 45). The release is volitional and growth rate is monitored to parallel wild fish development. Although several million Green River origin fish have been introduced into the Stillaguamish River, it is not known if there has been any significant hybridization between the Green River and Stillaguamish River stocks.

Comments: This broodstock is currently being used to supplement the depressed natural population. WDFW (Crawford 1998) considers this stock to be part of the ESU and essential for recovery.

ESU status: Given the relatively recent founding of this broodstock by a stock native to the Stillaguamish River, this broodstock is considered part of the ESU and the BRT classified this a Category 1. Hatchery protocols utilized to minimize domestication effects have kept this broodstock very similar to its naturally-spawning counterpart. Summer-run populations exist elsewhere in the Skagit and Stillaguamish River Basins; however, given the depressed abundance for naturally spawning North Fork Stillaguamish River summer-run chinook this broodstock may be necessary for the recovery. It is recommended that the use of this broodstock be limited to the N.F. Stillaguamish River Basin under present conditions, but may be extended to other local basins (within the existing WDFW Genetic Diversity Unit (GDU)) if necessary.

May Creek/Wallace River Summer-Run Chinook Salmon Stock: In 1972, the founding broodfish for this stock were obtained from native adults returning to the Wallace River (Snohomish River Basin). Adults returning to the Wallace River Hatchery (ex-Skykomish Salmon Hatchery) presently meet broodstock needs. There was some concern that summer-run fish had hybridized with the Wallace River fall-run chinook stock (Soos Creek origin) which is also reared at the hatchery. Allozyme analysis does not indicate a close genetic resemblance between these two stocks (Marshall et al. 1995).

Comments: In 1997, because of fears of hybridization between Wallace River summer-run and Green River origin fall-run chinook salmon returning to the hatchery, the fall-run program was terminated. WDFW (Crawford 1998) considers this broodstock to be part of the ESU, but not essential for recovery at this time.

ESU status: This broodstock was derived primarily from locally obtained broodstock. The hatchery broodstock is considered part of the ESU and a Category 2 broodstock. The hatchery broodstock may have diverged from its naturally spawning counterpart due to hybridization with introduced Soos Creek (Green River) fall-run chinook salmon. This stock is not considered essential for recovery.

Soos Creek Fall-Run Chinook Salmon Stock: Fall chinook salmon from the Soos Creek Hatchery Complex (ex-Green River Hatchery) have been transported to watersheds throughout Puget Sound and to various other locations throughout Washington State and the Pacific Northwest. Hatchery operations began in 1901. Broodstock acquisition has varied, but currently

a temporary weir is set in Soos Creek to collect broodstock. There have been a number of releases of fish from hatcheries outside of the Green River Basin; however, the majority of these hatcheries were established with Soos Creek stock. Furthermore, there is a large naturally-spawning population of chinook salmon in the Green River and there is the possibility for a high degree of exchange between naturally-spawning and hatchery populations. Two satellite facilities, Icy Creek Ponds and Crisp Creek, rear and release juvenile chinook salmon from the Soos Creek Hatchery.

Comments: WDFW considers this broodstock to be part of the ESU, but not essential for recovery (Crawford 1998).

ESU status: This broodstock is considered part of the ESU, due to the limited introduction of stocks from outside of the ESU. This broodstock has probably undergone some genetic changes during the nearly 100 years of artificial propagation. There have been limited introductions of non-native fish into the hatchery, but it is not know to what extent they have influenced the characteristics of this stock. The sizable number of naturally spawning fall-run chinook salmon in the Green River, and the resulting gene flow between hatchery and naturally-spawning populations, have probably bufferred the influence of these non-native transfers or the magnitude of domestication selection during hatchery rearing. The majority of the BRT concluded that this is a Category 2 broodstock, primarily due to the length of time under artificial propagation. The minority of the BRT concluded that because of domestication and introductions from other hatcheries this stock is a Category 3 broodstock. Presently this hatchery stock is not considered essential for recovery.

Other facilities that rear fall chinook salmon, either wholly or partly derived from the Soos Creek Fall-Run Chinook Salmon Stock, include:

Wallace River Hatchery (formerly Skykomish Salmon Hatchery)
Tulalip Tribal Hatchery -
    Wallace River Hatchery, Soos Creek, Marblemount Hatchery (†*)
Puyallup Salmon Hatchery (Voight's Creek Hatchery)
Minter Creek Hatchery
Coulter Creek Hatchery
Keta Creek (*)
Grover's Creek/Gorst Creek Tribal Hatchery (B†?) -
    Finch Creek, Soos Creek, and Deschutes River stocks
Garrison Springs Hatchery
Kalama Creek Hatchery -
    Soos Creek, Voights Creek, and Deschutes River stocks (B, since 1988)
Nisqually Hatchery (Clear Creek) -
    Finch Creek, Soos Creek, and Deschutes River, Nisqually River stocks (B)
McAllister Creek Hatchery

Deschutes River Hatchery (†)
Little Boston Creek Hatchery (*) -
This program was discontinued in 1997
George Adams Hatchery (see text)
Hoodsport Hatchery (see text)
Skokomish (Enetai) Tribal Hatchery (*)
Big Beef Creek Hatchery
Samish River Hatchery
Kendall Creek Hatchery (see text)
Lummi Sea Ponds (*) -
Soos Creek (1975-1988), Samish Hatchery, and Kendall Creek Hatchery
Bellingham Heritage
Glenwood Springs (†)
University of Washington Hatchery (†)
Issaquah Creek Hatchery (†)

(B) denotes that returning adults are generally sufficient to meet production needs
(*) denotes limited or no adult returns–insufficient to generally meet production needs
(†) denotes areas where chinook salmon were not historically present

Comments: WDFW is still reviewing the status of a number of the Green River "derivative" stocks (Crawford 1998). They do identify a number of broodstocks that have naturally spawning populations associated with them (founded by hatchery strays): Deschutes River, Voight Creek, and Nisqually River stocks. Two broodstocks were specifically given as being outside of the ESU (using the criteria given by WDFW): University of Washington and Issaquah Creek broodstocks. None of these stocks is considered essential for recovery.

ESU status: These stocks are considered part of the ESU. Primarily, they are representative of the Soos Creek (Green River) Hatchery stock, but have also been influenced by transfers from other hatcheries, integration with local stocks (in some cases), and potential founder effects. In some cases, naturally-spawning populations have been established by straying hatchery fish. These broodstocks are Category 3 broodstocks. Because these stocks are most closely aligned with the Green River fall run, and that population is not currently at risk, these stocks are not considered essential for recovery. In general, these stocks should only be used in areas where there is little chance of introgression with native stocks. Furthermore, in watersheds where there is some question concerning the persistence of native stocks (for example Nisqually River, Hood Canal, North Lake Washington tributaries) efforts should be made to document the existence or extirpation of native stocks.

Tulalip Tribal Facility Spring-Run Chinook Salmon: Marblemount spring-run chinook salmon are released from this facility. New broodstock are brought into the facility each year. Spring chinook are not native to this area.

ESU status: This stocks is considered part of the ESU. Primarily because it is reared outside of its native watershed it was considered Category 3 by the BRT. There appears to be little risk of fish from this program interbreeding with local native fish. Because this stock is derived from the Marblemount Hatchery spring run, and that population is not currently at risk, this stock is not considered essential for recovery.

White River Spring-Run Chinook Salmon: In the 1970s, in response to dramatically declining numbers of returning adults, an intensive broodstock program was developed to restore the spring-run chinook salmon stock in the White River. A portion of the progeny produced from White River spring-run adults taken at the Buckley Trap (White River Basin) were transferred to and released from the Minter Creek Hatchery Complex (incubation and rearing were done at the nearby Hupp Springs Hatchery). Adults returning to the Minter Creek were used to establish a broodstock at Minter Creek Hatchery. Additionally, a portion of progeny were captively reared in marine net-pens at Manchester, Washington until 1986 when the program was transferred to the South [Puget] Sound Net Pens. From the beginning of the program to 1986, additional broodstock were taken annually from the Buckley Trap. In 1991 and 1992 some of the progeny from the Minter Creek operation were transferred to the Muckleshoot Tribe's White River Hatchery. Throughout this period, unmarked presumably naturally-produced fish were allowed to proceed upstream of the Buckley Trap. Currently, only CWT marked fish are used as hatchery broodstock to ensure that only White River fish are propagated. Each female is crossed with two males (the second male is used as a back-up). The majority of juveniles are released as sub-yearlings to mimic the natural life-history of the population. Allozyme analysis indicates that there are no statistical genetic differences among White River spring-run chinook salmon at the Hupp Springs Hatchery, South Sound Net Pens, and naturally produced juveniles captured from the White River. The White River Spring Chinook Salmon stock most closely resembles other South Puget Sound stocks (fall runs) (Marshall et al. 1995).

Comments: WDFW (Crawford 1998) considers this broodstock to be part of the ESU, and until it can be shown that the naturally spawning population is self-sustaining this broodstock should be considered essential for recovery.

ESU status: This broodstock was founded by native White River spring run chinook salmon,and is considered part of the ESU. However, it may have undergone some genetic divergence since its founding. During artificial propagation, especially during captive culture, the effective number of parents used may have been quite low. This is classified as a Category 2 broodstock. Because this is the last south Puget Sound spring run, and the abundance of naturally produced fish is still low, this stock was considered essential for recovery by the majority of the BRT.

Solduc Spring-Run Chinook Salmon: This stock of chinook salmon originated at the Solduc Hatchery on the Washington Coast. In 1971, crosses between Cowlitz Hatchery (Lower Columbia River) spring run and the Umpqua River (Oregon Coast) spring run were made to

establish the hatchery broodstock. In later years, additional transfers of Cowlitz Hatchery spring-run chinook salmon were incorporated into the Solduc Hatchery broodstock. Fish from two additional stocks of chinook salmon reared concurrently at the Solduc Hatchery (the Dungeness River spring run and Solduc summer run), and these stocks may have been accidentally incorporated into the Solduc spring-run stock. Genetic analysis suggests that the influence of these two stocks has been substantial. The Solduc spring-run chinook salmon stock most closely resembles Elwha River chinook salmon (Marshall et al. 1995). In the Puget Sound ESU, the Solduc spring-run chinook stock is released from the Hoodsport Hatchery (Finch Creek, Hood Canal).

Comments: The propagation of this broodstock has been discontinued. WDFW (Crawford 1998) does not consider it to be part of the ESU.

ESU status: This broodstock is not considered part of the ESU due to its out origins from outside the ESU.

George Adams Hatchery Fall-Run Chinook Salmon: This hatchery was built to increase chinook salmon production in the Hood Canal area (Fuss and Ashbrook 1995). Currently, the hatchery operates a weir on Purdy Creek, a tributary to the Skokomish River, to collect returning adults. Presently, returning numbers of adults are sufficient to meet production goals (George Adams Hatchery also supplies eggs to other Hood Canal hatcheries and local enhancement programs). The broodstock was founded by fish obtained from the Hoodsport Hatchery (Finch Creek Stock, Hood Canal). In addition to the Hoodsport Hatchery stock, fish from other Puget Sound stocks (Soos Creek or Soos Creek derivatives) have been included in George Adams Hatchery releases. The influence of non-native fall-run chinook salmon on this stock is thought to be considerable (WDF et al. 1993, Fuss and Ashbrook 1995).

Comments: WDFW (Crawford 1998) states that there has been considerable exchange of broodstocks between the Finch Creek and George Adams Hatcheries. Furthermore, they assume that naturally spawning adults in Hood Canal are the result of hatchery strays. WDFW is still reviewing the status of this broodstock and has not made any recommendation as to whether it is part of the ESU, although they do state that it is not necessary for recovery.

ESU status: This broodstock was originally derived from local Hood Canal chinook salmon, but has been substantially affected by the introduction of hatchery fish from Green River derivative hatcheries. The George Adams fall-run broodstock is considered part of the ESU, because of the use of within ESU stocks There have been considerable introductions from a variety of other hatchery stocks, although most of these broodstocks are Soos Creek derivatives. Because of the frequent exchange of George Adams Hatchery and Finch Creek fall-run broodstocks, and the strong genetic similarity between Finch Creek and Soos Creek broodstocks, it is not thought that this stock is very representative of the native Skokomish River (Hood Canal) fall-run, and is therefore a Category 3 broodstock. This stock is not considered essential for recovery. There is

some uncertainty regarding the existence of native chinook salmon in the Hood Canal that have not been influenced by hatchery strays. Although, George Adams fall-run chinook salmon are no longer representative of the historical population, the continued use of this stock at this site would not appear to present a risk to the genetic diversity of the ESU unless distinct native naturally-spawning populations are identified.

Finch Creek Fall-Run Chinook Salmon: The Hoodsport Hatchery began operations in 1953. It currently collects broodstock at a permanent weir on Finch Creek. Returning adults have been sufficient to meet production needs in most years. The hatchery broodstock was primarily founded by introductions of Soos Creek (Green River) fish. There is a strong genetic similarity between Finch Creek fish and the Skagit River fall run and Green River fall run. WDFW considers this stock as "introduced" (Fuss and Ashbrook 1995). The hatchery releases into Finch Creek and from the Sund Rock Net Pens (marine).

Comments: WDFW combined the Finch Creek and George Adams Hatchery comments (see above).

ESU status: The BRT considers this broodstock to be part of the ESU as a Category 3 hatchery stock (see George Adams Hatchery).

Quilcene Spring-Run Chinook Salmon: The Quilcene Hatchery stock of spring-run chinook salmon represents a hybrid of various spring-run stocks brought into the hatchery. These stocks include: Nooksack River, Cowlitz River, and Umpqua River spring-run chinook salmon. This stock is released from the WDFW's Hoodsport Hatchery and Quilcene NFH.

Comments: This program was terminated by WDFW in 1992 (Crawford 1998). The U.S. Fish and Wildlife Service (USFWS) does not consider this stock to be part of the ESU (Hillwig 1998).

ESU status: Not in the Puget Sound ESU, due to introductions from outside the ESU

Dungeness Spring-Run Chinook Salmon: There has been a hatchery program operating on the Dungeness River since 1902. The majority of spring-run releases from the hatchery were produced from locally returning adults, with the exception of releases in 1977 and 1978 of some 187,000 Solduc Hatchery spring-run chinook salmon. The chinook hatchery program on the Dungeness River (on-station releases) was terminated in 1981. Since 1992, no adults have been collected from the Dungeness River; instead, naturally produced eggs and fry are collected from the river and transferred to Hurd Creek Hatchery and the Squaxin Island net pens for captive rearing (beginning in 1993). Elwha River fall-run chinook salmon have been reared at the Hurd Creek hatchery, some of these fish were released in the Dungeness River, while others were returned to the Elwha River. The progeny are planted into the Gray Wolf and upper Dungeness rivers to supplement natural production.

Comments: WDFW believes that this broodstock is part of the ESU and essential for recovery (Crawford 1998). Furthermore, because this stock is derived from eggs removed from redds, there is a close association between the hatchery broodstock and naturally spawning population.

ESU status: Although this broodstock was recently founded by naturally-spawning fish, the Dungeness River spring-run chinook salmon population has been influenced by artificial propagation efforts for nearly 100 years. There have been no recent introductions from outside the basin. No genetic analysis is available for either the historic or current populations. This broodstock was considered to be part of the ESU and a Category 2 broodstock. Due to the critically low population abundance (less than 100 natural spawners) and the fact that this broodstock is representative of the last spring run in the Straits of Juan de Fuca/ western Puget Sound, the use of this broodstock is considered essential for recovery by a majority of the BRT. Use of this broodstock should be limited to the Dungeness River Basin.

Elwha River Fall-Run Chinook Salmon: In 1911, the construction of two dams on the Elwha River blocked all but 4.9 miles of the historical spawning ground in the basin. Hatchery operations to mitigate the loss of habitat began in 1915, but were discontinued in 1920. In the 1930s, the mitigation program was restarted. Broodstock were collected by gaffing adults off the spawning ground (a procedure that has continue to this day). There are currently two hatchery facilities located on the Elwha River: the WDFW Elwha Rearing Channel and the Lower Elwha Tribal Facility. Poor temperature conditions in the lower river have limited natural production in this basin, and although the majority of fish returning to the basin are of hatchery origins there has been little introgression with outside stocks.

Comments: WDFW considers this stock to be part of the ESU, and in the event that the dams are removed from the Elwha River this stock should be considered essential for recovery (Crawford 1998). The Elwha Klallam Tribe believes that Elwha River hatchery broodstock should be considered essential for recovery, based on the limited success of fish naturally-spawning in the remaining available habitat (Crain 1998)

ESU status: There has been relatively little introgression from other stocks within the ESU, and even less from stocks from outside of the ESU; however, hatchery propagated fish have been a major contributor to the naturally spawning escapement for the past 70 years. A large proportion of the broodstock is removed from the natural spawning grounds each generation. Furthermore, the spring/summer runs which existed prior to the construction of the dams may have been extirpated or been integrated into the fall-run. It is doubtful whether or not sufficient habitat currently exists for Elwha River naturally spawning population to be self-sustaining. The BRT considered this stock part of the ESU and a Category 2 broodstock. Until such time as suitable habitat becomes available, the hatchery broodstock will be an important resource in preserving the genetic characteristics of this stock. This stock was considered essential for the recovery by a majority of the BRT.

Lower Columbia River Chinook Salmon ESU

There are a number of hatcheries operated in this ESU by state and/or federal agencies. To a large extent there has been considerable exchange of eggs collected throughout the 100 hundred years that hatcheries have been in operation. In general there are three stocks of fall chinook salmon reared in the ESU: lower river tules, lower river brights, and Rogue River brights.

Sea Resources Net Pens Fall-Run Chinook Salmon: This stock is derived from a variety of lower Columbia River fall-run stocks (NRC 1996). Located on the Chinook River, this private, non-profit, facility initially relied on transfers from other hatcheries. The hatchery now collects returning adults and rears their progeny. Although a native run of fall-run chinook salmon once existed, it was probably extirpated early in this century.

Comments: The USFWS considers this stock to be part of the ESU, but not essential for recovery (Hillwig 1998).

ESU status: This broodstock represents part of the evolutionary legacy of the ESU, but has probably diverged substantially from any single historical wild population. The broodstock is considered as a Category 3 broodstock. This stock is not considered essential for recovery.

Abernathy Salmon Culture and Technology Center Fall-Run Chinook Salmon: This facility was constructed in 1959 on Abernathy Creek. The hatchery is located 3 miles upstream of the confluence of Abernathy Creek at the site of a 10 foot high falls, which was laddered. There is some doubt whether fall chinook salmon are native to Abernathy Creek (Marshall et al. 1995). Returning adults are collected for broodstock. Although naturally spawning fall chinook salmon are present, these fish may be the legacy of transfers to the hatchery and (hatchery) strays from nearby systems. Prior to the initiation of the hatchery program there were a substantial number of releases of Spring Creek Hatchery fall-run chinook salmon. The present stock is considered to be widely-mixed (WDF et al. 1993).

Comments: WDFW does not consider this broodstock to be part of the ESU (Crawford 1998). They add that there are naturally spawning fish present in Abernathy Creek, but that these fish are hatchery strays or the progeny of hatchery strays. The USFWS considers this stock to be part of the ESU, but not essential for recovery (Hillwig 1998).

ESU status: This broodstock represents part of the evolutionary legacy of the ESU, but it does not reflect the within ESU diversity that once existed. It is not recommended that this stock be used outside of the immediate basin. In fact, there may be fall-run tule chinook salmon stocks which are more representative of the historical population that spawned in Abernathy Creek than that currently found in this hatchery. This broodstock is considered a Category 3, and is not essential for recovery.

Grays River Hatchery Fall-Run Chinook Salmon: The Grays River Hatchery began operations in 1961. Although fall-run chinook salmon are native to this watershed, as few as 34 adults were surveyed in 1944 and much of the spawning habitat available is marginal. Spring Creek fall-run chinook salmon were released into the Grays River prior to the development of a hatchery stock. Furthermore, the first recorded releases from the hatchery were 300,000 Spring Creek fall-run chinook salmon in 1962. Transfers of lower Columbia River fall-run chinook salmon to the hatchery have continued through the years to supplement production from adults returning to the hatchery. Fifteen different stocks have been released from this hatchery (NRC 1996). Additionally, strays from other hatcheries have been collected at the hatchery or observed on the spawning grounds.

Comments: WDFW does not consider this broodstock to be part of the ESU (Crawford 1998), due to the mixed nature of the broodstock. They add that there are naturally spawning fish present in the Grays River, but that these fish are hatchery strays or the progeny of hatchery strays. It is not recommended that this stock be used outside of the immediate basin. In fact, there may be fall-run tule chinook salmon stocks which are more representative of the historical population than that currently found in this hatchery. The USFWS considers this stock to be part of the ESU, but not essential for recovery (Hillwig 1998).

ESU status: This broodstock represents part of the evolutionary legacy of the ESU, but it does not reflect the within ESU diversity that once existed. This would be considered a Category 3, and is not considered essential for recovery.

Elochomin Hatchery Fall-Run Chinook Salmon: Although tule fall-run chinook salmon are apparently native to this watershed, there have been a large number of fish released into the Elochomin River from outside the basin prior to and following the construction of the hatchery in 1954. During the first few years of operation, juvenile fall-run chinook salmon from Spring Creek NFH were used to establish the hatchery run. This hatchery stock is considered to be widely-mixed due to stock transfers from other facilities (WDF et al. 1993). Since 1954, 20 different stocks have been released from this hatchery (NRC 1996). Additionally, strays from nearby hatcheries (including the Rogue River Brights--fall-run chinook from ESU #4--released from Young's Bay) comprise a large portion of the returning adults collected for broodstock.

Comments: WDFW does not consider this broodstock to be part of the ESU (Crawford 1998). This broodstock has been influenced by numerous transfers from a number of different hatcheries. Furthermore, strays from other hatchery programs comprise a large portion of the adults returning to the Elochomin Hatchery. The USFWS considers this stock to be part of the ESU, but not essential for recovery (Hillwig 1998).

ESU status: This broodstock represents part of the evolutionary legacy of the ESU, but it does not reflect the within ESU diversity that once existed. It is not recommended that this stock be used outside of the immediate basin. In fact, there may be fall-run tule chinook salmon stocks

which are more representative of the historical population than that currently found in this hatchery. This broodstock is considered a Category 3, and is not considered essential for recovery.

Cowlitz Salmon Hatchery Fall-Run Chinook Salmon: The present Cowlitz Salmon hatchery was completed in 1967. Prior to this there was a hatchery program for chinook and coho salmon operated out of the Clear Fork of the Cowlitz River until 1950 (Hymer et al. 1992). The completion of Mayfield Dam, in 1963, and Mossyrock Dam, in 1968, eliminated 37% of the historical spawning habitat for fall-run chinook salmon in the Cowlitz River (Hymer et al. 1992). Although hatchery production is dominant in the Cowlitz River Basin, there are still natural spawners in this watershed (Hymer et al. 1992). Analysis of natural spawners in 1980 indicated that the majority of fish were hatchery strays (WDF et al. 1993). Recent returns to the hatchery have been well below the mitigation goal for the hatchery, 8,300 fall-run fish; however, the hatchery has been able to maintain the run using predominantly locally-returning fish--there have been only 4 introductions of non-native fish since 1951 (WDF et al. 1993, Marshall et al. 1995).

Comments: WDFW considers this broodstock to be part of the ESU, but not essential for recovery (Crawford 1998). There are a considerable number of naturally spawning fall-run chinook salmon present in the Cowlitz River, and hatchery-derived adults appear to constitute a considerable portion of these naturally spawning fish. The USFWS considers this stock to be part of the ESU, but not essential for recovery (Hillwig 1998).

ESU status: This broodstock represents part of the evolutionary legacy of the ESU. The presence of naturally-spawning populations in the Cowlitz River basin may have somewhat bufferred the loss of local adaptation through introductions of non-local within ESU broodstocks, or the effects of artificial propagation; therefore the majority of the review group classified this stock as Category 2. This broodstock is suited for use in the immediate basin, any may also be useful in reestablishing tule fall-run chinook populations in nearby river systems. This stock is not considered essential for recovery at this time, but some members were considered about the sustainability of the naturally-spawning population.

Cowlitz Hatchery Spring-Run Chinook Salmon: The present Cowlitz Salmon hatchery was completed in 1967. Prior to this there was a hatchery program for chinook and coho salmon operating out of the Clear Fork of the Cowlitz River until 1950 (Hymer et al. 1992). The completion of Mayfield Dam, in 1963, and Mossyrock Dam, in 1968, eliminated all of the historical spawning habitat for spring-run chinook salmon in the Cowlitz River. With the exception of an 8 miles stretch of river below the hatchery, the production of spring-run chinook salmon in the Cowlitz River is completely dependant on artificial propagation. The average naturally-spawning escapement has been 169 fish (1980-96), and there is considerable potential for hybridization between spring and fall run adults. The majority of naturally-spawning fish are thought to be hatchery strays. Recent returns to the hatchery have been well below the mitigation goal for the hatchery,17,300 spring-run fish; however, the hatchery has been able to

maintain the run using predominantly locally-returning fish (WDF et al. 1993, Marshall et al. 1995). Only a few fall chinook salmon stocks from outside the basin have been released from the Cowlitz Hatchery, and none since 1981 (Marshall et al. 1995). The Toutle Hatchery receives its spring chinook salmon stock from the Cowlitz Hatchery (NRC 1996).

Comments: This stock is considered part of the ESU by WDFW (Crawford 1998); however, it is not considered essential for recovery. The USFWS was unsure of the status of this stock (Hillwig 1998).

ESU status: This stock was founded by Cowlitz River spring run chinook salmon, and is considered part of the ESU. There have been relatively minimal introductions of fish from outside of the basin. The majority of the BRT classified this as a Category 2 broodstock, primarily due to possible introgression with the fall run reared at the same hatchery. Dam construction has eliminated access to the historical spring run spawning habitat, and some hatchery propagated spring run adults spawn naturally below the hatchery, where there is a potential for hybridization with spawning fall run adults. This stock represents one of the few remaining spring runs in the ESU and the majority of the BRT considers it essential for recovery.

Toutle Salmon Hatchery Fall-Run Chinook Salmon: The Toutle Salmon Hatchery was constructed in 1956 on the North Fork of the Toutle (Green) River, under the Mitchell Act. With the eruption of Mt. St. Helens in 1980, the hatchery was destroyed; however, in 1985, juvenile releases of fall-run chinook salmon were resumed from rearing ponds associated with the original hatchery. In 1990, an adult collection facility was established. In the years immediately following the eruption adult returns were at or near zero. It is most likely that the current hatchery stock consists of fish transferred into the North Fork Basin following resumption of hatchery activities in 1985. Since 1985, introduced fish were obtained from the Cowlitz, Grays River, Big Creek, Kalama, and Washougal Hatcheries, which themselves are predominately Category 3 broodstocks.

Comments: WDFW considers this broodstock to be part of the ESU, but not essential for recovery (Crawford 1998). The USFWS considers this stock to be part of the ESU, but was unsure of whether it was essential for recovery or not (Hillwig 1998).

ESU status: This broodstock represents part of the evolutionary legacy of the ESU. The presence of naturally-spawning populations in the Cowlitz River basin may have bufferred the loss of local adaptation through introductions of non-local within-ESU broodstocks. The BRT concluded that this stock should be classified as a Category 3 and not essential for recovery.

Kalama River Fall-Run Chinook Salmon: There are three facilities in the Kalama River Basin which release fall-run chinook salmon: Kalama Falls Hatchery, Lower Kalama Hatchery, and Gobar Ponds. Broodstock for these facilities are captured at the Modrow Trap (RKm 5); however excess broodstock are passed upstream and there can be a substantial number of

naturally-spawning fish in some years (WDF et al. 1993). There have been limited introductions of fish from outside of the basin. The Snake River fall-run egg bank program was operated during the 1970s and 1980s at the Kalama Falls Hatchery, but the marking of egg-bank fish, in addition to differences in return and spawning time, would have minimized the chance of any introgression by Snake River fish into the local broodstock. Genetically, fall-run chinook salmon from the Kalama River hatchery stock most closely resemble fish from the Cowlitz and North Fork Lewis rivers (Marshall 1995).

Comments: The ESU status of this broodstock is still under review by WDFW, although they did conclude that this broodstock is not essential for recovery (Crawford 1998). The USFWS considers this stock to be part of the ESU, but was unsure of whether it was essential for recovery or not (Hillwig 1998).

ESU status: Due to limited introductions, this broodstock may still retain characteristics of the founding population; however, for a number of years returning adults were intercepted in the lower river and not allowed to spawn naturally thus increasing the potential for domestication and inadvertent selection. This broodstock is in the ESU and considered a Category 2 broodstock. This broodstock is not considered essential for recovery at this time, but would be the most appropriate choice for use in the Kalama River Basin.

Kalama River Spring-Run Chinook Salmon: There are three facilities in the Kalama River Basin which release spring-run chinook salmon: Kalama Falls Hatchery, Lower Kalama Hatchery, and Gobar Ponds. The Kalama River had few spring chinook salmon historically. Prior to the establishment of the spring-run program at the Kalama Falls Hatchery in 1959, average escapements were less than 100 fish. The current broodstock was derived from Cowlitz Salmon Hatchery, Eagle Creek NFH, Little White Salmon NFH, Lewis Hatchery, and the Willamette River (NRC 1996, Marshall et al. 1995). Returning adults at captured in the lower River at the Modrow Trap and then transported to the Kalama Falls Salmon Hatchery for spawning (Delarm and Smith 1990a). Genetically this stock most closely resembles the Cowlitz Salmon Hatchery spring run and the Lewis River spring run (which has been large derived from Cowlitz Salmon Hatchery transfers (WDF et al. 1993). Since 1958, 18 different stocks have been released from this hatchery (NRC 1996).

Comments: This broodstock was not considered part of the ESU by WDFW and USFWS, nor essential for recovery (Crawford 1998, Hillwig 1998).

ESU status: This stock is primarily a derivative of the Cowlitz Hatchery spring run, and is representative of the evolutionary legacy of the ESU. It is considered a Category 3, and not considered essential for recovery at this time. Since native spring-run chinook salmon no longer exist, the use of a Cowlitz Hatchery derived spring run in the Kalama River Basin provides the best opportunity for reestablishing a spring run (especially given the genetic similarity between Cowlitz and Kalama River fall runs).

Lewis Hatchery Spring-Run Chinook Salmon: Attempts by this hatchery in the 1930s, following the construction of Merwin Dam, to save the indigenous Lewis River spring chinook salmon stock failed. The current broodstock originated from Cowlitz Hatchery, Kalama Falls Hatchery, Carson NFH, Klickitat Hatchery, and Willamette River stocks (Marshall et al. 1995). Returning adults are trapped at the Lewis Hatchery and at the base of Merwin Dam (Delarm and Smith 1990). In the Lewis River Basin, natural spawning occurs below Merwin Dam and in Cedar Creek (Howell et al. 1985a), and escapement has averaged 662 from 1980-1996 (Myers et al. 1998). Due to poor trapping efficiency at the Lewis River Hatchery, it is possible that a large proportion of the natural spawners are hatchery strays (Hymer et al. 1992). Strays from other hatcheries are also common in the Lewis River (Marshall et al. 1995), and may contribute to natural and/or hatchery production. Fish have also been released from the Speelyai hatchery. Genetically, Lewis River Hatchery Spring chinook salmon are intermediate between ocean-type spring chinook salmon from the Cowlitz and Kalama River Hatcheries and stream-type Klickitat Hatchery spring chinook salmon (Marshall et al. 1995, Myers et al. 1998).

Comments: WDFW presently considers this population part of the ESU, but not essential for recovery (Crawford 1998). Furthermore, naturally spawning spring-run adults are considered to primarily be hatchery produced fish, due to poor trapping efficiency at the hatchery. The USFWS did not consider this stock to be part of the ESU, not essential for recovery (Hillwig 1998).

ESU status: This stock was founded by spring-run chinook salmon native to the Lewis River Basin, but has been strongly influenced by transfers from the Cowlitz Hatchery spring-run stock; however it is still possible that there is a significant legacy remaining from the founding native Lewis River spring run. Because of its within ESU origins, this stock is considered part of the ESU, and a Category 3. At this time it is not considered essential for recovery.

Washougal Hatchery Fall-Run Chinook Salmon: The Washougal Hatchery is located on the Washougal River (RKm 32) and began operations in 1959. The hatchery collects its broodstock from adults returning to the hatchery. Fall-run chinook salmon are native to this basin (WDF et al. 1993), but historically passage was only possible to Salmon Falls (RKm 24) until it was laddered in the 1950s (Marshall et al. 1995). Since 1953, 16 different stocks have been released from this hatchery, and with the exception of a transfer of 1.2 million upriver bright fall-run chinook salmon from Priest Rapids Hatchery, these transfers have consisted of lower Columbia River fall-run tule stocks (Myers et al. 1998). A distinct Washougal River fall chinook salmon stock may no longer exist (Marshal et al. 1995). There is no genetic information available on this stock.

Comments: The ESU status of this broodstock is still under review by WDFW, although they did conclude that this broodstock is not essential for recovery (Crawford 1998). The USFWS considers this stock to be part of the ESU, but was unsure of whether it was essential for recovery or not (Hillwig 1998).

ESU status: Although initially founded by adults native to the Washougal River Basin, this hatchery has received numerous transfers from other hatcheries in the ESU, the majority of which are Category 3 broodstocks. WDFW biologists believe that due the unique ecological conditions that exist in the basin, the impact of these transfers was considerably less than would have been assumed given the magnitude of the transfers. The BRT concluded that this is a Category 3 broodstock. The broodstock is not considered essential for recovery at this time, but would be best suited for use in the Washougal River Basin if recovery activities are undertaken.

Carson National Fish Hatchery Spring-Run Chinook Salmon: Historically, the Wind River did not have a run of spring chinook salmon. Shipperd Falls at Rkm 4, block access to the upper watershed (Fulton 1968). The Carson NFH was constructed in 1938; however early attempts to establish a spring run (primarily using Willamette River spring-run stocks) were unsuccessful. The hatchery operated adult collecting facilities below Shipperd Falls (Bryant 1949), prior to the laddering of the falls in 1956. In 1958, a program was begun using spring chinook collected at Bonneville Dam. The majority of these fish were probably returning to spawning grounds in the Snake River Basin, although other stocks from rivers in the upper and middle Columbia rivers also significantly contributed to the broodstock (Hymer et al. 1992). Genetically, Carson NFH spring chinook salmon most closely resemble fish from the upper Columbia and Snake River Basins (Myers et al. 1998). Carson stock or Carson stock derivatives have also been released, or are also currently being released from the Little White Salmon and Willard NFH (WDF et al. 1993).

Comments: This broodstock was not considered part of the ESU by WDFW and USFWS, nor essential for recovery (Crawford 1998, Hillwig 1998).

ESU status: Considered to be out of the ESU, due to substantial transfers of fish from outside of the ESU. Furthermore, because this stock was founded by representatives from three ESUs (Middle Columbia River Spring Run, Upper Columbia River Spring Run, and Snake River Spring- and Summer-Run ESUs), it may not belong to any biological ESU.

Little White Salmon NFH Fall-Run Chinook Salmon: This hatchery began operations in 1898. Production programs utilizing lower Columbia River tule stocks were discontinued in the 1980s, and was replaced with an upriver bright fall-run stock from Bonneville Hatchery (see Bonneville Hatchery Upriver Bright Fall-Run Stock).

Comments: This broodstock was not considered part of the ESU by WDFW or USFWS, nor essential for recovery (Crawford 1998, Hillwig 1998).

ESU status: Considered to be out of the ESU, due to substantial introductions from outside of the ESU.

Spring Creek NFH Fall-Run Chinook Salmon: The Spring Creek NFH began operations in 1901 with adult fall-run chinook salmon collected from the White Salmon River (Howell et al. 1985a). Returning adults captured at the hatchery and at a weir on the White Salmon River have provided sufficient numbers of gametes to meet production in needs in all but a few years. Since 1976, fish from Little White Salmon NFH, Abernathy NFH, and Bonneville Hatchery have occasionally been released from Spring Creek NFH (NRC 1996). Genetically, Spring Creek NFH fall-run chinook salmon are distinct from other lower river chinook stocks.

Comments: WDFW does not consider this broodstock to be part of the ESU, nor essential for recovery (Crawford 1998). The USFWS considers this stock to be part of the ESU, but not essential for recovery (Hillwig 1998).

ESU status: It is not known to what extent artificial propagation activities or recent introductions from outside the ESU have caused this stock to diverge form the founding White Salmon River tule fall-run population. Genetically, this stock most closely resembles other populations in the ESU (although it is an outlier), and it is considered part of the ESU, and the BRT considered it a Category 3 broodstock. This broodstock may be useful for the recovery of chinook salmon to the White Salmon River if fish passage is restored, but at this time it is not considered essential for recovery.

Klickitat Hatchery Fall-Run Chinook Salmon: The current Klickitat Hatchery was built in 1949, although a hatchery operated on the river during the turn of the century (Delarm and Smith 1990). Fall-run chinook salmon are not native to the Klickitat River Basin, due to Lyle Falls, a set of waterfalls at Rkm 4 that was impassable during autumn the return migration for fall-run fish (Bryant 1949). Introductions of fall-run chinook salmon into the Klickitat River Basin began in 1946 (Marshall et al. 1995), and although a hatchery broodstock was established, there were subsequent introductions of lower Columbia River "tule" stocks continued until 1986, the majority of which came from Spring Creek (40 million fish from 1952-1983). In 1986, hatchery production of tule chinook salmon was terminated and replaced with upriver bright fall-chinook salmon from Priest Rapids Dams and Bonneville Upper River Bright (URB) stocks (WDF et al. 1993). The present hatchery stocks is a hybrid of tule and upriver bright stocks, and exhibits some life history traits from each of the original stocks (Marshall et al. 1995). Genetically, this stock more closely resembles Hanford Reach fall-run and upper Columbia River summer-run chinook salmon (Marshall et al. 1995, Myers et al. 1998).

Comments: This broodstock was not considered part of the ESU by WDFW and USFWS, nor essential for recovery (Crawford 1998, Hillwig 1998).

ESU status: Considered to be out of the ESU, due to substantial introductions from outside the ESU.

Youngs Bay Net Pens Spring-Run Chinook Salmon: Spring chinook salmon have been released from these net pens since 1990. 82% of the liberated fish were of Willamette River stock (NRC 1996).

Comments: The USFWS did not consider this stock to be part of the ESU, not essential for recovery (Hillwig 1998).

ESU status: Considered to be out of the ESU, due to substantial transfers of fish from outside of the ESU.

Big Creek Hatchery Fall-Run Chinook Salmon: ODFW Stock #13. This facility began operation in 1941. Fall-run chinook salmon are native to this basin, and there is suitable habitat available for several hundred natural spawners. The founding broodstock apparently was derived from adults returning to Big Creek. In 1941 and 1942 there were releases of spring-run chinook salmon from the Willamette River into Big Creek (there is little indication that these fish were incorporated into the fall-run broodstock). Currently, adults are collected in Big Creek for broodstock, a portion of these fish are strays from other hatchery programs. Furthermore, there have been a number of transfers of fish to the Big Creek facility, primarily from the Bonneville and Klaskanine Hatcheries. Since 1941, 8 different stocks have been released from this hatchery (NRC 1996). Although Rogue River fall-run chinook salmon (ODFW Stock #52) have been released from this site, ODFW managers state that due to differences in spawn timing, and the fact that they are marked, Rogue River fish are excluded from Oregon "tule" hatchery programs (ODFW 1995b).

Comments: The USFWS considers this stock to be part of the ESU, but was unsure of whether it was essential for recovery or not (Hillwig 1998).

ESU status: There have been numerous transfers from other hatcheries within the ESU. It is not recommended to use this stock outside of its immediate location in Big Creek. Given the limited spawning habitat available and the magnitude of artificial propagation efforts in this basin, it is unlikely that the present stock retains any special affinity to the historical fall-run chinook salmon population. This hatchery population is part of the ESU, and considered a Category 3 stock. If further analysis indicates that there has been substantial introgression by Rogue River fall-run chinook salmon, then it may be advisable to replace this stock.

Rogue River Fall-Run Chinook Salmon: ODFW Stock #52. As part of a fisheries enhancement program fall-run chinook salmon from the Rogue River's Cole Rivers Hatchery were released from facilities at Big Creek (beginning in 1984) and Young's Bay (beginning in 1989). Several hundred to a few thousand adults return to the Big Creek facility annually. Recently, because of the large number of straying adults observed in tributaries to the lower Columbia River the release of fish from the Big Creek facility was terminated; however, Rogue River stock continue to be released from the Young's Bay site (NRC 1996). The ODFW Rogue

River program is scheduled to be moved to Klaskanine Hatchery in 1999 (R. Z. Smith, NMFS, pers. commun., 1997; see also Rogue River Fall-Run Chinook Salmon in ESU #4).

Comments: The USFWS did not consider this stock to be part of the ESU, nor essential for recovery (Hillwig 1998).

ESU status: Considered to be out of the ESU, due to its origin from outside the ESU. This broodstock may be considered part of the Southern Oregon and California Coast ESU.

Klaskanine River Hatchery Fall-Run Chinook Salmon: ODFW Stock #15. The Klaskanine Hatchery program began operations in 1911. Historically, the Klaskanine River Basin supported a sizable population of naturally-spawning fall-run chinook salmon. For several years during the operation of the hatchery, weirs used to collect returning adults prevented passage to much of the historical habitat. Hatchery broodstock were derived from returning hatchery adults and strays from other lower Columbia River hatchery- and naturally-produced strays. In addition, there have been over 37 million fall-run chinook salmon released into the Klaskanine River Basin, primarily from other hatcheries in this ESU. There were a number of return years when, apparently, no eggs were taken at the hatchery and imports of eggs (primarily from the Big Creek Hatchery and Spring Creek NFH/White Salmon River) were used.

Comments: The USFWS considers this stock to be part of the ESU, but did not report on whether it was essential for recovery or not (Hillwig 1998).

ESU status: This broodstock represents part of the evolutionary legacy of the ESU, but it does not reflect the within ESU diversity that once existed. It is not recommended that this stock be used outside of the immediate basin. In fact, there may be fall-run tule chinook salmon stocks which are more representative of the historical population than that currently found in this hatchery. This broodstock is considered a Category 3, and is not considered essential for recovery.

Klaskanine Hatchery Spring-Run Chinook Salmon: Spring chinook salmon have been released from these net pens since 1912. Since 1989, 85% of the liberated fish were of Willamette River stock (NRC 1996).

Comments: The USFWS did not consider this stock to be part of the ESU, not essential for recovery (Hillwig 1998).

ESU status: Considered to be out of the ESU, due to substantial transfers of fish from outside of the ESU.

Clackamas Hatchery Spring-Run Chinook Salmon: ODFW Stock #19. In addition to Clackamas Hatchery fish, small numbers of upper Willamette River and Carson NFH spring

chinook salmon were used at Clackamas Hatchery before 1988. Since 1989, only early and late-run Clackamas River stocks have been used (ODFW 1995b, NRC 1996).--see ESU #10 Upper Willamette River.

Comments: The USFWS did not consider this stock to be part of the ESU, nor did it consider this stock essential for recovery (Hillwig 1998).

ESU status: Considered to be out of the ESU, due to substantial transfers of fish from outside of the ESU.

Bonneville Hatchery Fall-Run Chinook Salmon: ODFW Stock #14. The Bonneville Hatchery is one of the oldest artificial propagation facilities in the Columbia River Basin (continuous operations began in 1909). The hatchery is located on Tanner Creek, just downstream of Bonneville Dam. Historically, there was little available habitat for anadromous salmonids (there is a 100 foot waterfall at Rkm 2). Records of early hatchery operations are limited, releases in 1909 (from Spring Creek NFH) resulted in adult returns beginning in 1911. There is no record of adults returning to the Bonneville Hatchery in 1909 and 1910. Subsequently, there have been numerous transfers of different stocks. In the absence of suitable habitat for natural spawning for any large number of chinook salmon in Tanner Creek, the source of future broodstock has been returning hatchery-produced adults, strays, and transfers from other hatcheries. The majority of transfers into Bonneville Hatchery have been from other lower Columbia River hatcheries (Spring Creek NFH, Eagle Creek NFH, Kalama Hatchery, and Cascade Hatchery). Furthermore, several million spring-run chinook salmon (from a variety of sources from the Oregon Coast, Willamette River Basin, and Snake River Basin) have been released from the Bonneville Hatchery. The success of these spring runs is thought to be low and the potential for integration into the fall-run stock, minimal.

Comments: This broodstock was not considered part of the ESU, nor essential for recovery (Crawford 1998). The USFWS considers this stock to be part of the ESU, but was unsure on whether it was essential for recovery or not (Hillwig 1998).

ESU status: This stock represents a mixture of fall-run stocks from throughout the ESU. Furthermore, there is a likelihood that some interbreeding has occurred between the tule (native Lower Columbia River stocks) and upriver bright stocks being reared at the Bonneville Hatchery. This stock is part of the ESU, and the BRT considers it to be a Category 3 broodstock.

Bonneville Hatchery Upriver Bright Fall-Run Chinook Salmon: ODFW Stock #95. As part of a fisheries mitigation program, fall-run chinook salmon returning to areas in the mid and upper Columbia River were intercepted at Bonneville Dam beginning in 1977. These fish represented a mix of several different upriver stocks that were selected on the basis of their run timing and physical appearance (showing little spawning coloration). Migrating fall-run chinook salmon were trapped at Bonneville dam through 1988, these fish were used in

conjunction with returns to the hatchery (which began in 1981). Genetically, these upriver fish are distinct from lower Columbia River "tules" and naturally spawning "lower river bright" fall-run chinook salmon in the Lewis and Sandy rivers. This stock has also been introduced into the Little White Salmon NFH, and Klickitat Hatchery stocks.

Comments: The USFWS did not consider this stock to be part of the ESU, not essential for recovery (Hillwig 1998).

ESU status: Considered to be out of the ESU, due to its origin from outside the ESU.

Hood River Spring-Run Chinook Salmon: ODFW Stock #66. Spring-run chinook salmon were native to the Hood River Basin, but have been extirpated (ODFW 1995b). Fish from a number of different hatcheries have been released in the Hood River Basin to reestablish a spring run. From 1985 to 1992, over one million fish were released into the Hood River Basin from the Carson NFH and the ODFW Lookingglass Hatchery (ODFW Stock #81), a Carson stock derivative. Beginning in 1993, spring run fish from the Deschutes River Basin (Round Butte, ODFW Stock #66) we released in the Hood River. In 1999, adults returning to the Hood River will be used a broodstock for future releases.

ESU status: Considered to be out of the ESU, due to its origin from outside the ESU.

Clackamas River Spring-Run Chinook Salmon: ODFW Stock #19. Several hatcheries have reared spring-run chinook salmon in the Clackamas River Basin, although only two hatcheries currently or have recently propagated spring-run chinook salmon. The Eagle Creek NFH was completed in 1956 under the Mitchell Act. It is located on Eagle Creek, a tributary to the Clackamas River and part of the Willamette River Basin below Willamette Falls. The Clackamas Hatchery is located on the Clackamas River and was constructed in 1979. Spring salmon were native to the Clackamas River; however, with the construction of Cazadero Dam (Faraday Dam), most of the historic spawning ground in the upper Clackamas River Basin was inaccessible to spring-run fish due to poor passage facilities at the dam (Willis et al. 1995). Improvements in the fish ladder at the dam in 1939 restored access to the upper watershed; however, by this time the naturally-spawning population had been reduced considerably. Naturally spawning spring-run chinook salmon have reestablished themselves in the upper Clackamas River; however, the origin of these fish is unknown and may consist of the descendants of fish that spawned below Cazadero Dam or the progeny of hatchery-produced strays. Production for the Clackamas Hatchery have been derived from adults returning to the hatchery or transfers from out-of-basin hatcheries, primarily from the upper Willamette River. The Eagle Creek NFH terminated its spring-run program in the 1980s, although it has reared spring-run chinook salmon for release elsewhere. Genetically, Clackamas Hatchery spring-run fish and fish from hatcheries in the upper Willamette River Basin are very similar. Willis et al. (1995) suggested that differences in spawning times for Clackamas River spring-run chinook

salmon prior to and following the laddering of Cazadero Dam would indicate that the native stock was replaced by upper Willamette River origin fish.

Currently, Clackamas Hatchery spring-run chinook salmon are released into the Sandy River Basin. Releases are made from two acclimation sites: at Marmot Dam and at a series of net pens. There are no collection facilities for adults in the Sandy River Basin.

Comments: This broodstock was not considered part of the ESU by USFWS, nor was it considered by them to be essential for recovery (Hillwig 1998). However, the USFWS response was to the original placement of the Clackamas River spring-run in the Lower Columbia River ESU, and did not reflect the placement of the Clackamas River spring-run population into the Upper Willamette River ESU.

ESU status: The BRT concluded that releases of Clackamas Hatchery spring-run chinook salmon into the Lower Columbia River ESU should be considered introductions from outside the ESU.

Upper Willamette River Spring Chinook Salmon ESU

Oregon Department of fish and Wildlife lists several stocks as being released in this ESU. Spring chinook salmon Stock Nos. 21, 22, 23, and 24 are all released in the Upper Willamette River Basin from different hatcheries, yet ODFW list a common source stock, the "Willamette Mix." The common source stock reflects the high level of fish transfers between hatcheries over the last 100 years. Interbasin transfers have been reduced considerably since the mid-1970s. Genetically, there is a high degree of similarity between Upper Willamette, Clackamas, and Sandy River stocks (Myers et al. 1998). Nicholas (1995) stated that:

> Conceivably, genetic differences may have existed between some indigenous spring chinook populations located in geographically distinct portions of the Willamette basin. Sampling to date has not been sufficient to determine whether such differences may persist within the Willamette/Sandy spring chinook ESU [sic] that currently consists largely of hatchery fish... If any group of spring chinook in the Willamette/Sandy ESU [sic] is genetically distinguishable from others in this ESU [sic], it is thought most likely that this might occur in the McKenzie basin.

North Fork Santiam River Spring-Run Chinook Salmon Stock: ODFW Stock #21. Spring chinook salmon with this designation have been reared at the Marion Forks Hatchery. This hatchery began operations in 1951 to mitigate the effects of the Detroit and Big Cliff Dams. Adults are collected at the Minto Pond satellite facility (53 km downstream of the Marion Forks Hatchery) on the North Fork of the Santiam River. The majority of fish released into the North Fork Santiam River have come from within the ESU (Santiam and MacKenzie River Basins),

with a limited number of fish from outside the ESU. Introductions of spring chinook salmon from the Carson Hatchery (1.5 million in total) were apparently not successful.

ESU status: Transfers of broodstocks between hatcheries in the Upper Willamette River have been substantial, reducing or nearly eliminating within ESU diversity; however, the hatchery populations in this ESU are genetically distinct form neighboring ESUs and are thought to retain the genetic resources of the ESU. This hatchery population is considered part of the ESU, and is a Category 3 broodstock. Although there are naturally spawning spring-run chinook salmon in the North Fork Santiam River Basin, their productivity is thought to be minimal (ODFW 1998). This stock is not presently considered to be essential for recovery, but may be if conditions in this basin change. Efforts by ODFW to encourage local adaptation by reducing between hatchery transfers in this ESU should be continued.

Middle Fork Willamette River Spring-Run Chinook Salmon Stock: ODFW Stock #22. Broodstock for this stock is collected at the Dexter Rearing Pond and transferred to the Willamette Hatchery for spawning. Prior to the construction of Dexter Dam, adults were taken from racks established at various locations in the Middle Fork. Juveniles are reared at both of these facilities. Much of the historical spawning habitat for spring chinook salmon is currently inaccessible or has been degraded (due to changes in water temperature) and the majority of adults collected are of hatchery origin. As with the other Willamette River Basin hatchery stocks there was considerable interchange of fish between hatcheries prior to the mid-1970, but these have been reduced in recent years with reliance on locally returning adults as broodstock.

ESU status: Transfers of broodstocks between hatcheries in the Upper Willamette River have been substantial, reducing or nearly eliminating within ESU diversity. This hatchery population is considered part of the ESU, and is a Category 3 broodstock. Historical spawning habitat is inaccessible due to dam construction. This stock is not presently considered to be essential for recovery, but may be if conditions in this basin change. Efforts by ODFW to encourage local adaptation by reducing between hatchery transfers in this ESU should be continued.

McKenzie River Spring-Run Chinook Salmon Stock: ODFW Stock #23. ODF&W identified the McKenzie River stock as being the most unique of the Willamette River Basin stocks (ODFW 1995b). This conclusion was based on the "relatively" smaller proportion of non-local fish introduced into the basin, and the "relatively" larger proportion of historical spawning habitat that is still available. A number of hatcheries have been operated on the McKenzie River since the early 1900s. In the past there was considerable transfer of eggs and fish between hatcheries in the Willamette River Basin and out to the Bonneville and Klaskanine Hatcheries (Wallis 1961a). Currently, the McKenzie River Hatchery collects returning adult hatchery fish and some naturally produced adults.

ESU status: The McKenzie River Hatchery is somewhat different from the other hatcheries in that a "self-sustaining" naturally spawning population is thought by ODFW to still exist in the

McKenzie River Basin (Nicholas 1995), however; the majority of these naturally spawning fish are hatchery produced. This hatchery broodstock is classified as a Category 3 broodstock. The majority of the BRT did not consider it essential for recovery. The majority opinion was based, in part, on the belief that sufficient numbers of naturally-produced spawners (approx. 1,000) existed to exploit the available spawning habitat; however, full recovery of the ESU would be predicated on the improvement or addition of spawning habitat, and not the maintenance of a large proportion of the population in fish hatcheries. The minority opinion expressed a concern that the there was little evidence to support the conclusion that the only remaining naturally-spawning population was self-sustaining. Efforts by ODFW to encourage local adaptation by reducing between hatchery transfers in this ESU should be continued.

South Santiam River Spring-Run Chinook Salmon Stock: ODFW Stock #24. The first South Santiam Hatchery began operation in 1925. Originally the hatchery was located on Coal Creek, a tributary to the South Santiam River between the present day Green Peter and Foster Dams. The hatchery was moved in conjunction with the construction of Foster Dam. Presently, adults are collected at Foster Dam, which is adjacent to the hatchery site. Prior to 1948, it was policy to take as many spawners as possible, although difficulties in installing the weir each year probably allowed a significant number of fish to spawn naturally (Wallis 1961b). Changes in policy limited the adult collection to correspond with hatchery capacity and reduced the interchange of eggs and fish between hatcheries in the Upper Willamette River Basin (Olsen et al. 1992). There is some natural production in the mainstem South Santiam River and its tributaries (Crabtree and Thomas Creek). This stock is considered a substock of Santiam River spring chinook salmon (ODFW 1995b).

ESU status: Transfers of broodstocks between hatcheries in the Upper Willamette River have been substantial, reducing or nearly eliminating within ESU diversity. This hatchery population still represents the evolutionary legacy of historical populations from this ESU, and should be considered part of it. Because of the homogenized nature of this broodstock it would be considered Category 3. Historical spawning habitat is inaccessible due to dam construction. This stock is not presently considered to be essential for recovery, but may be if conditions in this basin change. Efforts by ODFW to encourage local adaptation by reducing between-hatchery transfers in this ESU should be continued.

Clackamas River Spring-Run Chinook Salmon: ODFW Stock #19: Several hatcheries have reared spring-run chinook salmon in the Clackamas River Basin, although only two hatcheries currently or have recently propagated spring-run chinook salmon. The Eagle Creek NFH was completed in 1956 under the Mitchell Act. It is located on Eagle Creek, a tributary to the Clackamas River and part of the Willamette River Basin below Willamette Falls. The Clackamas Hatchery is located on the Clackamas River and was constructed in 1979. Spring salmon were native to the Clackamas River; however, with the construction of Cazadero Dam (Faraday Dam), most of the historic spawning ground in the upper Clackamas River Basin was inaccessible to spring-run fish due to poor passage facilities at the dam (Willis et al. 1995).

Improvements in the fish ladder at the dam in 1939 restored access to the upper watershed; however, by this time the naturally-spawning population had been reduced considerably. Naturally spawning spring-run chinook salmon have reestablished themselves in the upper Clackamas River; however, the origin of these fish is unknown and may consist of the descendants of fish that spawned below Cazadero Dam or the progeny of hatchery-produced strays. Production for the Clackamas Hatchery have been derived from adults returning to the hatchery or transfers from hatcheries outside the basin, primarily from the upper Willamette River. The Eagle Creek NFH terminated its spring-run program in the 1980s, although it has reared spring-run chinook salmon for release elsewhere. Genetically, Clackamas Hatchery spring-run fish and fish from hatcheries in the upper Willamette River Basin are very similar. Willis et al. (1995) suggests that differences in spawning times for Clackamas River spring-run chinook salmon prior to and following the laddering of Cazadero Dam would indicate that the native stock was replaced by upper Willamette River origin fish.

Currently, Clackamas Hatchery spring-run chinook salmon are released into the Sandy River Basin. Releases are made from two acclimation sites: at Marmot Dam and at a series of net pens. There are not collection facilities for adults in the Sandy River Basin.

Comments: This broodstock was not considered part of the ESU by USFWS, nor essential for recovery (Hillwig 1998). However, the USFWS response was to the original placement of the Clackamas River spring-run in the Lower Columbia River ESU, and did not reflect the placement of the Clackamas River spring-run population into the Upper Willamette River ESU.

ESU status: The BRT concluded that naturally spawning spring run chinook salmon in the Clackamas River were part of the Upper Willamette River ESU. The hatchery stock genetically resembles the naturally spawning population in the Clackamas River Basin and should also be considered part of the ESU. The history of extensive transfers from hatchery populations in the Upper Willamette River Basin would suggest that this population is a Category 3 broodstock. It is not known to what degree this stock has retained its historical local adaptation. Given the current status of the naturally spawning population in the Clackamas River this stock is not considered essential for recovery.

Stayton Ponds Fall-Run Chinook Salmon: ODFW Stock #14. Throughout the later part of this century there have been a number of attempts to establish fall-run chinook salmon in the upper Willamette River Basin. Nearly 200 million fall-run chinook salmon were introduced, primarily from Lower Columbia River hatcheries. This program was terminated in 1995 (1994 broodyear). Some 5-year-old fish are expected to return in 1999, but there is no plan to utilize these fish for artificial propagation purposes.

ESU status: Considered to be out of the ESU, due to its origin from outside the ESU.

Upper Columbia River Spring Chinook Salmon ESU

Grand Coulee Fish Maintenance Program: The construction of Grand Coulee Dam (1941, RKm 959) prevented thousands of adult spring-run chinook salmon from reaching their natal streams. In an effort to mitigate the loss of spawning habitat above the dam, the Grand Coulee Fish Maintenance Project (GCFMP) was authorized by the federal government. The GCFMP sought to relocate all chinook salmon migrating past Rock Island Dam (RKm 730) into three of the remaining accessible tributaries to the Columbia River: the Wenatchee, Entiat, and Methow rivers. As a part of this relocation, efforts were made to improve salmonid habitat (primarily through the screening of irrigation systems) and to increase run sizes through artificial propagation (Fish and Hanavan 1948). Several hatchery sites were designated as part of the GCFMP; the primary site on Icicle Creek, a tributary to the Wenatchee River, would later become the Leavenworth NFH (1940). Secondary substations were to be located on the Entiat (Entiat NFH, 1941), Methow (Winthrop NFH, 1941), and Okanogan rivers. The hatchery on the Okanogan River was never developed due to the lack of a suitable site and wartime building restrictions (Fish and Hanavan 1948).

In 1938, the last salmon was allowed to pass upstream through the uncompleted Grand Coulee Dam. The trapping of adult salmon at Rock Island Dam began in May 1939 and continued until the autumn of 1943. Spring- and summer/fall-run fish were differentiated according to the time of their arrival at Rock Island Dam. A 9 July separation date was established, based on weekly counts observed during 1933-1938 (Fish and Hanavan 1948). However, Mullan (1987) estimated that 23 June was a more accurate discriminator between the two run times. It is likely that some summer-run fish were misidentified as belonging to the spring run. The GCFMP combined all late-run fish passing Rock Island Dam, including those destined for now-inaccessible spawning areas in Washington and British Columbia (Fish and Hanavan 1948). Offspring of these adults were reared at the newly constructed Leavenworth, Entiat, and Winthrop NFHs, and transplanted into the Wenatchee, Methow, and Entiat rivers (Fish and Hanavan 1948). Furthermore, a number of late-run adults were transported to Nason Creek, a tributary to the Wenatchee River, and the Entiat River and allowed to spawn naturally.

The GCFMP effectively prevented an entire generation of spring-run fish from reaching their natal watersheds and homogenized within-ESU diversity. Recent genetic analysis (Utter et al. 1995, Myers et al. 1998) indicates that significant differences exist between populations in this ESU. Whether this within ESU diversity is indicative of historical population structure is unknown, but management efforts to preserve this diversity should be continued.

Winthrop National Fish Hatchery Spring-Run Chinook Salmon Stock: Winthrop NFH was constructed as part of the GCFMP to mitigate the losses of anadromous fish populations above Grand Coulee Dam. Stream-type chinook salmon production began at this facility in 1941, using the mixed upriver stock derived from the GCFMP. Local (GCFMP-derived) stock were used until 1962, when the spring chinook program was discontinued.

(Chapman et al. 1995). Production resumed in 1976, using primarily non-local stocks (Carson NFH, Cowlitz Salmon Hatchery, Little White Salmon NFH, Leavenworth NFH, Klickitat Hatchery). The Carson NFH spring-run stock and its derivatives (Little White Salmon NFH and Leavenworth NFH) were founded by representatives from three ESUs (Middle Columbia River Spring Run, Upper Columbia River Spring Run, and Snake River Spring- and Summer-Run ESUs). The majority of these fish were probably returning to spawning grounds in the Snake River Basin (Hymer et al. 1992). The Winthrop NFH spring chinook salmon stock is considered to be non-native (WDF et al. 1993), although only returnees have been propagated recently. In recent years, returns to the Methow River have been so low that all returning adults have been intercepted at Wells Dam. Genetically, the Winthrop NFH spring-run stock most closely resembles other stocks derived from the Carson NFH spring-run chinook salmon stock (Myers et al. 1998).

Comments: WDFW and USFWS do not consider this broodstock to be part of the ESU, nor essential for recovery (Crawford 1998, Hillwig 1998).

ESU status: Considered to be out of the ESU. The Winthrop NFH spring-run stock is mostly derived from spring-run broodstock from the Carson NFH or Carson NFH spring-run stock derivatives. Furthermore, because the Carson NFH stock (see Lower Columbia River ESU) was derived from a mixture of ESUs, it and its derivatives may not belong to any biological ESU. It is unknown to what extent native spring-run chinook salmon were incorporated into the hatchery broodstock following the initiation of the Carson NFH spring-run program at the Winthrop NFH, although genetic analysis suggests that the current influence of native Methow River fish is minimal.

Entiat National Fish Hatchery Spring-Run Chinook Salmon Stock: Entiat NFH was constructed as part of the GCFMP to mitigate the losses of anadromous fish populations above Grand Coulee Dam. Stream-type chinook salmon production began at this facility in 1941, using the mixed upriver stock derived from the GCFMP. This mixture may not have included fish from the Entiat River, Craig and Suomela (1941) did not observe any spring-run fish in Entiat River stream surveys prior to the GCFMP and the population may have been extirpated. Spring chinook salmon were reared sporadically at Entiat NFH until the mid-1960s (Chapman et al. 1995). Production resumed in 1976, using primarily non-local stocks (Carson NFH, Cowlitz Hatchery, Little White Salmon NFH, Winthrop NFH). The Carson NFH spring-run stock and its derivatives (Little White Salmon NFH and Winthrop NFH) were founded by representatives from three ESUs (Middle Columbia River Spring Run, Upper Columbia River Spring Run, and Snake River Spring- and Summer-Run ESUs) in 1958. The majority of these fish were probably returning to spawning grounds in the Snake River Basin (Hymer et al. 1992). The Entiat NFH spring chinook salmon stock is considered to be non-native (WDF et al. 1993), although only returnees have been propagated recently. The Entiat NFH spring-run fish are considered by WDFW to be a Carson NFH stock derivative.

Comments:: WDFW and USFWS do not consider this broodstock to be part of the ESU, nor essential for recovery (Crawford 1998, Hillwig 1998).

ESU status: Considered to be out of the ESU. The Entiat NFH spring-run stock is primarily derived from spring-run broodstock from the Carson NFH. Furthermore, because the Carson NFH stock (see Lower Columbia River ESU) was derived from a mixture of ESUs, it and its derivatives may not belong to any biological ESU. It is unknown to what extent native spring-run chinook salmon were incorporated into the hatchery broodstock following the initiation of the Carson NFH spring-run program. Genetic analysis (Myers et al. 1998), and the small size of the naturally-spawning spring run, suggests the influence of naturally-spawning fish on the hatchery broodstock is small.

Leavenworth National Fish Hatchery Spring-Run Chinook Salmon Stock: Leavenworth NFH was constructed as part of the GCFMP to mitigate the effects of the Grand Coulee Dam. Stream-type chinook salmon production began at this facility in 1941, using the mixed upriver stock derived from the GCFMP. There were only releases of spring-run chinook salmon during 3 years between 1946 and 1968 (Chapman et al. 1995). Production resumed in 1971, using primarily non-local stocks, the majority of which came from the Carson NFH, or other hatcheries rearing the Carson spring-run chinook salmon stock (Chapman et al. 1995). The Carson NFH spring-run stock and its derivatives (Little White Salmon NFH and Winthrop NFH) were founded by representatives from three ESUs (Middle Columbia River Spring Run, Upper Columbia River Spring Run, and Snake River Spring- and Summer-Run ESUs) in 1958. The majority of these fish were probably returning to spawning grounds in the Snake River Basin (Hymer et al. 1992). The Leavenworth NFH spring chinook salmon stock is considered to be non-native (WDF et al. 1993), although only returnees have been propagated recently.

Comments: WDFW and USFWS do not consider this broodstock to be part of the ESU, nor essential for recovery (Crawford 1998, Hillwig 1998).

ESU status: Considered to be out of the ESU. The Leavenworth NFH spring-run stock is primarily derived from spring-run broodstock from the Carson NFH. Furthermore, because the Carson NFH stock (see Lower Columbia River ESU) were derived from a mixture of ESUs, it and its derivatives may not belong to any biological ESU. It is unlikely that since the resumption of the spring run chinook salmon program in 1971 that native Upper Columbia River spring-run chinook salmon have had a significant influence on this stock. Genetic analysis (Myers et al. 1998) indicates that significant differences exist between the Leavenworth NFH spring-run stock and naturally-spawning populations in the Wenatchee River Basin (outside of Icicle Creek where the hatchery is located).

Chiwawa River Spring-Run Chinook Salmon Stock: The Rock Island Fish Hatchery complex (RIFHC) began operation in 1989 as mitigation for production lost as a result of the construction of Rock Island Dam and consists of a main hatchery at Eastbank, and several

satellite acclimation and trapping facilities, including the Methow River Hatchery Complex (Chapman et al. 1995). Adults do not return to the Eastbank Hatchery facilities. This facility is located on the Columbia River (RKm 762) and operated to mitigate the effects of the Rock Island Dam. Operations began in 1989. This program is operated as a supplementation program for natural production in the Chiwawa River. Adult broodstock are trapped at a weir on the Chiwawa River (RKm 2) and then transported to holding facilities. Until 1995, only naturally-produced fish were retained as brood, and the total collection could not remove more than 30% of the total run (Chapman et al. 1995). Since 1995, hatchery fish have also ben collected as broodstock. The Eastbank Hatchery is used for spawning, incubating, and rearing Chiwawa River spring-run chinook salmon, which are then transported back to the Chiwawa River Pond for final acclimation before release (WDF et al. 1993).

Comments: WDFW and USFWS consider this stock to be in the ESU and essential for recovery (Crawford 1998, Hillwig 1998).

ESU status: The Grand Coulee Fish Maintenance Project resulted in the mixture of populations and the probable loss of much within ESU variability. Additionally, there may have been some introgression of Carson NFH spring run fish from the Winthrop NFH. Genetically, this stock is still distinct from Carson NFH stock and is considered part of the Upper Columbia River spring run ESU, and the majority of the BRT concluded that this is a Category 3 broodstock. Given the critically depressed status of the natural spawning population this stock is considered essential for recovery. In the 50 years since the termination of the GCFMP some within ESU genetic structure has developed (Utter et al. 1995, Myers et al. 1998). The degree to which this reflects historical patterns is unknown, because of the potential for local adaptation this stock (and other stocks from the ESU) should be utilized in their native basin.

Methow River Spring-Run Chinook Salmon Stock: Adults voluntarily enter the Methow Hatchery and are subsequently incubated and reared there. The Methow Fish Hatchery Complex was constructed in 1993 and is operated by WDFW to compensate for fish loss due to Wells Dam. The Methow Hatchery is also the central facility for incubation and rearing of Twisp River, and Chewuch River spring-run chinook salmon. Gene flow between Methow Hatchery and Winthrop NFH is thought to be inevitable (Chapman et al. 1995). For example, in 1993, 62% of the volunteers spawned at Methow Hatchery were or hatchery origin, presumably from Winthrop NFH (Bartlett 1996). Beginning in 1998, wild and marked Methow Hatchery and Chewuch River supplementation program adults will be spawned together to form a Methow River Composite spring-run chinook salmon stock.

Comments: WDFW and USFWS consider this stock to be in the ESU and essential for recovery (Crawford 1998, Hillwig 1998).

ESU status: The Grand Coulee Fish Maintenance Project resulted in the mixture of populations and the probable loss of much within ESU variability. There may have been some introgression

of Carson NFH spring run fish from the Winthrop NFH. Genetically, this stock is still distinct from Carson NFH stock and is considered part of the Upper Columbia River spring run ESU, and a Category 3 broodstock. Given the critically depressed status of the natural spawning population this stock is considered essential for recovery. In the 50 years since the termination of the GCFMP some within ESU genetic structure has developed (Utter et al. 1995, Myers et al. 1998). The degree to which this reflects historical patterns is unknown, because of the potential for local adaptation this stock (and other stocks from the ESU) should be utilized in their native basin.

Twisp River Spring-Run Chinook Salmon Stock: Initially broodstock were trapped at the Twisp River Trap and transferred to the Methow Hatchery for spawning, incubation and rearing, before being transferred back to a remote acclimation pond prior to release (Bartlett 1996). Chinook salmon captured at the Twisp River Trap are supposed to be more representative of the original CGFMP stocks established in the Methow River Basin. Poor returns of adults in recent years have greatly limited the population size of this broodstock, and resulted in adults being intercepted at Wells Dam and transported to the Methow Hatchery for subsequent spawning based on CWT identification. Beginning in 1998, returning marked Twisp River spring-run chinook salmon adults will be used to produce a captive broodstock.

Comments: WDFW and USFWS consider this stock to be in the ESU and essential for recovery (Crawford 1998, Hillwig 1998).

ESU status: The Grand Coulee Fish Maintenance Project resulted in the mixture of populations and the probable loss of much within ESU variability. Genetically, this stock is still distinct from Carson NFH stock and is considered part of the Upper Columbia River spring run ESU, and a Category 3 broodstock. Given the critically depressed status of the natural spawning population this stock is considered essential for recovery.

Chewuch River Spring-Run Chinook Salmon Stock: Initially returning naturally produced adults were trapped at the Chewuch River Trap for use as broodstock and transferred to the Methow Hatchery for spawning, incubation and rearing, before being transferred back to a remote pond for acclimation prior to release (Bartlett 1996). In 1998 Chewuch River spring-run chinook salmon will be integrated into the Methow River Composite Stock.

Comments: WDFW and USFWS consider this stock to be in the ESU and essential for recovery (Crawford 1998, Hillwig 1998).

ESU status: The Grand Coulee Fish Maintenance Project resulted in the mixture of populations and the probable loss of much within ESU variability. Genetically, this stock is still distinct from Carson NFH stock and is considered part of the Upper Columbia River spring run ESU, and a Category 3 broodstock. Given the critically depressed status of the natural spawning population this stock is considered essential for recovery. In the 50 years since the termination

of the GCFMP some within ESU genetic structure has developed (Utter et al. 1995, Myers et al. 1998). The degree to which this reflects historical patterns is unknown, because of the potential for local adaptation this stock (and other stocks from the ESU) should be utilized in their native basin.

White River Spring-Run Chinook Salmon Stock: In response to declining chinook salmon spring runs in the Wenatchee River, a captive broodstock program was established for White River spring-run chinook salmon in 1997. This stock is genetically one of the most distinct in the upper Columbia River, and has had minimal recent hatchery influence. Due to budget constraints the fish have been transferred to different hatcheries during the course of the program. Most recently, redds were pumped to obtain eggs for captive rearing.
Comments: WDFW and USFWS consider this stock to be in the ESU and essential for recovery (Crawford 1998, Hillwig 1998).

ESU status: The Grand Coulee Fish Maintenance Project resulted in the mixture of populations and the probable loss of much within ESU variability. This broodstock was founded from naturally spawning adults with little or no history of artificial propagation. Strays from the Leavenworth Hatchery (Carson stock derivative) have generally not been found outside of the Icicle Creek. Genetically, this stock is still distinct from Carson NFH stock and is considered part of the Upper Columbia River spring run ESU. The majority of the BRT concluded that this is a Category 2 broodstock. In the 50 years since the termination of the GCFMP some within ESU genetic structure has developed (Utter et al. 1995, Myers et al. 1998). The degree to which this reflects historical patterns is unknown, because of the potential for local adaptation this stock (and other stocks from the ESU) should be utilized in their native basin. Given the critically depressed status of the natural spawning population this stock is considered essential for recovery.

Ringold Hatchery Spring-Run Chinook Salmon Stock: Ringold Hatchery is located on the Columbia River near Richland, Washington, and began operating in 1963, primarily as a fall chinook salmon facility. Fish are collected at the Ringold Hatchery complex (on the Columbia River), but are transferred to Lyons Ferry Hatchery for spawning, incubation, and early juvenile rearing. Spring chinook salmon stocks released from this hatchery include Cowlitz Salmon Hatchery, Klickitat Hatchery, and Carson NFH, but have mostly been Carson NFH stock or stock derivatives.

Comments: WDFW and USFWS do not consider this broodstock to be part of the ESU, nor essential for recovery (Crawford 1998, Hillwig 1998).

ESU status: Considered to be out of the ESU, due to substantial transfers of fish from outside of the ESU.

Nason Creek Spring-Run Chinook Salmon Stock: In response to declining chinook salmon spring runs in the Wenatchee River, a supplementation program was established for Nason Creek spring-run chinook salmon. Redds were subsampled to provide eggs from a number of different spawns. Nason Creek is recognized as a distinct population within the Wenatchee River Basin (WDF et al. 1993). In 1997, in order to assure a representative collection of Nason Creek fish, redds were not sampled because of the presence of stray adults from the Chiwawa River spring-run supplementation program. The first collection eggs from Nason Creek began in 1998.

Comments: The program had not begun when comments were requested by NMFS.

ESU status: The Grand Coulee Fish Maintenance Project resulted in the mixture of populations and the probable loss of much within ESU variability. This broodstock was founded from naturally spawning adults with little or no history of artificial propagation. Strays from the Leavenworth Hatchery (Carson stock derivative) have generally not been found outside of the Icicle Creek. Genetically, this stock is still distinct from Carson NFH stock and is considered part of the Upper Columbia River spring run ESU. The majority of the BRT concluded that this is a Category 3 broodstock. In the 50 years since the termination of the GCFMP some within ESU genetic structure has developed (Utter et al. 1995, Myers et al. 1998). The degree to which this reflects historical patterns is unknown, because of the potential for local adaptation this stock (and other stocks from the ESU) should be utilized in their native basin. Given the critically depressed status of the natural spawning population, this stock is considered to be essential for recovery.

Based on the BRT's conclusions, Table 1 summarizes the ESU status for these hatchery populations. For those populations considered to be in any of these four ESUs, the table indicates their category assignments and whether the BRT considers them essential for recovery or not. See the Appendix for the criteria used to make these determinations.

Table 1. Determinations of ESU status, hatchery population category (see Appendix for descriptions), and qualification for recovery for hatchery chinook salmon populations in the Puget Sound, Lower Columbia River, Upper Willamette River, and Upper Columbia River Spring-Run ESUs. Majority determinations by the BRT are indicated by an "X" in the columns for each of these determinations. For the populations, the number in parentheses is the state management agency's stock number.

			ESU Status		Category			Essential?	
ESU	Population	Run	In	Out	1	2	3	No	Yes
Puget Sound	Kendall Cr.	Spring	X			X			X
	Kendall Cr./Samish R.	Fall	X				X	X	
	Clark Cr.	Fall	X				X	X	
	Marblemount (I)	Summer	X				X	X	
	Marblemount (II)	Summer	X		X			X	
	Marblemount	Spring	X			X		X	
	N. Fk. Stillaguamish R.	Summer	X		X				X
	May Cr./Wallace R.	Summer	X			X		X	
	Soos Cr.	Fall	X			X		X	
	Tulalip Tribal	Fall	X				X	X	
	Tulalip Tribal	Spring	X				X	X	
	Puyallup	Fall	X				X	X	
	Minter Cr.	Fall	X				X	X	
	Coulter Cr.	Fall	X				X	X	
	Keta Cr.	Fall	X				X	X	
	Grover's Cr.	Fall	X				X	X	
	Garrison Springs	Fall	X				X	X	
	Kalama Cr.	Fall	X				X	X	
	Nisqually (Clear Cr.)	Fall	X				X	X	
	McAllister Cr.	Fall	X				X	X	
	Deschutes R. (WA)	Fall	X				X	X	
	Little Boston Cr.	Fall	X				X	X	
	George Adams	Fall	X				X	X	
	Hoodsport	Fall	X				X	X	
	Skokomish (Enetai)	Fall	X				X	X	
	Big Beef Cr.	Fall	X				X	X	
	Samish R.	Fall	X				X	X	
	Lummi Sea Ponds	Fall	X				X	X	
	Bellingham Heritage	Fall	X				X	X	
	Glenwood Springs	Fall	X				X	X	
	Univ. of Washington	Fall	X				X	X	
	Issaquah Cr.	Fall	X				X	X	
	White R.	Spring	X			X			X
	Solduc	Spring		X					
	Finch Cr.	Fall	X				X	X	
	Quilcene R.	Spring		X					
	Dungeness R.	Spring	X			X			X
	Elwha R.	Fall	X			X			X

			ESU Status		Category			Essential?	
ESU	Population	Run	In	Out	1	2	3	No	Yes
Lower Columbia River	Sea Resources Net Pens	Fall	X				X	X	
	Abernathy SCTC	Fall	X				X	X	
	Grays R.	Fall	X				X	X	
	Elochomin	Fall	X				X	X	
	Cowlitz R.	Spring	X			X			X
	Cowlitz R.	Fall	X			X		X	
	Toutle R.	Fall	X				X	X	
	Kalama R.	Spring	X				X	X	
	Kalama R.	Fall	X			X		X	
	Lewis R.	Spring	X				X	X	
	Washougal R.	Fall	X				X	X	
	Carson NFH	Spring		X					
	Little White Salmon R.	Fall		X					
	Spring Cr. NFH	Fall	X				X	X	
	Klickitat R.	Fall		X					
	Youngs Bay	Spring		X					
	Big Cr. (13)	Fall	X				X	X	
	Rogue R. (52)	Fall		X					
	Klaskanine R.	Spring		X					
	Klaskanine R. (15)	Fall	X				X	X	
	Bonneville H. (14)	Fall	X				X	X	
	Bonneville H. URB (95)	Fall		X					
	Clackamas R. (19)	Spring		X					
	Hood River (66)	Spring		X					
Upper Willamette River	N. Fk. Santiam R. (21)	Spring	X				X	X	
	M. Fk. Willamette R. (22)	Spring	X				X	X	
	McKenzie R. (23)	Spring	X				X	X	
	S. Fk. Santiam R. (24)	Spring	X				X	X	
	Stayton Ponds (14)	Fall		X					
Upper Columbia River Spring-Run	Winthrop NFH	Spring		X					
	Entiat NFH	Spring		X					
	Leavenworth NFH	Spring		X					
	Chiwawa R.	Spring	X				X		X
	Methow R.	Spring	X				X		X
	Twisp R.	Spring	X				X		X
	Chewuch R.	Spring	X				X		X
	Nason Ck.	Spring	X				X		X
	White R.	Spring	X			X			X
	Ringold H.	Spring		X			X		

CHUM SALMON

In evaluating the importance of hatchery stocks for recovery, the chum salmon BRT considered the relationship between the natural and hatchery populations and the degree of risk faced by the natural population(s) in the Hood Canal Summer-Run and Columbia River Chum Salmon ESUs. Although the BRT recognized that many of these stocks might play an important role in recovery, no hatchery populations in these two ESUs were identified as essential for recovery.

Hatchery Population Descriptions and Evaluations

Hood Canal Summer-Run Chum Salmon ESU

Quilcene National Fish Hatchery: Summer-run chum salmon from Hood Canal were first reared at the Quilcene National Fish Hatchery (QNFH) from 1912 to 1937, and at a satellite hatchery, Duckabush River Station, from 1911 to 1942 (Cook-Tabor 1994). Broodstocks reared at these facilities were collected from various rivers in Hood Canal and released primarily into the Little Quilcene and Big Quilcene rivers, although some releases occurred at other nearby locations, such as Walcott Slough. The program terminated in 1938 when the lower Big Quilcene River was hydrologically "modified" and fish could no longer return to the hatchery (Cook-Tabor 1994).

Little further artificial propagation of summer-run chum salmon occurred in Hood Canal until 1992, when, in response to declines of returning summer-run fish, the USFWS, WDFW, and Point No Point Treaty Council began a program to rear native summer-run chum salmon at the QNFH (Cook-Tabor 1994). From 1992 to 1994, about half of the returning fish to the Big Quilcene River were spawned artificially (Cook-Tabor 1994). In 1995, 203 pairs of summer chum salmon were spawned in the hatchery, and the USFWS reported that over 300 pairs had successfully spawned in the Big Quilcene River (Cook-Tabor 1995). Spawning surveys conducted on the Big Quilcene River during this period counted 4,029 fish (WDFW 1996). Average escapements of natural spawners in 1996 and 1997 averaged over 7,900 fish per year. Due to the success of the program, less than 10% of the returning fish have been removed from the river for artificial propagation since 1995 (WDFW 1998). Current production goals call for the release of about 500,000 juvenile summer-run chum salmon per year. Primary goals of this program are to 1) rebuild summer-run chum salmon run while preserving the genetic character of the Quilcene River stock, 2) limit the program to a maximum of three generations (12 years), 3) allow at least 50% of returning fish in any given year to spawn naturally, and 4) collect eggs throughout the spawning cycle (WDFW 1998).

Comments: WDFW believes that all artificially propagated chum salmon in this ESU (including the hatchery fish) should be included in the ESU (Crawford 1999). These supplementation programs are using only the local, native fish, and the fact that recent artificial propagation of

these fish has occurred does not change the importance of the supplementation recruits to the recovery of the overall population. The objective of these programs is to supplement specific existing high risk populations until such time as they become self-sustaining, and the supplementation is to be discontinued when a population is no longer at risk of extinction. They also believe that the artificially propagated fish, derived from the supplementation of native populations used in this program, are essential components of recovery.

ESU status: The BRT concluded that fish produced from this program are in the Hood Canal Summer-Run ESU and fall into Category 1. The majority of the BRT concluded that these fish are not essential to the recovery of the ESU. Appropriate use of the fish from this program include supplementation within the Quilcene River.

Long Live the Kings (LLTK) Enhancement Facility on Lilliwaup Creek: In 1992, WDFW began a cooperative project with the Hood Canal Regional Salmonid Enhancement Group (HCSEG) to rebuild the indigenous Lilliwaup Creek summer-run chum salmon run through a hatchery supplementation program (WDFW 1998). Later, the LLTK group assumed responsibility for this project. Broodstock for this program are collected at a weir on Lilliwaup Creek and transferred into the nearby LLTK facility for ripening and spawning. The objectives of this program are to restore a healthy, self-sustaining population of Lilliwaup Creek summer-run chum salmon while retaining the genetic characteristics of the native stock, and to counteract the current risk of extinction caused by low abundance. From 1992 and 1996, between 7% and 18% (12 to 18 fish) of the total run were removed for the hatchery program (except in 1995, when no fish were taken). However, due to continued low returns, 58% and 84% of the total run were removed for artificial propagation in 1997 and 1998, respectively (WDFW 1998).

Comments: See comment section under Quilcene National Fish Hatchery, above.

ESU status: The BRT concluded that fish produced from this program are in the Hood Canal Summer-Run ESU and fall into Category 1. The BRT also concluded that these fish are not essential for recovery. Appropriate use of fish produced by the program includes supplementation of naturally spawning chum salmon in this drainage.

Hamma Hamma River Supplementation Project: In 1997, HCSEG and LLTK initiated a program to supplement summer-run chum salmon on the Hamma Hamma River, where the summer-run chum salmon populations have not been responding to reductions in harvest as well as those in the nearby Duckabush and Dosewallips rivers. Goals of this project are similar to those used in summer-run chum salmon program in the Quilcene River and Lilliwaup Creek (WDFW 1998). Adult spawners are hooked or gaffed from the spawning grounds, and the resulting eggs are either placed in remote site incubators for hatching, or reared until approximately 1 gram in weight in a pond in Johns Creek, a Hamma Hamma River tributary. In 1997, 5 females and 9 males were captured, with 12,000 fry subsequently released into Johns

Creek. In 1998, 43,178 green eggs were secured with the removal of 17 females and 15 males from the Hamma Hamma River (WDFW 1998).

Comments: See comment section under Quilcene National Fish Hatchery, above.

ESU status: The BRT concluded that fish produced from this program are in the Hood Canal Summer-Run ESU and fall into Category 1. The BRT concluded that these fish are not essential for recovery. Appropriate use of fish produced by this program includes supplementation of naturally spawning chum salmon in this drainage.

Big Beef Creek Summer-Run Chum Salmon Reintroduction Project: The native summer-run chum salmon population in Big Beef Creek was extirpated at least ten years ago (WDFW 1998). A joint project among Point-No-Point Treaty Tribes, WDFW and USFWS to reestablish summer-run chum salmon to this stream was conceived in 1996, using surplus Big Quilcene river stock transferred from the ongoing summer-run chum salmon program at the Quilcene NFH (WDFW 1998). This stock was selected because of its geographic proximity and the similarity of its run timing to the former summer-run chum salmon in Big Beef Creek. In 1997, 204,000 juveniles were reared to a size of 1 gram in a pond downstream of the NMFS hatchery at Big Beef Creek, and released from early February through early March. In 1998, 112,000 fish were reared at the NMFS hatchery and released in early February (WDFW 1998). The Big Beef Creek reintroduction project is limited to no more than 12 years (commencing in 1996), as are all other summer chum salmon supplementation and reintroduction projects.

Comments: The purpose of this program is to reintroduce summer chum salmon into a stream where they no longer exist. The fish chosen for re-introduction are from the Big Quilcene River, a nearby stream in northern Hood Canal. WDFW believes that chum salmon from this re-introduction program should be included in the ESU and that they are essential components of recovery.

ESU status: The BRT concluded that fish produced from this program are in the Hood Canal Summer Run ESU. The majority of BRT members concluded that these fish fall into Category 1. The majority of the BRT also concluded that fish produced by this program are not essential to the recovery of the entire ESU. The use of these fish should be limited at present to the reintroduction effort in Big Beef Creek.

WDFW/Wild Olympic Salmon COOP for Salmon and Chimacum creeks: Until recently, there has been no artificial propagation of summer-run chum salmon in the Strait of Juan de Fuca portion of this ESU. However, since 1992 a cooperative restoration program has been conducted by WDFW and North Olympic Salmon Coalition and Wild Olympic Salmon, two local salmon advocacy groups, and about 85,000 native summer-run chum salmon fry have been released annually into Discovery Bay. Eggs are taken from fish collected at the WDFW weir on Salmon Creek and are then transferred to the WDFW Dungeness Hatchery until eyed.

The eggs are then transferred to Houck Creek, a Salmon Creek tributary, for hatching and early rearing. Finally, the juveniles are transferred to a net pen in Discovery Bay for short-term saltwater rearing prior to release. This is the fifth year of a ten-year restoration program. The Salmon Creek supplementation project is limited to no more than 12 years (commencing in 1992), as are all other summer chum salmon supplementation and reintroduction projects. (J. Ames, WDFW, pers. commun., February 1999).

Large returns of summer-run chum salmon to Salmon Creek in 1997 provided eggs for a reintroduction program in nearby Chimacum Creek. In Chimacum Creek, Salmon Creek eggs are incubated in Heath trays on Naylor's Creek, a tributary. Hatchlings emerge into raceways where they are reared until they reach a size of 1 gram. They are then transferred to a release site near the estuary. The Chimacum Creek reintroduction project is limited to no more than 12 years (commencing in 1996), as are all other summer chum salmon supplementation and reintroduction projects.

Comments: See WDFW comments for Big Quilcene River hatchery program, above.

ESU status: The BRT concluded that fish produced from this program are in the Hood Canal Summer-Run ESU and fall into Category 1. The BRT also concluded that these fish are not essential to the recovery of the ESU. Appropriate use of these fish includes supplementation of naturally spawning chum salmon in this drainage.

Columbia River Chum Salmon ESU

Washington

Little artificial propagation of chum salmon has occurred in the Columbia River compared to other areas in the Pacific Northwest. Presently, on the Washington side of the lower Columbia River only three streams are recognized as containing natural self-sustaining populations of chum salmon: Hamilton Creek and Hardy Creek near Bonneville Dam, and the Grays River (WDF et al. 1993) nearer the mouth of the Columbia River. However, native populations are suspected to be present in an unknown number of Lower Columbia River tributaries (Wolf Dammers, WDFW, pers. commun., November 1998).

Sea Resources Hatchery: In recent years, only the cooperatively run Sea Resources Hatchery has produced chum salmon in this ESU. This hatchery, operated as a vocational training facility for students at Ilwaco High School, Ilwaco, Washington is located on the Chinook River, a tributary to mainstem Columbia River, and propagates chum salmon originally imported from Willapa Bay (NRC 1996). Approximately 360,500 chum salmon fry per year were released by this hatchery between 1982 and 1991 (WDF et al. 1993).

In 1998, less than 20 chum salmon (and only 4 females) were trapped and spawned at the Sea Resources Hatchery. Fry from these crosses will be genetically tested in 1999 to determine their genetic ancestry (Wolf Dammers, WDFW, pers. commun., January 1999). No chum salmon will be released from the Sea Resources Hatchery in 1999 (S. Schroder, WDFW, pers. commun., February 1999).

ESU status: The BRT concluded that fish from this program are not in the ESU. Fish from this program should not be used for any supplementation program in the Columbia River ESU.

Grays River Hatchery: In November and December 1998, 46 male and 47 female fall-run chum salmon were trapped in Gorley Creek, a tributary of the Grays River, transported to the Grays Harbor Hatchery where they were spawned. From these fish, approximately 126,000 eggs were collected and these embryos are presently being incubated at the Hatchery. The fry will be released either from the hatchery or transferred back to Gorley Creek at release. At the hatchery the fish will be marked by thermal-treatment of their otoliths. If the restoration to Grays River is successful, this stock will be used to restore native fall-run chum salmon to other lower Columbia River tributaries on the Washington side, including the Chinook River (Wolf Dammers, WDFW, pers. commun., November 1998 and January 1999).

Comments: See WDFW comments for Big Quilcene River hatchery program, above.

ESU status: The BRT concluded that fish produced from this program are in the Hood Canal Summer-Run ESU and fall into Category 1. The BRT also concluded that these fish are not essential to the recovery of the ESU. Appropriate use of fish produced by this program includes supplementation of naturally spawning chum salmon in this drainage.

Other WDFW Lower Columbia River Hatcheries: A program was instituted beginning in the fall of 1998 to spawn any chum salmon (at least one pair) returning to WDFW Lower Columbia River hatcheries, rear the fry for about a month, and release them back into the river. The goal is to create a local lower Columbia River chum salmon broodstock at several WDFW hatcheries (Wolf Dammers, WDFW, pers. commun., November 1998). However, in 1998 the only hatchery where chum salmon were trapped was the Cowlitz Salmon Hatchery where five chum salmon were spawned for a total egg take of about 8,800. Smolts from these eggs will be released into the Cowlitz River (Wolf Dammers, WDFW, pers. commun., January 1999).

Comments: See WDFW comments for Big Quilcene River hatchery program, above.

ESU status: The BRT concluded that fish produced from this program are in the Hood Canal Summer-Run ESU. The majority of the BRT concluded that fish in this program fall into Category 1. The BRT also concluded that these fish are not essential to the recovery of the entire ESU. Appropriate use of fish produced by this program includes supplementation of naturally spawning chum salmon in this drainage.

Oregon

Big Creek and Klaskanine Hatcheries: No ODFW hatcheries have released fall-run chum salmon since 1984 (NRC 1996).

Based on the BRT's conclusions, Table 2 summarizes the ESU status for these eight hatchery populations. For those populations considered to be in either of these ESUs, the table indicates their category assignments and whether the BRT considers them essential for recovery or not. See the Appendix for the criteria used to make these determinations.

Table 2. Determinations of ESU status, hatchery population category (see Appendix for descriptions), and qualification for recovery for hatchery chum salmon populations in the Hood Canal Summer Run and Columbia River ESUs. Majority determinations by the BRT are indicated by an "X" in the columns for each of these determinations. In cases where BRT members were evenly split (or nearly so) in their assessments of hatchery category, "<<<SPLIT>>>" denotes the two categories across which assessments were split.

			ESU Status		Category			Essential?	
ESU	**Population**	**Run**	**In**	**Out**	**1**	**2**	**3**	**No**	**Yes**
Hood Canal Summer Run	Quilcene NFH	Summer	X		X			X	
	Long Live the Kings Enhanc. (Lilliwaup Cr.)	Summer	X		X			X	
	Hamma Hamma R. Supplementation Project	Summer	X			X		X	
	Big Beef Cr. Reintroduction Project	Summer	X		<<<SPLIT>>>			X	
	WDFW/Wild Olympic Salmon Co-op	Summer	X		X			X	
Columbia River	Sea Resources Hatchery	Fall		X					
	Grays River Hatchery	Fall	X		X			X	
	Cowlitz Hatchery	Fall	X		X			X	

STEELHEAD

In evaluating the importance of hatchery stocks for recovery, the steelhead BRT considered the relationship between the natural and hatchery populations and the degree of risk faced by the natural population(s) in the Upper Willamette River and Middle Columbia River Steelhead ESUs. Although the BRT recognized that many of these stocks might play an important role in recovery, no hatchery populations in these two ESUs were identified as essential for recovery.

Hatchery Population Descriptions and Evaluations

Upper Willamette River Steelhead ESU

North Santiam River ODFW Stock #21 (late winter run), (Marion Forks Hatchery): Although culture of this stock has been discontinued, smolts released in 1997 and 1998 are expected to return in March through May 1999, 2000 (as 2-salt returns), and 2001 (as 3-salt returns) (R. Hooton, ODFW Natural Production Program Manager, pers. commun., February 1999). This stock has also been referred to as the Willamette River Winter Steelhead hatchery stock (Howell et al. 1985b). ODFW (1986, 1995a) stated that this stock was derived from indigenous winter steelhead and has been cultured since at least the 1930s. Chilcote (1997) also stated that this stock was developed from wild North Santiam River winter steelhead. Hatchery releases of winter steelhead in the North Santiam River have been primarily of North and South Santiam substocks, although Foster/Skamania stock summer steelhead (originating in the Lower Columbia River ESU) are still released in the North Santiam River, and both Big Creek and Klaskanine River winter steelhead stock (from the Southwest Washington ESU) have been released here in the past (Olsen et al. 1992). From 1930 to 1950 broodstock consisted of fish taken at a rack in the Breitenbush River (a North Santiam tributary). Since 1951, broodstock for North Santiam River winter steelhead ODFW Stock #21 has been a mixture of native and hatchery fish (Howell et al. 1985b) collected at Minto Dam on the North Santiam River in April and May (Olsen et al. 1992). This stock is referred to as "late run" because its timing is later than coastal and Big Creek Hatchery winter steelhead stocks (Howell et al. 1985b). Chilcote (1997) stated that return and spawn timing of this hatchery stock "is considerably later than the Big Creek hatchery stock and is more similar to the wild population in the Santiam." According to ODFW (1986), "run timing and spawning period have remained relatively unchanged since 1951." ODFW (1995b) stated that the current winter steelhead hatchery program calls for "100,000 native Santiam stock for the Santiam River." Egg incubation and rearing of ODFW winter steelhead Stock #21 occurred at Marion Forks Hatchery (Christianson 1993, Montgomery Watson 1997b); however, adults were not collected at this facility but were captured and spawned at Minto Ponds (Minto Fish Collection facility), 33 miles downstream. Marion Forks Hatchery began operation in 1951 and is located along Marion and Horn creeks (tributaries of the North Santiam River) about 17 miles east of Detroit, Oregon (Delarm and Smith 1990b). Minto Pond is operated as a satellite facility. Most of the juveniles subsequently reared at this hatchery are released off-station in the North Santiam River. Production goals for winter steelhead at

Marion Forks Hatchery consist of 100,000 smolts (20,000 lb) for release into the North Santiam River and 25,500 eggs for Oregon's Salmon and Trout Enhancement Program (STEP) (Montgomery Watson 1997b). Electrophoretic data, based on 41 allozyme loci, revealed no genetic distance between Marion Forks Hatchery winter steelhead and wild steelhead from the North Fork Molalla River and little genetic distance between this hatchery stock and wild winter steelhead in the North Santiam River (NMFS 1999).

Comments: According to R. Hooton (ODFW, pers. commun., February 1999) the Marion Forks Hatchery (North Santiam River) winter steelhead program has been discontinued in the Upper Willamette ESU. However, first generation progeny of this hatchery program still exist and are expected to return in March through May 1999, 2000 (as 2-salt returns), and 2001 (as 3-salt returns). Only the Skamania/Foster/McKenzie ODFW summer steelhead stock (see below) is still released into the North and South Santiam rivers. ODFW (R. Hooton, pers. commun., February 1999) does not consider this hatchery population to be in the ESU, or to be essential for recovery.

ESU status: Although culture of this stock has been discontinued, first generation progeny of this hatchery program will continue to return to the North Santiam River through May of 2001. A majority of the BRT concluded that because North Santiam River ODFW Stock #21 was developed from wild North Santiam River winter steelhead it is part of the ESU. It is probable that there has been divergence of this hatchery stock from the historical population that existed in the Santiam River, since the stock has been under artificial propagation for many years and some degree of hybridization may have occurred with winter steelhead transplanted from outside the ESU into the basin. Therefore, the BRT concluded that this broodstock is in the ESU and should be considered Category 2. The BRT concluded that any use of this broodstock in supplementation efforts should be limited to the Santiam River Basin. The BRT also concluded that this stock is not essential for recovery. The BRT's conclusion was influenced by the presence of significant numbers of wild steelhead in the ESU as a whole, which could be used in recovery efforts.

Big Creek ODFW Stock #13 and Klaskanine ODFW Stock #15 (winter runs), (Big Creek Hatchery, Gnat Creek Hatchery, Klaskanine Hatchery, Roaring River Hatchery, Trojan Rearing Ponds): Although culture and release of this stock in the Upper Willamette ESU has been discontinued, smolts released in 1998 in the Tualatin River are expected to return in December 1999 through January 2000 (R. Hooton, ODFW, pers. commun., February 1999). According to ODFW (1986), this winter steelhead stock was developed in the 1940s at Big Creek Hatchery in the Southwest Washington ESU (ESU 3) from native Big Creek adults, with the first smolt releases occurred in 1961 (ODFW 1995a). However, release records for this stock are incomplete prior to 1970 (Olsen et al. 1992). Howell et al. (1985b) stated that this stock was developed in the 1960s from native Big Creek steelhead exhibiting the earliest run timing and maturity, in order to provide an early fishery in December and January. As a result of this hatchery selection, the run and spawn timing of this hatchery stock has been shifted to the

earliest portion of the natural Big Creek run (ODFW 1986). Big Creek ODFW hatchery Stock #13 has been, and continues to be, outplanted in Willamette River tributaries above Willamette Falls. Winter steelhead arriving at Willamette Falls prior to February 15 are classified by ODFW as descendants of Big Creek ODFW Stock #15 winter steelhead (Olsen et al. 1992). Klaskanine ODFW Stock #15, originally developed from Big Creek ODFW Stock #13, is used as a back-up broodstock source for ODFW Stock #13 (ODFW 1986). Chilcote (1997) stated that planting of Big Creek ODFW Stock #13 in the Molalla River was to have terminated in 1997; however, outplanting of this stock continues in the Tualatin River and Gales Creek in the Upper Willamette ESU. Broodstock for this stock is collected at Big Creek and Klaskanine Hatcheries. Hatcheries that have reared ODFW Stock #13 steelhead smolts prior to their release into the Upper Willamette ESU include Big Creek Hatchery, Gnat Creek Hatchery, Klaskanine Hatchery, Roaring River Hatchery and Trojan Pond.

Comments: According to R. Hooton (ODFW, pers. commun., February 1999) the Big Creek winter steelhead program has been discontinued in the Upper Willamette ESU. However, first generation progeny of this hatchery program still exist and are expected to return in December 1999 through January 2000 in the Tualatin River. Only Skamania/Foster/McKenzie ODFW summer steelhead stocks (see below) are still released into the North and South Santiam rivers. ODFW (R. Hooton, pers. commun., February 1999) does not consider this hatchery population to be in the ESU, or to be essential for recovery.

ESU status: The BRT concluded that this stock is not part of the Upper Willamette River ESU, due to its origin from hatchery stocks in the Southwest Washington ESU.

Skamania/Foster/McKenzie ODFW stock (South Santiam Stock #24 and McKenzie Stock #23, summer run), (Gnat Creek Hatchery, Leaburg Fish Hatchery, McKenzie River Hatchery, Oak Springs Hatchery, Roaring River Hatchery, South Santiam Hatchery, Willamette Hatchery): The Skamania summer steelhead hatchery stock was originally developed in the late 1950s from a mixture of native Washougal River (Lower Columbia River ESU) and Klickitat River (Middle Columbia River ESU) summer steelhead (Crawford 1979). Oregon's Foster/Skamania Stock #24 (also referred to as South Santiam Stock #24) originated from eggs imported from the Skamania Hatchery on the Washougal River between 1967 and 1973 (ODFW 1986, 1995a). Since 1974, broodstock for ODFW's South Santiam Stock #24 has, for the most part, come from returns to Foster Dam on the South Santiam River (ODFW 1986). According to ODFW (1986, 1995a), in years of low abundance some egg-take for this hatchery stock occurred at other ODFW facilities in the Willamette River Basin. ODFW's McKenzie summer steelhead Stock #23 originated from offspring of South Santiam Stock #24 returning to the McKenzie River (ODFW 1986, 1995a). Broodstock for Stock #24 is taken at Foster Trap near Foster Dam on the South Santiam River. Broodstock for Stock #23 is taken at Leaburg Dam and at McKenzie River Hatchery on the McKenzie River (ODFW 1986, 1995a; Montgomery Watson 1997a). South Santiam 24 and McKenzie 23 hatchery summer steelhead stocks continue to be released into the Molalla, and North and South Santiam rivers (Chilcote

1997). Hatcheries that have reared Stock #24 and Stock #23 steelhead smolts prior to their release into the Upper Willamette ESU include Gnat Creek Hatchery, Leaburg Fish Hatchery, McKenzie River Hatchery, Oak Springs Hatchery, Roaring River Hatchery, South Santiam Hatchery, and Willamette Hatchery.

Comments: According to R. Hooton (ODFW, pers. commun., February 1999) Skamania/ Foster/McKenzie ODFW summer steelhead stocks are still released into the North and South Santiam rivers. ODFW (R. Hooton, pers. commun., February 1999) does not consider this hatchery population to be in the ESU, or to be essential for recovery.

ESU status: The BRT concluded that this stock is not part of the Upper Willamette River ESU, due to its origin from the Skamania Hatchery stock in the Lower Columbia River ESU, which in turn originated from a combination of wild fish from the Washougal River (Lower Columbia River ESU) and the Klickitat River (Middle Columbia River ESU).

Middle Columbia River Steelhead ESU

Deschutes River ODFW Stock #66 (summer run) (Round Butte Hatchery, Pelton Trap): According to ODFW (1986, 1995a), this hatchery stock originated from wild fish collected in the 1960s in the Pelton Trap, below the Pelton Re-regulating Dam on the Deschutes River, Oregon. However, Olsen et al. (1992) stated that this "stock was developed from the native stock of summer steelhead collected at Warm Springs National Fish Hatchery, located at RM 9 on the Warm Springs River, and from both the native and hatchery components [Squaw Creek hatchery stock] of the run to Pelton Trap." The Squaw Creek stock was developed from native summer steelhead collected in Squaw Creek (a tributary of the Deschutes River) in the 1950s and 1960s and reared at Wizard Falls Hatchery on the Metolius River. Prior to the establishment of Round Butte Hatchery in 1972, ODFW hatchery summer steelhead Stock #66 was reared at a number of ODFW hatcheries including Wizard Falls, Oak Springs, Cedar Creek, and Gnat Creek (Olsen et al. 1992). Round Butte Hatchery is located on the Deschutes River at the base of Round Butte Dam, 10 miles west of Madras, Oregon and was constructed in 1972 to mitigate for fish losses caused by Pelton/Round Butte Hydroelectric Complex. The Pelton Ladder is operated as a satellite rearing facility. The facility is a former fish passage ladder which has had some sections converted for fish rearing (Montgomery Watson 1996b). Broodstock are collected at Pelton Dam and at Sherars Falls. Currently, hatchery fish are mated only with other hatchery fish (Christianson 1993). Production goals for summer steelhead at this hatchery call for 162,000 smolts (40,500 lb) for release into the Deschutes River. Between 1978 and 1984, a portion of ODFW Stock #66 was reared at Warm Springs National Fish Hatchery. Since the 1960s, ODFW hatchery Stock #66 summer steelhead smolts have received unique fin-marks that differentiate them from both wild fish and strays from outside the basin. Prior to 1982, wild (unmarked) summer steelhead were incorporated into the broodstock. Since 1982, only adults with Round Butte Hatchery fin-marks have been used for broodstock (ODFW 1986).

Comments: ODFW (R. Hooton, pers. commun., February 1999) does not consider this hatchery population to be in the ESU, or to be essential for recovery.

ESU status: A majority of the BRT concluded that since Deschutes River ODFW Stock #66 was originally developed from local, wild steelhead it should be considered part of the Middle Columbia River ESU. The BRT was split on whether this broodstock should be considered Category 2 or Category 3. This split decision was primarily related to the uncertainty concerning to what degree stray steelhead from outside the basin were incorporated into the broodstock prior to 1982. Prior to 1982, both Round Butte hatchery steelhead and unmarked steelhead were used as broodstock and an unknown portion of these unmarked steelhead may have been strays from outside the basin (and potentially from outside the ESU). This uncertainty would argue for a Category 3 designation. In addition, this stock has been under artificial propagation for many years and it is probable that there has been divergence from the historical population that existed in the Deschutes River. The BRT concluded that the use of this broodstock should be limited to the Deschutes River Basin. The BRT concluded that this stock is not essential for recovery. The BRT's conclusion was influenced by the presence of significant numbers of wild steelhead in the ESU as a whole, which could be used in recovery efforts.

Umatilla River ODFW Stock #91 (summer run) (Umatilla Hatchery, Bonneville Hatchery, Minthorn Springs, Bonifer Pond, Thornhollow): ODFW (1986, 1995a) stated that ODFW summer steelhead Stock #91 was developed, starting in 1980, from adults collected at Three Mile Dam on the Umatilla River. Chilcote (1997) stated that "most of the hatchery fish are of local origin developed from wild Umatilla broodstock." Between 1967 and 1969 hatchery summer steelhead releases in the Umatilla River included Idaho (Ox Bow) and Skamania stocks (Olsen et al. 1992, Rowan 1997). Between 1980 and 1990, ODFW Stock #91 was reared in most years at Oak Springs Hatchery and transferred to Bonifor Pond, on Meacham Creek, for acclimation and release. This stock was also reared at Wizard Falls Hatchery in 1975, Irrigon Hatchery in 1988 and Bonneville Hatchery in 1988 and 1989 (Olsen et al. 1992, Rowan 1997). Since 1975, all summer steelhead releases in the Umatilla River have been from Umatilla River broodstock (Rowan 1997). Currently, adults are collected at Three Mile Dam, held and spawned at the Minthorn Springs facility, reared to the smolt stage at Umatilla Hatchery and Bonneville Hatcheries, and transferred to Minthorn Springs, Bonifer Pond and Thornhollow for acclimation and release (Montgomery Watson 1996a, Rowan 1997). Howell et al. (1985b) stated, at the time this report was written, that broodstock consisted primarily of unmarked adults collected at Three Mile Dam. Currently, broodstock is collected at Three Mile Dam (Rowan 1997). Christianson (1993) stated that only naturally-spawned steelhead were used for broodstock, although no more than 10% of the natural run was to be was utilized. The practice for the past 2 to 3 years has been to use 55 pairs of unmarked steelhead and an additional 11 hatchery males (identified as Umatilla River hatchery stock by Coded Wire Tags) as broodstock for this program (B. Zimmermann, Confederated Tribes of the Umatilla Indian Reservation, pers. commun., February 1999). Fiscal Year 1996 production goals for summer steelhead at the Umatilla Hatchery called for 150,000 smolts (30,000 lbs) for acclimation and release at Bonifer and Minthorn facilities on

the Umatilla River (Montgomery Watson 1996a). The Confederated Tribes of the Umatilla Indian Reservation operate Minthorn Springs, Bonifer Pond and Thornhollow in cooperation with ODFW. Minthorn Springs is located 4 miles east of Mission, Oregon on Minthorn Springs Creek and serves as an adult holding, spawning, and acclimation and release site for Umatilla River hatchery summer steelhead. Bonifor Pond is located on Meacham Creek, which flows into the Umatilla River at RM 79 and Thornhollow is located on the Upper Umatilla River at RM 73.5, both above Pendleton, Oregon. Bonifor Pond and the Thornhollow Facility serve as acclimation and release sites for Umatilla River hatchery summer steelhead (Rowan 1997).

Comments: ODFW (R. Hooton, pers. commun., February 1999) does not consider this hatchery population to be in the ESU, or to be essential for recovery.

ESU status: The BRT concluded that, based on its apparent origin from a local wild population, Umatilla River ODFW Stock #91 was part of the Middle Columbia River ESU. Although this stock is re-founded each year from unmarked, apparently wild, steelhead caught at Three Mile Dam on the Umatilla River, the BRT concluded that this stock was a Category 2. This conclusion was based on the uncertain history of wild steelhead in the Umatilla River, in regard to severe dewatering of the river, and uncertainty over the presence of stray unmarked steelhead in the Umatilla River that may become incorporated into the broodstock. The BRT concluded that use of this broodstock in supplementation efforts should be limited to the Umatilla River Basin. The BRT concluded that this stock is not essential for recovery. The BRT's conclusion was influenced by the presence of significant numbers of wild steelhead in the ESU as a whole, which could be used in recovery efforts.

Other Hatchery Stock Releases in the Middle Columbia ESU: Within the Middle Columbia River ESU, hatchery steelhead stocks from outside the ESU are imported into the ESU and released into the White Salmon (Skamania Hatchery winter and summer steelhead stocks), Klickitat (Skamania Hatchery summer steelhead stock), and Walla Walla (Lyons Ferry Hatchery stock) rivers. Broodstock for these programs are collected outside of the ESU, and juvenile rearing prior to release occurs in hatcheries outside of the ESU.

Comments: Crawford (1999) listed the above transplantation programs in the White Salmon, Klickitat, and Wall Walla rivers and stated that these hatchery fish should not be considered part of the Middle Columbia River ESU.

ESU status: Hatchery steelhead derived from these transfers should not be considered part of the Middle Columbia River ESU.

Based on the BRT's conclusions, Table 3 summarizes the ESU status for these five hatchery populations. For those populations considered to be in either of these ESUs, the table indicates their category assignments and whether the BRT considers them essential for recovery or not. See the Appendix for the criteria used to make these determinations.

Table 3. Determinations of ESU status, hatchery population category (see Appendix for descriptions), and qualification for recovery for hatchery steelhead populations in the Upper Willamette River and Middle Columbia River ESUs. Majority determinations by the BRT are indicated by an "X" in the columns for each of these determinations. In cases where BRT members were evenly split (or nearly so) in their assessments of hatchery category, "<<<SPLIT>>>" denotes the two categories across which assessments were split. For the populations, the number in parentheses is the state management agency's stock number.

			ESU Status		Category			Essential?	
ESU	Population	Run	In	Out	1	2	3	No	Yes
Upper Willamette River	N. Santiam R. (21)	Winter	X			X		X	
	Big Cr. (13)	Winter		X					
	Skamania/Foster/McKenzie ODFW stock	Summer		X					
Middle Columbia River	Deschutes River (66)	Summer	X			<<< SPLIT >>>		X	
	Umatilla River (91)	Summer	X			X		X	

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APPENDIX

This Appendix describes the approach used to evaluate the ESU status of hatchery populations and characterize their relationship to natural populations in listed ESUs.

Determining whether a hatchery broodstock is in or out of the ESU

In general, a hatchery population will be considered to be part of a biological ESU if the population or populations from which it was derived were also part of the ESU. More specifically, a hatchery population will be considered part of the biological ESU so long as the proportion of non-ESU fish effectively incorporated into the hatchery population over its history has not been substantially higher than the proportion of stray non-ESU fish in natural populations within the ESU. In extreme cases, a hatchery population derived from within the ESU (as defined above) could be excluded from the ESU if it has been severely genetically modified by, for example, artificial selection, long-term domestication, genetic engineering, or cytological manipulation.

Determining categories of hatchery populations (all are considered to be part of the ESU)

We have assigned each in-ESU hatchery population to one of three categories (1, 2, or 3). The categories are based on the degree to which the hatchery population contains genetic resources similar to a native, local population, and each category is characterized by a number of possible uses of the hatchery stock that are appropriate to consider for recovery. In general, an artificially propagated population should not be considered for use in recovery or conservation efforts if a lower category population exists or could be created. For example, in choosing an appropriate broodstock source for supplementation of a native, natural population, no Category 3 hatchery population should be considered if a Category 1 or 2 hatchery population exists or could be created (e.g., by collecting natural fish from the population as broodstock). On the other hand, sometimes a Category 3 hatchery population may be all that remains of an ESU or population that is extinct or nearly extinct in the wild. In this case, no lower category hatchery population is available or could be created, so the Category 3 population would be appropriate to consider for recovery efforts. This approach thus allows for the full range of biologically appropriate uses of hatchery fish in ESA recovery planning while providing guidance to managers that helps to focus attention on stocks most likely to contribute towards recovery of natural populations.

When a hatchery population is designated as part of an ESU, this is a recognition that the hatchery population was originally derived from natural populations in the ESU, that it has not been substantially affected by introgression of fish from outside of the ESU, and that it has not experienced severe genetic change due to artificial propagation or other factors. Not all hatchery populations considered to be part of an ESU are necessarily equally appropriate for use in conservation or recovery efforts, however, and propagation of hatchery populations, even if they

are considered part of the ESU, poses varying levels of risk to native, natural populations. The level of these risks will vary depending on number of factors, including the genetic relationship between the artificially propagated population and native, natural populations. In some cases, the propagation of artificial populations that are part of the ESU but are genetically diverged from local natural populations (e.g., due to non-local origin of the hatchery population) will pose a level of risk to native populations comparable to the propagation of non-ESU hatchery populations. Because of this, the NMFS believes it is essential to provide some guidance on appropriate conservation or recovery strategies to consider for different categories of within-ESU hatchery populations. The first step in providing this guidance is to categorize existing hatchery populations based on the degree to which they have diverged from the historical populations of the ESU.

The following three categories are intended to encompass a broad range of artificially propagated populations. Appropriate conservation or recovery strategies to consider for each of these categories are discussed below.

Category 1: The hatchery population is a native, local population that is released within the range of the natural population from which it was derived and has experienced only relatively minor genetic changes from causes such as founder effects, domestication or non-local introgression. Examples of populations that fall into this category include:

a) A hatchery population that has been recently founded (e.g., within one or two generations) from a large (either in absolute terms or as a proportion of the donor population), representative sample of a native, natural population which has not itself experienced substantial genetic changes due to artificial propagation or other factors.

b) A hatchery population that was founded some time in the past (e.g., more than two generations ago) as a large representative sample from a native, natural population, and has received regular, substantial and representative infusions of natural fish from the original founding population into the broodstock since that time. The natural population must not itself have experienced substantial genetic changes due to artificial propagation or other factors.

Category 2: The hatchery population is derived from a local natural population, and is released within the range of the natural population from which it was derived, but is known or suspected to have experienced a moderate level of genetic change from causes such as founder effects, domestication or non-native introgression. Examples of populations that fall into this category include:

a) A hatchery population where there is direct evidence (e.g., from molecular genetic data or breeding studies) of moderate genetic divergence between the hatchery population and the natural population from which it was derived. In this context, moderate genetic

divergence might be, for example, a level of divergence similar to that observed among natural populations within the ESU.

b) A hatchery population that was founded from a native, natural population, but the sample was not representative or was small or the broodstock has received few or no reintroductions of native, natural fish since the time of founding, or the hatchery population is believed to have experienced moderate genetic change (e.g., from domestication or non-local introgression) since the time of founding.

c) A hatchery population that was founded from a natural population that itself is known or suspected to have had substantial non-native introgression or been genetically affected by previous artificial propagation actions or other factors.

Category 3: The hatchery population meets the criteria necessary for inclusion in the ESU, but is known or suspected to have experienced substantial genetic changes from causes such as founder effects, domestication or non-local introgression. Examples of populations that fall into this category include:

a) A hatchery population that has been deliberately artificially selected, has experienced substantial unintentional domestication, or both.

b) A hatchery population that was founded with a very small number of fish or was founded long ago (e.g., many salmon generations) and has received few or no infusions of wild fish into the broodstock since the time of founding.

c) A hatchery population that was founded from a mixture of several natural or hatchery populations from within the ESU, or has experienced substantial introgression from non-local populations within the ESU.

d) A hatchery population that was founded from or strongly influenced by a natural population known or suspected to have had substantial genetic impacts from non-local introgression or be substantially genetically affected by previous artificial propagation actions or other factors.

e) A hatchery population with substantial uncertainty about its origin and history.

f) A hatchery population released outside of the historical range of the natural population from which it was founded.

Determining whether a hatchery population is essential for recovery

If a hatchery population is determined to be part of a listed ESU, a decision must be made whether to include the existing hatchery fish in the formal listing notice. The criteria used by the BRT to determine whether a hatchery stock is essential for the recovery of the ESU has remained largely unchanged from previous determinations. Two questions are used to determine if a particular group of hatchery fish are essential: (1) Are the hatchery fish essential for the survival and recovery of the population with which they are associated?, and, (2) Is the population with which they are associated critical to the survival and recovery of the ESU as a whole? Affirmative answers to both questions indicate that the hatchery fish under consideration should be considered essential for recovery of the ESU. Examples of situations where hatchery fish are essential to the survival and recovery of an individual population include cases where the population is extinct in the wild, not capable of sustaining itself in the wild, or where a substantial fraction of the total genetic resources of the population are contained in the hatchery fish. Examples of situations where a population is considered critical to the survival and recovery of the ESU as a whole include cases where the population makes up a substantial fraction of the total abundance of the ESU, or where the fish in the population contain genetic resources not contained in other populations in the ESU (e.g., unique life-history characteristics). If any hatchery broodstock are determined by the BRT to be essential for recovery, they are not necessarily automatically considered part of the listed species. Final listing determination is made by NMFS after consideration of conservation efforts and other factors (e.g., whether listing the existing hatchery fish would provide important benefits to the listed species).

The number and/or proportion of hatchery stocks classified as essential for recovery in an ESU is not a constant. Hatchery stocks are not all equally representative of the ESU, and the hatcheries themselves may or may not be associated with biologically important populations. Hatchery location and broodstock management are related to a variety of biological, historical, management, and political factors. Furthermore, the risks identified by the BRT for each ESU are different, and the recovery of a specific ESU may be partially dependent on the improved status of a specific life history type, a specific geographic component of the ESU, and/or improvement in overall abundance. So, it is not surprising that in some ESUs where the majority of the hatcheries are managed for fisheries enhancement (e.g., Lower Columbia River tule chinook salmon), there are few hatchery broodstock programs that will be considered essential for the recovery of the ESU. Alternatively, in the Upper Willamette River Spring-Run Chinook Salmon ESU, one of the main risks identified by the BRT is the lack of suitable spawning habitat. In this case, since there are 1,000-2,000 naturally-produced spawners remaining, but current habitat in the entire ESU is suitable for only 5,000 fish (in the McKenzie River Basin), there is not a critical need for all the 20,000 or more hatchery fish that return each year. If it is determined that supplementation would be beneficial, it would probably be better to try and establish a new program with the existing natural spawners. Full recovery is not expected to occur without an expansion of current habitat capacity. If more habitat becomes available it may be necessary to use the hatchery broodstock to recolonize these areas. Similarly, some hatchery

programs are associated with populations that are currently at low abundance levels, but historically these programs may have never contributed significantly to the overall abundance of the ESU. While the existence of these smaller populations may be dependent on the success of the hatchery program, the loss of these populations singly may not constitute a risk to the existence of the ESU. In other cases, the relative abundance of hatchery fish to naturally spawning fish is quite small, and a compelling case cannot be made that the existence of the natural population is dependent on the hatchery broodstock.

Types of conservation strategies that would be reasonable to consider for different categories of hatchery population

This list describes conservation strategies that are reasonable to consider for the different categories of hatchery populations. As is discussed in the NMFS's *Interim Policy on Artificial Propagation of Pacific Salmon Under the Endangered Species Act* (NMFS 1993), artificial propagation should not be considered a substitute for addressing the underlying causes of an ESU's decline.

Furthermore, even under ideal circumstances artificial propagation will entail genetic and ecological risks to natural populations. The determination of whether to actually pursue one of the strategies listed below should be based on an objective analysis of potential benefits and hazards on a case by case basis, as well as how the proposed action fits into the overall recovery strategy of the ESU. The determination that a hatchery population is part of an ESU does not imply that propagation of that population is free of risks to native, natural populations in the ESU. In some cases, the risks may be just as high those associated with the artificial propagation of fish from outside of the ESU.

As is discussed in the *Interim Policy*, hatchery fish that are considered to be part of a biological ESU are not generally included as part of the listed species unless they are considered to be essential for recovery. This is true for any hatchery population that is considered part of the biological ESU, regardless of its category.

More details on specific conservation strategies involving artificial propagation are provided below. The discussion below does not cover artificial propagation programs not intended to provide conservation benefits (e.g., fisheries enhancement programs). Please refer to the *Interim Policy* for guidance on how these programs should be managed under the ESA.

Artificial reserves: Artificial reserves provide a conservation benefit by maintaining a population in a protected, often productive, artificial environment. Populations held captive for part or all of their life-cycle help to ensure that even if many or all of the wild populations in an ESU become extinct, at least part of the ESU may survive in captivity and be available for reintroduction or supplementation efforts. As they are defined here, fish in artificial reserve populations are generally not intended to spawn in the wild in significant numbers unless or until

the population is needed for supplementation or reintroduction purposes. Category 1 populations, because they have experienced little genetic divergence from the natural population from which they were derived, are likely to provide the greatest benefits and least risks as reserve populations. However, Category 2 and even Category 3 hatchery populations may provide conservation benefits as artificial reserves in specific cases, especially if a Category 1 population does not exist or cannot be created (e.g., if the natural populations from which the hatchery stocks were founded are now extinct or have also experienced substantial genetic change from artificial propagation or other factors).

Supplementation: For purposes of this paper, supplementation is defined as the use of artificial propagation to increase the number of natural spawners in an existing natural population. A supplemented population essentially exists concurrently in both a natural and artificial environment. Supplementation by definition involves close integration with a natural population, and therefore has a greater potential to lead to genetic changes in a natural population than does an artificial reserve project that is successfully isolated from natural populations. If a hatchery population is used as a broodstock source for supplementation, a key factor to consider is the relationship between the hatchery population and the natural population to be supplemented. If the natural population to be supplemented is a native, natural population with relatively little genetic change from previous artificial propagation or other factors, then except in very unusual circumstances only a Category 1 hatchery population derived from the natural population to be supplemented should be used as a source of fish for supplementation. If a natural population proposed for supplementation is believed to have already experienced substantial genetic change from artificial propagation or other factors (e.g., if the natural population has already been supplemented for many generations), then a Category 2 or 3 hatchery populations associated with the natural population could be considered for supplementation. In general, hatchery populations should only be used to supplement the natural population from which they were derived.

Reintroduction: As defined here, reintroduction is the use of artificial propagation to establish a natural population in an area formally inhabited by a now extinct conspecific natural population. In many cases, the ideal source of fish for reintroduction purposes would be a Category 1 or Category 2 hatchery population derived from the extinct natural population. If such a hatchery population is not available, any population (hatchery or natural) or even combination of populations within the ESU could potentially be a candidate source of fish for reintroduction. The choice of which population(s) to consider should be based on an objective assessment of the likelihood of success, risks (e.g., straying or ecological effects such as competition or predation) the reintroduction may impose to other populations or species (including the donor population), and how the reintroduction fits into the overall recovery strategy for the ESU. Category 3 populations should be used only with caution, especially if there is a possibility of straying into local native populations. In general, reintroducing fish from the same donor population into many areas of a large or diverse ESU should be avoided in order to promote and maintain diversity among populations.

Introduction: An introduction is defined here as the establishment of a natural population in an area previously inaccessible or unused by the species to be introduced (e.g., by removal of a natural barrier). If the newly accessible habitat is unlikely to experience significant natural colonization in the foreseeable future, then artificial propagation could be used to establish a naturally spawning population in the newly accessible area. If there are naturally spawning populations that are likely to exchange significant numbers of migrants with fish spawning in the newly accessible area, then one of those populations or an appropriate hatchery population derived from and similar to one of those populations should be used for broodstock.