Hatchery Broodstock Summaries and Assessments for Chum, Coho, and Chinook Salmon and Steelhead stocks within Evolutionarily Significant Units listed under the Endangered Species Act

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INTRODUCTION

As part of the process of updating the status of Endangered Species Act (ESA) listed salmon species, staff at the Northwest Fisheries Science Center (NWFSC) and Southwest Fisheries Science Center (SWFSC) have evaluated the relationships between hatchery stocks and listed natural salmon and steelhead populations in the Pacific Northwest and California.

We have assigned each hatchery stock to a category based on variation across three axes (Figure 1): 1) the degree of genetic divergence between the hatchery stock and the natural population(s) that occupy the watershed into which the hatchery stock is released, 2) the origin of the hatchery stock, and 3) the status of the natural population(s) in the watershed. There are four categories of divergence: minimal, moderate, substantial, and extreme. Minimal divergence means that based on the best information available, there is no appreciable genetic divergence between the hatchery stock and the natural population(s) in the watershed (e.g., because the hatchery and wild populations are well mixed each generation). Moderate divergence means the level of divergence between the hatchery stocks and the local natural populations is no more than what would be expected between closely related populations within the ESU. Substantial divergence is roughly the level of divergence expected between more distantly related populations within the ESU. Extreme divergence is divergence greater than what would be expected among natural population in the ESU, such as that caused by deliberate artificial selection or inbreeding. The second axis describes the origin of the hatchery stock, and can either be local, non-local but predominantly from within the ESU, or predominantly from outside of the ESU. The third axis describes the status of the natural population(s) (of the same species as the hatchery stock) in the watershed, and can either be native or non-native.

Category 1 stocks are characterized by no more than minimal divergence between the hatchery stock and the local natural population(s) and regular, substantial incorporation of natural origin fish into the hatchery broodstock. Within category 1, category 1a stocks are characterized by the existence of a native natural population of the same species in the watershed, while category 1b stocks are characterized by the lack of such a population (e.g., the local naturally spawning population was introduced from elsewhere). Note that a category 1a designation can describe a range of biological scenarios, and does not necessarily imply that the hatchery stock and the associated natural population are close to a "pristine" state. For example, a hatchery program that started many years ago with local broodstock and regularly incorporated local natural origin fish in substantial proportions thereafter would likely be a category 1a, even if both the hatchery stock and the local natural population have diverged from what the natural population was like historically.

Category 2 stocks are no more than moderately diverged from the local, natural population(s) in the watershed. Category 2a stocks were founded from a local, native population in the watershed in which they are released. Category 2b stocks were founded non-locally but from within the ESU, and are released in a watershed that does not contain a native natural population. Category 2c stocks were founded non-locally but from within the ESU, and are released in a watershed that contains a native natural population.

Category 3 stocks are substantially diverged from the natural population(s) in the watershed in which they are released. The “a”, “b” and “c” designations are the same as described for category 2 above.

Category 4 stocks characterized either by being founded predominantly from sources that are not considered part of the ESU in question, or by extreme divergence from the natural population(s) in the watershed in which they are released, regardless of founding source.

Regardless of category, the fact that a hatchery population exists does not imply that it should necessarily be used for conservation purposes. That decision is best made on a case-by-case basis after evaluating the relative benefits and risks of artificial propagation and other conservation strategies.

<table>
<tr><th colspan="6">Source of hatchery stock and status of local population</th></tr>
<tr><th></th><th></th><th>source from local, native natural population</th><th>source non-local but within ESU, no native local natural population</th><th>source non-local but within ESU, native local natural population exists</th><th>source non-local and predominantly from outside of ESU</th></tr>
<tr><td rowspan="4">relationship to natural population</td><td>Substantial natural origin fish in broodstock and minimal divergence</td><td>1a</td><td>1b</td><td>NA</td><td rowspan="3">4</td></tr>
<tr><td>Moderate to few natural origin fish in broodstock and no more than moderate divergence *</td><td>2a</td><td>2b</td><td>2c</td></tr>
<tr><td>substantial divergence **</td><td>3a</td><td>3b</td><td>3c</td></tr>
<tr><td>extreme divergence ***</td><td>4</td><td>4</td><td>4</td><td>4</td></tr>
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* moderate divergence = no more than observed between similar populations within ESU
** substantial divergence = comparable to divergence observed within entire ESU
*** extreme divergence = greater than divergence observed within ESU or substantial artificial selection or manipulation

Figure 1 – Summary of hatchery categorization system

List of stocks and categories

Species	ESU	Stock	Run	Basin	Category
O. tshawytscha	Puget Sound	Kendall Creek	Spring	Nooksack	2a
		Lummi Bay	Fall	Nooksack	3b or 3c
		Samish River	Fall	Samish	3b
		Marblemount	Spring	Skagit	2c
		Marblemount	summer	Skagit	1a
		Marblemount	Fall	Skagit	1a
		Tulalip	Spring	Tulalip Bay	3b or 3c
		Tulalip	Summer	Tulalip Bay	2b or 2c
		Tulalip	Fall	Tulalip Bay	3b or 3c
		N.F. Stillaguamish	Summer	Stillaguamish	1a
		Wallace River	Summer	Snohomish	2a
		Issaquah Hatchery	Fall	Lk Washington	2b
		UW Portage Bay	Fall	Lk Washington	3b or 4
		Soos Creek	Fall	Green	2a
		Keta Creek	Fall	Green	2a
		Grover's Creek	Fall	East Kitsap	2b
		Garrison Springs	Fall	Chambers Cr	2b
		Voights Creek	Fall	Puyallup	2b or 2c
		Diru Creek	Fall	Puyallup	2b or 2c
		White River	Spring	Puyallup	2a
		Clear/Kalama Cr.	Fall	Nisqually	2b or 2c
		Minter Creek	Fall	S. Sound	2b
		Tumwater Falls	Fall	Deschutes	2b
		George Adams	Fall	Skokomish	2b or 3c
		WSC Hood Canal	Fall	Skokomish	2b or 3c
		Finch Cr.	Fall	S. Hood Canal	2b or 3c
		Hamma Hamma	Fall	S.Hood Canal	2b or 3c
		Big Beef Cr	Fall	N. Hood Canal	2b
		Dungeness	Spring	Dungeness	1a
		Elwha	Fall	Elwha	2a
		Glenwood Springs	Fall	San Juan Is.	2b
O. tshawytscha	LCR	Sea Resources	Fall	Chinook R.	2b
		Abernathy NFH	Fall	Abernathy Cr.	2b
		Grays River	Fall	Grays	2b
		Elochoman	Fall	Elochoman	2b
		Cowlitz	Fall	Cowlitz	2a
		Cowlitz	Spring	Cowlitz	2a
		Toutle	Spring	Cowlitz	2c
		Kalama	Fall	Kalama	2a
		Kalama	Spring	Kalama	2b
		Lewis	Spring	Lewis	2a or 2b
		Washougal	Fall	Washougal	2a or 2b
		Carson	Spring	Wind	4
		LWS NFH	Fall	Little White	4

		Spring Cr. NFH	Fall	Spring Cr.	2a
		Klickitat	Fall	Klickitat	4
		Willamette	Spring	Youngs Bay	4
		Big Cr.	Fall	Big Cr.	3b
		Rogue River (#52)	Fall	Youngs Bay	4
		Klaskanine (# 15)	Fall	Klaskanine	2b
		Willamette	Spring	Klaskanine	4
		Bonneville (#14)	Fall	Gorge	3a
		Bonneville (#95)	Fall	Gorge	4
		Sandy River sp chinook (ODFW#11)	spring	Sandy	1a
		Hood River	Spring	Hood	4
O. tshawytscha	UWR	N.F. Santiam (#21)	Spring	Santiam	2a or 2b
		Willamette H. (#22)	Spring	MF Willamette	2b or 2c
		McKenzie (#24)	Spring	McKenzie	2a
		S.F. Santiam (#23)	Spring	Santiam	2b
		Clackamas (# 19)	Spring	Clackamas	2b or 2c
O. tshawytscha	UCR	Leavenworth NFH	Spring	Wenatchee	3c or 4
		Entiat NFH	Spring	Entiat	3c, 4, or 2b
		Winthrop NFH	Spring	Methow	3c or 4
		Chiwawa	Spring	Wenatchee	1a
		Methow Composite	Spring	Methow	2a/c
		Twisp	Spring	Methow	1a
		Chewuch	Spring	Methow	1a
		Methow	Spring	Methow	3c or 4
		UCR Captive			
		Nason	Spring	Wenatchee	1a
		White R.	Spring	Wenatchee	1a
		Twisp	Spring	Methow	1a
		Methow	Spring	Methow	1a
		Ringold H.	Spring	UCR	3c or 4
		Carson H.	Spring	Wind	3c or 4
O. tshawytscha	SR Fall	Lyons Ferry	Fall	SR	2a
O. tshawytscha	SR Spr/Smr	McCall (suppl)	Spring	Salmon	1a
		McCall (prod)	Spring	Salmon	2a
		Rapid River	Spring	Little Salmon	3c
		Sawtooth	Spring	Salmon	1a
		Pahsimeroi	Summer	Salmon	1a and 2a
		Captive Broodstock			
		Catherine Cr.	Summer	Grande Ronde	1a
		Up. Grande Ronde	Summer	Grande Ronde	1a
		Lostine R.	Summer	Grande Ronde	1a
		Clearwater	Spring	Clearwater	2b
		Imnaha (# 29)	Spr/Sum	Imnaha	1a
		Dworshak	Spring	Clearwater	3b or 4
		Kooskia	Spring	Clearwater	3b or 4
		Tucannon	Spring	Tucannon	1a
O. tshawytscha	CA Coastal	Mad R.	Fall	Mad R	2a,b,c
		Freshwater Cr.	Fall	Humboldt Bay	1a

		Yaeger Cr.	Fall	Van Duzen	1a
		Redwood Cr.	Fall	Redwood Cr.	1a
		Hollow Tree Cr.	Fall	Eel R.	1a
		Van Arsdale	Fall	Eel R.	2a
		Mattole	Fall	Mattole R.	1a
O. tshawytscha	CV Winter	Livingston Stone	Winter	Sacramento R.	1a
O. tshawytscha	CV Spring	Feather R.	Spring	Feather R.	4
O. mykiss	LCR	Skamania	summer	Washougal	4
		Sandy (ODFW 11)	winter	Sandy	1a
		Clackamas (#122)	winter	Clackamas	1a
		Hood (ODFW #50)	winter	Hood	1a
		Hood (ODFW #50)	summer	Hood	1a
		Big Cr./Eagle Cr.	winter	Clackamas	4
		Chambers Cr.	winter	various	4
		Cowlitz	late-winter	Cowlitz	2a
		Kalama	winter	Kalama	1a
		Kalama	summer	Kalama	1a
O. mykiss	UWR	Skamania (# 24)	summer	Santiam	4
O. mykiss	MCR	Deschutes (# 66)	summer	Deschutes	2a or 2c
		Umatilla (# 91)	summer	Umatilla	1a
		Dayton P.	summer	Touchet	4
		Dayton P. (new)	summer	Touchet	1a
O. mykiss	UCR	Wells	summer	UCR	2b
		Wenatchee	summer	Wenatchee	1b
O. mykiss	SR	Wallowa	summer	Wallowa	3c
		Cottonwood	summer	Grande Ronde	3c
		Little Sheep Cr.	summer	Imnaha	2a
		Oxbow	summer	SR	3c
		Sawtooth	summer	Salmon	3c
		Pahsimeroi	summer	Salmon	3c
		Dworshak	summer	Clearwater	2a
		Lyons Ferry	summer	SR	3c or 4
		Tucannon (LyonsF)	summer	Tucannon	3c or 4
		East Fork Salmon	summer	Salmon	1a
		Tucannon (new)	summer	Tucannon	1a
O. mykiss	N. CA Coast	Mad R.	winter	Mad	3c
		Yager Cr.	winter	Yager	1a
		NF Gualala	winter	Gualala	1a
O. mykiss	Central CA	Don Clausen	winter	Russian	2a
		Monterey Bay	winter	Scott Cr.	1a
O. mykiss	S. Central CA	Whale Rock	winter	Old Creek	3b
O. mykiss	CV	Coleman NFH	winter	Sacramento R.	2a
		Feather R.	winter	Feather R.	2a
		Nimbus H.	winter	American R.	4
		Mokelumne H.	winter	Mokelumne R.	4
O.kisutch	LCR	Big Creek		Big Cr.	2a
		Klaskanine		Klaskanine	4
		Tanner Cr.		Lower Gorge	2b

		Sandy River	late	Sandy	2a
		Eagle Cr.		Clackamas	2c
		Little White Salmon		Upper Gorge	3c
		Toutle	Type S	Cowlitz	2a
		Type S Complex	Type S	various	2c or 3c
		Cowlitz	Type N	Cowlitz	2a
		Lewis River "wild"		Lewis	2a
		Type N Complex	Type N	various	2b or 2c
O.kisutch	Oregon Coast	NF Nehalem	(# 32)	Nehalem	2c
		Fishhawk Lk	(# 99)	Nehalem	2a or 3a
		Trask R.	(# 34)	Trask	2c or 3c
		Siletz	(# 33)	Siletz	2a or 3a
		Umpqua	(# 55)	Umpqua	2a
		Cow Cr.	(# 18)	Umpqua	2a
		Woahink		Stilcoos	1a
		Coos	(# 37)	Coos	2a
		Coquille	(# 44)	Coquille	2a
O.kisutch	S OR/N CA	Rogue R.	(# 52)	Rogue R.	2a
		Iron Gate		Klamath	2c
		Trinity R.		Trinity	2b
		Mad R.		Mad R.	4
O.kisutch	Cental CA	Noyo R.		Noyo R.	2a
		Don Clausen		Russian	1a
		Monterey Bay		Scott Cr.	1a
O. keta	Hood Canal	Big Quilcene	summer	Quilcene	1a
		Lilliwaup Cr.	summer	S. Hood Canal	1a
		Hamma Hamma	summer	S. Hood Canal	1a
		Big Beef Creek	summer	N. Hood Canal	1b
		Salmon Creek	summer	Dungeness	1a
		Chimacum Cr	summer	Dungeness	1b
		Union River	summer	Union	1a
		Jimmycomelately	summer	Dungeness	1a
O. keta	LCR	Sea Resources	fall	Chinook R.	1a
		Gorley Cr.	fall	Grays	1a
		Hamilton Cr.	fall	Gorge	1a
		Washugal/Duncon Cr	fall	Washugal	1a
O. nerka	Lk. Ozette	Umbrella Ck.		Ozette	1a or 2a, or 1b or 2b

PUGET SOUND RECOVERY DOMAIN

Puget Sound Chinook Salmon ESU[2]

Stock name: *Kendall Creek spring-run chinook salmon (N.F. Nooksack R. spring chinook).*

Hatchery/collection site: Kendall Creek Hatchery holding pond, North Fork Nooksack River.

Broodstock origin and history

Year founded: The present program began in 1981.

Source: North Fork Nooksack Spring Chinook stock. Initial attempts to establish a spring chinook hatchery program at Kendall Creek used a variety of local and non-local stocks. The predominate source has been native Nooksack River spring chinook salmon, although some Solduc Hatchery chinook salmon were released from Kendall Creek. These plants occurred in 1975 (80,000 smolts), 1976 (123,450 smolts), 1978 (113,000 smolts), and 1981 (80,000 smolts).

Broodstock size/natural population size: Starting in 2002, approximately 500 adults will be needed for broodstock. The geometric mean natural spawning abundance in the NF Nooksack was 319 from 1987 - 2001 (Puget Sound TRT 2002). The geometric mean natural origin spawning abundance over the same time frame was 116 (Puget Sound TRT 2002).

Subsequent events: N/A

Recent events: Mates are chosen randomly from all ripe fish. Fish spawned represent the entire run time prior to August 24. Only chinook volunteering into the hatchery trap prior to September 21 will be considered for spawning. All eggs from adults spawned prior to August 24 will be used. After that date, and until September 21, only eggs from positively identified hatchery-origin (externally and coded-wire tag [CWT] marked) Nooksack spring chinook salmon will be used. Program production/release strategies have been recently re-evaluated and decreased from 600,000 to 150,000 on-station releases.

Relationship to current natural population: Chinook salmon spawning in the North Fork Nooksack River are considered to be an independent population by the Puget Sound TRT (Puget Sound TRT 2001). Surplus hatchery-origin fish are allowed to spawn naturally in the North Fork and Middle Fork Nooksack River. The program was started with natural-origin fish from the North Fork Nooksack River. Since that time, the program has relied totally on volunteer returns to the hatchery. In the past, hatchery and wild fish were not entirely differentiated with distinguishing marks, so it was possible that wild fish contributed to the broodstock at some level. All spring chinook salmon spawned in recent years have been of hatchery origin.

[2] All information on Puget Sound chinook salmon is from WDFW and Puget Sound Treaty Tribes (2002) draft Research Management Plan, unless otherwise noted.

Current program goals: Restoration. The goal of this program is to use indigenous stock to restore spring chinook salmon in the North Fork Nooksack River to a self-sustaining level of 2,000 natural-origin spawners. This stock is used as a harvest indicator stock for North Fork Nooksack spring-run chinook salmon (Hatchery Scientific Review Group (HSRG), Nooksack/Samish Briefing Book April 2002).

Population genetics: North Fork Nooksack spring-run chinook salmon are one of the most distinct in the Puget Sound (Marshall et al. 1995). Young and Shaklee (2002) conducted a microsatellite analysis of Nooksack River chinook, but included very few North Fork samples.

Morphology/behavior/fitness: Data not available.

Previous determination: NMFS (1999b) determined that this stock was in the ESU and essential for recovery.

Category and rationale: Category 2a. The extended duration under which this stock has undergone artificial propagation and the unknown, but likely limited, input of natural fish into the broodstock means that there has been opportunity for this stock to diverge from the natural population in the North Fork Nooksack River Basin.

Stock name: *Lummi Bay fall-run chinook salmon.*
(Info is from Lummi Tribe HGMP 2001).

Hatchery/collection site: The hatchery does not currently have a chinook salmon broodstock collection program. Broodstock, whose progeny will eventually be reared at Lummi Bay, are collected at the Samish Hatchery operated by the Washington Department of Fish and Wildlife (WDFW).

Broodstock origin and history

Year founded: The original stock is derived from the Green River and has been propagated in the Samish Hatchery (WDFW) since the early 1900s (BIA 1999).

Source: See Green River (Soos Creek and Samish River fall-run chinook salmon).

Broodstock size/natural population size: See source stocks.

Subsequent events: N/A

Recent events: The majority of the broodstock is from fish collected at the Samish Hatchery. Eggs are shipped to Kendall Creek Hatchery for incubation and early rearing.

Relationship to current natural population: Fall-run chinook salmon historically existed in the Nooksack River Basin. The origin of the current naturally spawning fall run populations in the Nooksack River Basin is unclear, however, and some genetic evidence suggests these late run populations may be genetically similar to non-local (Green River origin) fall chinook released as hatchery production (Young and Shaklee 2002).

Current program goals: Harvest augmentation. The primary goal of the program is to support tribal fisheries in North Bellingham Bay and the tidally influenced portion of the Nooksack River adjacent to the Lummi Reservation.

Population genetics: Young and Shaklee (2002) found that natural origin fall run chinook salmon in the South Fork Nooksack were genetically similar to the fall run fish reared at Kendall Creek Hatchery.

Morphology/behavior/fitness: Data not available.

Category and rationale: Category 3b or 3c. This broodstock was founded from within the ESU, having been derived primarily from fish native to the Green River Basin, but it is not native to the Nooksack River Basin. Further, there is a potential for interaction with late-spawning elements of the native North Fork and South Fork spring (early)-run populations in the Nooksack Basin. The native fall-run is thought to have been extirpated or overwhelmed by introductions of Green River origin fall-run chinook salmon.

Stock name: *Samish River fall-run chinook salmon.*

Hatchery/collection site: Samish Hatchery, Friday Creek (03.0017) RKm 1.6, tributary to Samish River (03.0005) at RKm 16.9, Puget Sound, Washington. Samish River Rearing Pond, Samish River at RKm 16.9.

Broodstock origin and history

Year founded: Fall chinook salmon eggs were first transferred into Samish Hatchery in 1914 (WDFG 1916) from the Columbia River. Columbia River-origin eggs were supplanted by Green River-origin eggs in 1929.

Source: Green River-origin chinook salmon eggs were first transferred to the Samish Hatchery in 1929, supplanting Columbia River-origin eggs (Kalama River and Wind River)—which were first transferred in by the Bureau of Commercial Fisheries in 1914 (WDFG 1916)—as the source of fall chinook salmon production for the facility (WDFG 1932). In an attempt to create a return to the Samish River that could be self sustaining (WDF 1938), a consistent year-to-year chinook salmon egg transfer program from Green River to Samish began in 1938. No chinook salmon eggs were taken from adults returning to Samish prior to 1937. However, after 1937, the adult chinook return was sufficient to meet hatchery production needs (WDF 1939, 1941).

Broodstock size/natural population size: Fall chinook salmon broodstock are collected at Samish Hatchery for programs at Samish, Lummi Bay Hatchery, and for the yearling program at Glenwood Springs. Up to 3,900 adults are spawned to meet an annual egg take goal of 5.5 million. All other adult returns pass upstream of the hatchery weir. The natural population size is not known.

Subsequent events: N/A

Recent events: N/A

Relationship to current natural population: There are an unknown number of natural-origin recruits that return to the Samish River each year. These natural-origin adults may be the progeny of naturally spawning Samish hatchery fish, or strays from nearly natural populations. According to the Samish Hatchery HGMP, the Samish River is not thought to be a typical chinook salmon river, and the Puget Sound TRT did not identify chinook salmon in the Samish as an independent population (Puget Sound TRT 2001).

Current program goals: Harvest augmentation.

Population genetics: Genetic analysis identifies this stock as typical of Puget Sound fall-run chinook salmon (especially Soos Creek origin) (Marshall et al 1995).

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be in the ESU but not essential for recovery.

Category and rationale: Category 3b. This stock originated from within the ESU, but is not native to the area in which it is released. Historically, it is believed that the Samish River did not support a self-sustaining population of chinook salmon. Further, there appears to be limited interaction between Samish River fish and native populations in the Nooksack and Skagit Basins.

Stock name: *Marblemount spring-run chinook salmon (Skagit River).*

Hatchery/collection site: Marblemount Hatchery, Cascade River (04.1411) RKm 0.8 at confluence with Clark Creek (04.1421). The Cascade River is a tributary to the Skagit River (03.0176) at RKm 125.5.

Broodstock origin and history

Year founded: Marblemount Hatchery spring chinook stock appears to have originated from local Skagit River populations. References to Skagit spring chinook salmon were found in planting records in 1952.

Source: These fish may have originated from the Cascade River. Plants of spring chinook salmon were discontinued until the 1974 brood when fish from Buck Creek, a tributary to the Suiattle River, were introduced. From 1976-1986, tributaries of the Suiattle River were trapped for broodstock collection. The number of fish trapped each year may have been relatively small (USFWS 2003). In 1981, the first returns of Buck Creek stock returned to the hatchery. These progeny, along with the other tributary broods, were combined and released. The program currently uses only hatchery-origin (CWT marked) broodstock.

Broodstock size/natural population size: Broodstock size is 500 adults.

Escapement of Skagit spring chinook.

Year	Cascade	Up Sauk	Suiattle	Total
1988	133	870	740	1,743
1989	218	668	514	1,400
1990	269	557	685	1,511
1991	135	747	354	1,236
1992	205	580	201	986
1993	168	323	292	783
1994	173	130	167	470
1995	225	190	440	855
1996	208	408	435	1,051
1997	308	305	428	1,041
1998	323	290	473	1,086
1999	83	180	208	471

Source: WDFW data

Subsequent events: N/A

Recent events: The program was curtailed in 2002 for an undefined period.

Relationship to current natural population: Spring chinook salmon spawning in the Cascade River are considered to be an independent population by the Puget Sound TRT (Puget Sound

TRT 2001). WDFW collects broodstock from adults returning to the Marblemount Hatchery prior to August 15. Only coded-wire-tagged adults originating from the Marblemount Hatchery spring chinook program are used for broodstock. Marked adults entering the trap in excess of broodstock requirements are surplused to the Skagit Tribe, or are transported and released into Lake Shannon (Baker River Basin). Unmarked adults (0-450 fish per year) are returned to the Cascade River. Estimates of the annual proportions of hatchery-origin and natural-origin fish on natural spawning grounds are not available.

Current program goals: Augmentation. The goal of the fingerling and yearling program is to provide fish for harvest opportunity.

Population genetics: 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-run chinook salmon 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.

Morphology/behavior/fitness: There are no known differences between the natural and hatchery maintained chinook

Previous determinations: NMFS (1999b) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2c. This stock was founded from within the ESU and is native to the basin in which it is released. However, most of the broodstock was trapped in the Suiattle River and the program operates in the Cascade River. The Suiattle and Cascade River spring-run populations are recognized as distinct. 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 other spring run population in the Skagit River Basin (Marshall et al. 1995).

Stock name: *Marblemount summer-run chinook salmon (Skagit River).*

Hatchery/collection site: Marblemount Hatchery, Cascade River (04.1411) RKm 0.8 at confluence with Clark Creek (04.1421). The Cascade River is a tributary to the Skagit River (03.0176) at RKm 124.8. Broodstock are collected in the upper Skagit River using gill nets.

Broodstock origin and history

Year founded: The current program was established in 1995 using native Skagit River summer chinook stock collected in the Upper Skagit River above Marblemount (between RM 80 and RM 84). An earlier Skagit River summer chinook salmon program had been discontinued because of introgression by non-native Green River fall-run chinook salmon into the broodstock.

Source: Skagit River indigenous stock. Adults are gillnetted on the Upper Skagit River above Marblemount between late August and mid-September, spawned on site or brought to the Marblemount Hatchery for holding prior to spawning.

Broodstock size/natural population size: One hundred fifty adults are needed to meet a programmed release annual goal of 200,000 fingerling smolts. All wild fish netted in excess of program needs are returned to the river. The geometric mean natural spawning abundance and natural origin spawning abundance from 1987 to 2001 in the Upper Skagit River was 6419 and 6075, respectively (Puget Sound TRT 2002).

Subsequent events: N/A.

Recent events: Beginning in broodyear 1995, natural-origin fish were captured from the Skagit River for use as broodstock for the program.

Relationship to current natural population: Only natural origin fish are used for broodstock. The chinook salmon spawning in the Upper Skagit River are considered to be an independent population by the Puget Sound TRT (Puget Sound TRT 2001). Most of the spawners in the Upper Skagit River population are of natural origin (see above).

Current program goals: Research (monitoring and evaluation of wild summer chinook). The summer chinook salmon program is an indicator stock program with the purpose of marking fish with CWTs to better determine native wild summer chinook salmon population migration patterns, timing, distribution, and contribution to fisheries.

Population genetics: We are unaware of any genetic studies specifically comparing natural and hatchery origin fish from this population.

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) said that this stock was in the ESU but not essential for recovery.

Category and rationale: Category 1a, due to recent founding from native natural-origin fish.

Stock name: *Marblemount fall-run chinook salmon (Skagit River).*

Hatchery/collection site: Marblemount Hatchery, Cascade River (04.1411) RM 0.5; Baker River trap, Baker River (03.0435), Lower Skagit River (gill nets, 25 Rkm below Marblemount Hatchery)

Broodstock origin and history

Year founded: The current program started in 1998.

Source: Currently, the broodstock is Skagit River indigenous fall run chinook salmon. Adults are collected with gill nets by Skagit River Co-Op biologists between early and mid September and mid/late October in the lower Skagit River near Concrete, WA. The broodstock is selected randomly throughout the time period and spawned on site or trucked to Marblemount Hatchery for spawning. Fish collected that exceed need are released. All fall chinook salmon are considered native. Green River fall chinook salmon have been the only non-local introduction since 1951, and use of that stock ceased in 1992.

Broodstock size/natural population size: Up to 80 adult fish (40 pairs of fish) to achieve a program level of 222,000 fingerlings released (from WDFW HGMP). The geometric mean total and natural origin spawning abundance for the Lower Skagit River population from 1987 to 2001 was 1511 and 1499, respectively (Puget Sound TRT 2002).

Subsequent events: N/A

Recent events: Juvenile fish produced through the program are acclimated and released into the Baker River. Significant numbers of adults resulting from these releases are not expected to return to the Baker River trap until 2002 or 2003.

Relationship to current natural population: Only natural origin fish are used for broodstock. The chinook salmon spawning in the Lower Skagit River are considered to be an independent population by the Puget Sound TRT (Puget Sound TRT 2001). The spawning population consists nearly entirely of natural origin fish (see above).

Current program goals: Research (monitoring and evaluation of wild fall chinook). The Skagit River fall-run chinook salmon fingerling program is an indicator program for wild Skagit River fall chinook salmon.

Population genetics: We are unaware of any genetic studies comparing natural and hatchery origin fish from this stock.

Morphology/behavior/fitness: Data not available.

Previous determinations: N/A.

Category and rationale: Category 1a, due to use of indigenous fall-run chinook and recent origin of program.

Stock name: *Tulalip Tribal spring-run chinook salmon.*

Hatchery/collection site: The central facility for the Tulalip Tribe's chinook salmon programs is Bernie Kai-Kai Gobin Hatchery (also known as Tulalip Hatchery). The hatchery is located at RKm 1.9 at the junctures of the East and West Forks of Tulalip Creek (WRIA 07.0001), immediately upstream of the point at which Tulalip Creek feeds into Tony's Marsh.

Broodstock origin and history

Year founded: Skagit River spring-run chinook salmon were first released in 1995. No returning adults have been collected for use as broodstock at Tulalip Bay Hatchery.

Source: Skagit River (Marblemount Hatchery spring-run chinook salmon). The chinook stocks used for the tribe's hatchery programs originate from, and are sustained by, other Puget Sound hatcheries. The program relies on continuous annual transfers from WDFW Marblemount Hatchery to sustain production.

Broodstock size/natural population size: Chinook salmon are not native to Tulalip Creek. Conditions in the creek are not suitable for chinook salmon spawning.

Relationship to natural population: There is no local natural population.

Recent events: The program has been curtailed for an indefinite period. Through 2002, the annual release was 40,000 yearlings.

Current program goals: Harvest. Tribal ceremonial and subsistence fisheries in Tulalip Bay.

Population genetics: See source stocks.

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be in the ESU, but not essential for recovery.

Category and rationale: Category 3b or 3c. The stock originated from within the ESU, but is not native to the Tulalip Bay area where it is released. Historically, spring-run chinook salmon were not present in the Tulalip Bayarea. There is the potential for some interaction with summer-run elements in the Stillaguamish and Snohomish River Basins.

Stock name: *Tulalip Bay summer-run chinook salmon.*

Hatchery/collection site: The central facility for the tribe's chinook salmon programs is Bernie Kai-Kai Gobin Hatchery (also known as Tulalip Hatchery). The hatchery is located at RKm 1.9 at the junctures of the East and West Forks of Tulalip Creek (WRIA 07.0001).

Broodstock origin and history

Year founded: Summer-run chinook salmon juvenile releases began with the 1998 broodyear. No returning adults are collected for use as broodstock at Tulalip Bay.

Source: The program relies on continuous annual transfers from the WDFW's Wallace River Hatchery to sustain production. Summer chinook salmon and (through the 1999 return year) fall chinook broodstock that supply eggs for the program are collected and spawned at WDFW's Wallace River Hatchery on the Skykomish River. See Wallace River summer-run chinook salmon stock for more details.

Broodstock size/natural population size: 40 adults (through broodyear 1999).

Recent events: The program currently operates at the following release levels: Summer Chinook, 200,000 sub-yearlings (http://www.tulalip.nsn.us/htmldocs/salmonhatchery.htm).

Relationship to current natural population: No natural-origin summer chinook salmon are collected as broodstock and there is no natural chinook returning to Tulalip Bay.

Current program goals: Research, harvest augmentation. This program is currently being evaluated as a replacement for the Green River lineage fall-run chinook salmon program.

Population genetics: See Wallace River summer-run chinook salmon.

Previous determinations: None.

Category and rationale: Category 2b or 2c. The stock is derived from within the ESU, but is not native to its site of release. Historically, summer-run chinook salmon were not present in the Tulalip Bay area. There may be some interaction between fish released from this site and naturally-spawning populations in adjacent basins, the Snohomish (from which the stock originates) or the Stillaguamish.

Stock name: *Tulalip Bay fall-run chinook salmon.*

Hatchery/collection site: The central facility for the tribe's chinook salmon programs is Bernie Kai-Kai Gobin Hatchery (also known as Tulalip Hatchery). The hatchery is located at RKm 1.9 at the junctures of the East and West Forks of Tulalip Creek (WRIA 07.0001).

Broodstock origin and history

Year founded: Green River lineage fall-run chinook salmon were first released at this site in 1982. No returning fall-run chinook salmon adults have been collected for use as broodstock at the Tulalip Bay Hatchery.

Source: The program relies on continuous annual transfers of fall-timed chinook salmon eggs from WDFW hatcheries to sustain production. The stock originated from WDFW's Wallace River Hatchery in the Skykomish River Basin (the fall-run chinook salmon program was terminated in 1995), in 2001 and 2002, the broodstock source for the program was Samish Hatchery, Soos Creek (Green River-derived stocks). This program is continuing to use returns to the recently terminated Wallace River fall program for broodstock, supplementing the returns with Samish or Green River fall chinook (W. Eldridge, pers. commun., October 28, 2002).

Broodstock size/natural population size: Chinook salmon are not native to Tulalip Creek. Conditions in the creek are not suitable for chinook salmon spawning.

Relationship to natural population: There is no local natural population. Fish from the Tulalip program have been recovered in the Snohomish River Basin (Puget Sound TRT 2001).

Current program goals: Harvest.

Recent events: The program currently operates at the following release levels: Fall chinook, 1.5 million sub-yearlings (http://www.tulalip.nsn.us/htmldocs/salmonhatchery.htm).

Population genetics: See source stocks.

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be in the ESU, but not essential for recovery.

Category and rationale: Category 3b or 3c. The stock originated from within the ESU, but is not native to the Tulalip Bay area where it is released. Historically, fall-run chinook salmon were not present in the Tulalip Bay area. There is the potential for some interaction between released fall-run fish and naturally-spawning populations in the Stillaguamish and Snohomish Basins.

Stock name: *North Fork Stillaguamish River summer-run chinook salmon.*

Hatchery site: Whitehorse Pond is located 2.4 Km upstream of the mouth of Whitehorse Springs Creek (WRIA 05.0254A), a tributary to the North Fork Stillaguamish River (05.0135), located at RKm 44.8 from its confluence with the mainstem Stillaguamish River (05.0001). Harvey Creek Hatchery is located 2 miles upstream of the mouth of Harvey/Armstrong Creek (05.0126), a tributary to the Stillaguamish River (05.0001) at RKm 24.6.

Collection site: Broodstock are collected using drift gill nets in the mainstem North Fork Stillaguamish River between RKm 25 and RKm 50.

Broodstock origin and history

Year founded: 1980

Source: Returning adult summer chinook returning to the North Fork Stillaguamish River. Natural-origin and hatchery-origin adults are currently being collected as broodstock, although the origin program goal was to use only natural-origin fish (Stillaguamish Tribal Summer Chinook HGMP).

Broodstock size/natural population size: Approximately 30% to 60% of the fish returning to the spawning grounds are marked hatchery chinook originating from the restoration program. From 1980-1986, less than 50 fish were captured annually. The target broodstock collection size is 130-150 fish (Stillaguamish Tribal Summer Chinook HGMP). The geometric mean total and natural origin spawning abundance from 1987 to 2001 was 805 and 552, respectively (Puget Sound TRT 2002).

Relationship to natural population: The chinook salmon spawning in the North Fork Stillaguamish are considered to be an independent population by the Puget Sound TRT (Puget Sound TRT 2001). The hatchery program is a supplementation program, with a high level of exchange between the hatchery and natural components.

Current program goals: Restoration. The goal of this program is to help with the short-term preservation and long-term restoration of native Stillaguamish River summer chinook salmon to self-sustaining levels (Stillaguamish Tribal Summer Chinook HGMP).

Population genetics: There is no information available on the current relationship between the hatchery-origin and natural-origin summer run in the Stillaguamish River.

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be part of the ESU and essential for recovery.

Category and rationale: Category 1a. The stock was recently founded from the natural population inhabiting the basin in which it is released. There has been ongoing exchange between the hatchery and natural components since the time of founding.

Stock name: *Wallace River summer-run chinook salmon.*

Hatchery/collection site: Wallace River Hatchery, on the Wallace River, a tributary of the Skykomish River.

Broodstock origin and history

Year founded: 1972

Source: The founding broodstock for this population were obtained from fish returning to the Wallace River.

Subsequent events: There have been a considerable number of chinook salmon stocks introduced from outside of the Snohomish River Basin. The most common source has been from the Green River. The spawning population of summer chinook was originally recruited from fish that returned to the fish passage facility at Sunset Falls on the Skykomish River in the early 1970s. Since that time, the only source of eggs has been adult fish returning to the trap at the Wallace River Hatchery.

Recent events: The Green River-origin hatchery fall chinook salmon program at the Wallace River Hatchery has been terminated to eliminate the risk of interbreeding between the two stocks.

Broodstock size/natural population size: Broodstock size is 900 pairs. The geometric mean total and natural origin spawning abundance for the Skykomish population from 1987 to 2001 was 3036 and 1796, respectively (Puget Sound TRT 2002).

Relationship to current natural population: In the Snohomish River Basin, chinook spawning in the Skykomish and Snoqualmie Rivers have been identified by the Puget Sound TRT as two independent populations (Puget Sound TRT 2001). Hatchery produced fish (mostly from the Wallace River stock) make up a sizeable fraction of the Skykomish River spawning abundance (see numbers above). The Snoqualmie population contains a much lower proportion of hatchery origin fish (Puget Sound TRT 2002).

Current program goals: Augmentation. The Wallace Hatchery summer-run chinook salmon fingerling program currently releases 1, million subyearling and 250,000 yearlings.

Population genetics: Fish from the Wallace River hatchery are genetically similar to natural fish from the Skykomish River (Puget Sound TRT 2001).

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be in the ESU, but not essential for recovery.

Category and rationale: Category 2a. This broodstock was derived primarily from locally obtained natural-origin fish. However, the proportion of natural origin fish typically used in the broodstock is unknown and may be quite low, leading to the possibility of some divergence from the natural population.

Stock name: *Issaquah Creek fall-run chinook salmon.*

Hatchery/collection site: Issaquah Hatchery, Issaquah Creek (08.0178) RKm 4.8 in the City of Issaquah.

Broodstock origin and history

Year founded: The chinook program at Issaquah Hatchery started in 1937.

Source: The fall chinook stock was founded by Green River Hatchery (Soos Creek Hatchery) transfers. Green River chinook were used to found production at the Issaquah Hatchery in 1937 (WDF 1939). The Issaquah Hatchery stopped receiving eggs from Green River in 1992. A sufficient number of adults are trapped at the Issaquah Hatchery to sustain production needs.

Broodstock size/natural population size: Broodstock size is 1,600 adults. Adult fish collected in surplus of broodstock and not killed are passed upstream and allowed to spawn naturally. There are no direct estimates of hatchery-origin chinook on the spawning grounds due to lack of recent CWT releases in the Lake Washington system. The 2000 releases were 100% mass marked (adipose-fin clip only) so hatchery/wild percentages may be calculated starting in 2003.

Relationship to current natural population: It is likely that a high percentage of natural spawners in Issaquah Creek are of hatchery origin. There is little evidence available to establish whether there were historically any chinook salmon in Issaquah Creek. The relationship between the hatchery and natural populations will become much clearer after the returns of the mass marked releases, starting in 2003.

Current program goals: Augmentation. The goal of this program is to provide fish for harvest opportunity.

Population genetics: Genetic analysis of fish returning to the hatchery in 1992 and naturally spawning adults from Issaquah Creek showed some differentiation, although both samples clustered with other Green River-origin populations (WDFW unpublished data). Since the Issaquah Creek hatchery and natural samples were collected during different years, some of the differences may be due to interannual variation.

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be part of the ESU but not essential for recovery.

Category and rationale: Category 2b. This stock was founded from fish that are part of the ESU, but it is not released in its native watershed. Historically, fall-run chinook salmon were probably not present in Issaquah Creek. The current relationship between the hatchery population and the naturally-spawning populations in the North Lake Washington Tributaries or the Cedar River is largely unknown.

Stock name: *Portage Bay fall-run chinook salmon.*

Hatchery/collection site
University of Washington (UW) Portage Bay Hatchery, Northeast section on north shore of Portage Bay just west of Montlake Cut at RKm 8.0, Lake Washington.

Broodstock origin and history

Year founded: The chinook research and education program started in 1949.

Source: Until adequate numbers of adults returned to meet egg needs in 1955, the broodstock was derived from fish returning to Soos Creek Hatchery. Thereafter, the stock has been self sustaining, except for years in which chinook returns were low. In a low return year (1961), eggs from Soos Creek Hatchery and Issaquah Hatchery were transferred to the UW Hatchery (Fish Transfer Records, University of Washington). There were limited introductions from Clark Creek, Kalama, Puyallup, Samish, and Skagit (Ballard net pens). There are two spring chinook stocks listed—one Sunset Falls X Cowlitz, and the other is unknown. There are also some spring/fall hybrids listed as originating from Green River and Issaquah Creek.

Broodstock size/natural population size: The maximum number of adults spawned to meet production goals is 125 pairs. There are no natural spawning areas in the immediate vicinity of the hatchery. UW hatchery chinook may stray and spawn in North Lake Washington tributaries and the Cedar River, where natural populations are present.

Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Fry to adult survival is assumed to be very low due to predation by non-indigenous species (bass, perch).

Brood Year (BY)	Age*			Total BY Returns	Season Returns	Smolt Production	Excess Fry	Total Release	Smolt-to-Adult Survival
	1	2	3+						
1988	449	60	215	724	430	112,462	0	112,462	0.6438
1989	110	19	280	409	647	139,518	0	139,518	0.2932
1990	640	176	312	1,128	266	166,282	3,847	170,129	0.6784**
1991	2	12	205	219	874	55,844	1,957	57,801	0.3922**
1992	247	217	562	1,026	458	157,276	0	157,276	0.6524
1993	184	327	825	1,336	571	153,234	0	153,234	0.8719
1994	1,340	568	1,203	3,111	606	194,713	0	194,713	1.5977
1995	429	532	1,974	2,935	2,229	201,024	1,686	202,710	1.4600**
1996	366	723	1,388	2,477	1,822	180,047	7,724	187,771	1.3758**
1997	71	143		214	2,101	160,976	145,292	306,268	N/A
1998	138			138	2,768	118,419	0	118,419	N/A
1999				0	1,669	160,018	0	160,018	N/A

* Number of adult escapement for a specific brood year by age.
** Does not include release of excess fry in calculations.

The above table is derived from analysis of UW Portage Bay Hatchery data. Further analysis is currently in progress.

Relationship to current natural population: Unmarked chinook salmon have been observed in the UW return pond. The tagging of all fish released from the UW hatchery is recent and it is unclear whether unmarked fish returning to the hatchery were of hatchery or wild origin. There are not natural spawning areas in the immediate vicinity of the hatchery.

Current program goals: Research and education. The goal of this program is to support the ongoing research programs of UW faculty, research scientists, and graduate students, and also at other affiliated research organizations such as NMFS, USGS, and WDFW. A second goal of this program to provide space for salmonid stocks and fish culture in order to support educational activities for undergraduate and graduate students within the UW as well as K-12 outreach opportunities for the Puget Sound region's schools.

Population genetics: There are no studies that have examined genetic differences between the UW run and natural stocks in the Puget Sound area. However, the following facts are known: The stock was derived from the Green River, via the Soos Creek hatchery The run has undergone both a founding event and some bottlenecks during its history; therefore, the genetic variability within the run may be reduced relative to large, undisturbed natural populations.

Morphology/behavior/fitness: Purposeful selection. The run was initiated with selection in mind and purposeful selection for certain traits continues. The fish were initially selected for early maturation (return in 3 years as opposed to 4), early migration, and high fecundity. Following this early selection protocol, selection for shortened spawning cycle in the 3-year olds was deemed the main goal. The program ended in the mid-1960s, when research moved toward broodstock management. Blockage of the hatchery trap to prevent mortality for warm water conditions at the hatchery have resulted in the UW broodstocks spawning a few weeks later than naturally-spawning (Cedar River) fish in the Lake Washington Basin. There are no other deliberate selection protocols. Incidental information suggests that the UW chinook are more tolerant to higher temperatures than their wild counterparts. This may be a response to their early rearing conditions.

Previous determination: NMFS (1999 b) considered this stock to be in the ESU, but not essential for recovery.

Category and rationale: Category 3b or 4. This stock was founded from fish that are considered part of the ESU, but it is not released into its native watershed. Furthermore, it appears likely that this stock was founded from a mixture of several populations. The stock has been, and is still, subject to artificial selection, and may have diverged substantially from any native Puget Sound chinook population.

Stock name: *Soos Creek fall-run chinook salmon.*

Hatchery/collection site: Soos Creek Hatchery, Big Soos Creek (09.0072) RKm 1.6, tributary to the Green River (09.0001) at RKm 53.6. Broodstock are collected in an in-stream trap situated in Soos Creek. Two other facilities, Icy Creek Ponds (WDFW) and Crisp Creek (Muckleshoot Tribe), rear and release juvenile chinook salmon originating from the Soos Creek Hatchery into the Green River Basin.

Broodstock origin and history

Year founded: 1901

Source: Soos Creek Hatchery chinook originated from broodstock collected from the main-stem Green River from 1901 through 1924 (Becker 1967). After 1924, sufficient adult returns to the hatchery release site had been established to create a self-sustaining program (Becker 1967). .

Broodstock size/natural population size: The broodstock target is 3,500 adults. On average, 39.4% of the adult chinook returning to the Soos Creek hatchery are of natural origin (WDFW CWT data; WDFW HGMP 2002). Since 3,500 brood fish are needed to achieve the egg-take goal, between 780 and 1,380 natural-origin adults may be incorporated into the hatchery broodstock annually. With a permanent rack in place, all returning adults are captured. When the first 100% mass marked brood (1999 brood) returns in 2002 and 2003, WDFW will have the ability to pass adults of natural origin to spawn upstream of the hatchery, if that is a desired management policy for this population.

The ratio of Soos Creek hatchery-origin adults to naturally produced adults in the Green River averaged 33.4% in 7 years between 1989 and 1997 (WDFW CWT data). Small sample sizes (<4%) in five of these years, and the limited area sampled (river mile 33.8 to 41.4 only), make it difficult to expand these values to the entire river.

The ratio of Soos Creek hatchery-origin adults to naturally produced adults in Newaukum Creek averaged 23.3% in 9 years between 1989 and 1997 (WDFW CWT data). On average, 30% of the spawners were sampled each year.

The geometric mean total and natural origin spawning abundance for the Green River from 1987 to 2001 was 7191 and 1796, respectively (Puget Sound TRT 2002).

Current program goals: Augmentation. The Soos Creek Hatchery releases 3.2 million fall-run chinook salmon fingerlings annually, with 300,000 yearlings released at Icy Creek, and 600,000 sub-yearlings from Keta Creek.

Relationship to natural population: The chinook salmon spawning in the Green River are considered to be an independent population the Puget Sound TRT (Puget Sound TRT 2001).

There appears to be a high level of exchange between the Soos Creek Hatchery stock and the Green River natural population (see above).

Population genetics: Soos Creek Hatchery fall-run chinook salmon are genetically similar to naturally spawning chinook salmon in Newaukum Creek, a tributary to the Green River (Marshall et al. 1995, Marshall 2000).

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be in the ESU, but not essential for recovery.

Category and rationale: Category 2a. The hatchery population is derived from a native, local population. A moderate proportion of the broodstock are natural-origin recruits (based upon CWT data). However, there is some uncertainty in the proportion of natural-origin recruits to hatchery-origin recruits on the spawning grounds due small sample sizes and low mark rates. There are no data to indicate that substantial divergence has occurred between the hatchery and the natural spawning population, although both may have diverged from the historical population during ~100 years of artificial propagation.

Stock name : *Muckleshoot Tribe - Keta Creek fall-run chinook salmon.*

Hatchery/collection site: Eggs are transferred from WDFW with all mating done at Soos Creek Hatchery.

Broodstock origin and history

Year founded: Refer to Soos Creek Hatchery.

Broodstock size/natural population size: Muckleshoot Tribe chinook salmon program receives 600,000 eyed eggs from the WDFW Soos Creek Hatchery. The goal for natural spawning escapement has been 5,800 fish in the Green River Basin. Since 1987, this figure has been exceeded in most years .

Relationship to current natural population: Refer to Soos Creek Hatchery.

Current program goals: The primary goal of hatchery production in the Duwamish/Green River system is to provide adult fish for harvest. The Keta Creek program seeds portions of the Green River Basin (above Howard Hanson Dam) that is currently inaccessible to upstream migration.

Previous determinations: NMFS (1999b) considered this stock to be in the ESU, but not essential for recovery.

Category and rationale: Category 2a: see Soos Creek stock.

Stock name: *Suquamish Tribe - Grovers Creek fall-run chinook salmon.*

Hatchery/collection site. Grovers Creek hatchery – Miller Bay

Broodstock origin and history

Source: Eggs were transferred from Finch Creek in 1978 and from Soos Creek and Deschutes River stocks in 1979-1981 (NMFS Draft RMP 2002).

Broodstock size/natural population size: Enough broodstock are taken to produce up to 500,000 subyearlings for on-station release. Some 2.3 million subyearlings and 150,000 yearlings are released in neighboring East Kitsap streams. There is no known sustained natural production in adjacent streams.

Relationship to current natural population: Chinook salmon spawning in this area are considered part of the South Sound fall chinook salmon population complex based on geography (WDF et al. 1993) and genetic traits, which indicate that they are part of a large geographic group that resembles Green River-origin hatchery fish (Marshall et al. 1995). No historical evidence suggests that self-sustaining, independent chinook salmon populations occurred in these systems. Historically, many of these streams may have been too small to support persistent, independent populations of chinook salmon, although spawning and natural production may occur episodically. Natural spawning in nearby streams is predominantly by hatchery-origin fish.

Current program goals: The primary purpose of chinook salmon programs in East Kitsap streams is to produce fish for harvest in commercial and recreational fisheries in the Puget Sound and the Northeast Pacific Ocean.

Population genetics: Genetic traits indicate that they are part of a large population group that resembles Green River-origin hatchery fish (Marshall 1995). There have been limited introductions of non-native fish into the hatchery, but it is not known to what extent they have influenced the characteristics of this stock (Myers et al. 1998).

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be in the ESU, but not essential for recovery.

Category and rationale: Category 2b. This stock was derived from a natural population that is part of the ESU, but is not released in its native watershed. Further, a self-sustaining fall-run chinook salmon population may not have been present in the Grover's Creek area. Interaction with native naturally-spawning populations may be limited.

Stock name: *Garrison Springs/Chambers Creek fall-run chinook salmon.*

Hatchery/collection site: All three locations are on Chambers Creek (WRIA 12.0007). Garrison Springs Hatchery is located on the grounds of Western State Hospital in Steilacoom, Washington. Garrison is located in close proximity to Chambers Creek (less than 0.8 Km) behind the paper mill. Chambers Creek Hatchery is located at RKm 5.6. Lakewood Hatchery is located at RKm 5.4. There are no adult trapping facilities at Lakewood Hatchery or Chambers Creek Hatchery.

Broodstock origin and history

Year founded: The Garrison Springs Hatchery chinook salmon program was founded in 1976. Program releases of fall chinook salmon yearlings began at Lakewood in May of 1999. Program releases of yearling fall chinook began at Chambers in March 1998

Source: Between 1972 and 1980 four stocks, or combinations of stocks, were incorporated into the Garrison program: Minter Creek, Rivers' Inlet (B.C.) crossed with Deschutes, Portage Bay (UW), Voights Creek and Voights Creek x Deschutes.

Subsequent events: Between 1980 and 1990, seven stocks, or combinations of stocks, were produced. All of those stocks represent Green River (Soos Creek) legacy populations. From 1990 to the present, the predominant stock used is comprised of the adult fish returning to Chambers Creek trap. Planting records list this stock as Garrison in several years and then as Chambers Creek in more recent years. Chambers Creek has served as the release site because fish cannot be released directly from Garrison Hatchery due to a waterfall immediately downstream of the facility.

Broodstock size/natural population size: The fall-run chinook salmon for the yearling programs at Lakewood and Chambers Creek hatcheries are taken from the Garrison Springs fall chinook egg take of 1.35 million (870 adults). WDFW concluded that these streams are atypical of productive fall chinook habitat and not likely to support a self-sustaining, naturally spawning salmon population. The Puget Sound TRT indicated that there is considerably uncertainty about the function of small South Puget Sound streams with regard to maintaining chinook salmon populations (Puget Sound TRT 2002).

Relationship to current natural population: Past levels of natural fish in broodstock are unknown. WDFW uses fall chinook salmon adults volunteering to the Chambers Creek trap to supply this program. T he intent is to collect localized hatchery-origin broodstock at this location.

Current program goals: Augmentation. The goal of this program is to provide adult fish for harvest opportunity.

Population genetics: Data not available

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999 b) considered this stock to be part of the ESU but not essential for recovery.

Category and rationale: Category 2b. The broodstock was founded from fish considered part of the ESU, but is not released in its native watershed. Historically, a self-sustaining run of chinook salmon was not present in the Garrison Springs Basin. Interaction with native naturally-spawning populations may be limited.

Stock name: *Voights Creek fall-run chinook salmon.*

Hatchery/collection site: Voights Creek Hatchery is located at RKm 0.8 on Voights Creek (10.0414), a tributary of the Carbon River (10.0413). The Carbon River is a tributary to the Puyallup River (10.0021) and joins it at RKm 28.5. All returning adults are volitionally trapped in a creekside trap. Peak returns occur between early September and mid-October, with the range from July to late October.

Broodstock origin and history

Year founded: Built 1917. Green River fish produced up to 1990.

Source: Voights Creek Hatchery initially procured small numbers of eggs from native fall chinook on station. Approximately 50,000 eggs were collected annually between 1918 and 1923, with production at Voights Creek augmented through fry transfers from Green River and Lower Columbia River hatcheries (Kalama River and Little White Salmon) (WDFG 1925).

Subsequent events: Prior to 1990, production at Voights relied on transfers of Green River-lineage fall chinook eggs (Soos Creek), and on-station returns of this transplanted stock. Since then, the hatchery has been self-sufficient.

Broodstock size/natural population size: Broodstock size typically 1110 adults. The geometric mean natural spawning abundance (natural and hatchery origin fish) from 1987 to 2001 was 2105 (Puget Sound TRT 2002).

Relationship to current natural population: The number of naturally-produced adults incorporated in to the broodstock in the past is unknown, and the proportion of natural origin fish in the natural spawning population is not known. Chinook salmon spawning in the Puyallup River have been identified as an independent population by the Puget Sound TRT (Puget Sound TRT 2001).

Current program goals: The purpose of the two programs is to produce fish for harvest. Broodstock goal is 555 males and 555 females: 1,110 adults

Population genetics: Genetic data suggests that naturally spawning populations (e.g., South Prairie Creek) are closely aligned to Green River stock (WDFW unpublished data). WDFW plans to continue to collect and analyze genetic data from the hatchery and naturally spawning population.

Morphology/behavior/fitness: Data not available.

Category and rationale: Category 2b or 2c. This broodstock originated from a natural population within the ESU, but is not released in its native watershed. Pending a final determination on whether any elements of the native fall-run exists, the precautionary position would be to manage for the protection of a native population and consider this stock as a 2c (or possibly 3c). There are also concerns regarding the interaction of this hatchery stock with late-spawning elements of the White River spring (early)-run chinook salmon.

Stock name: *Diru Creek fall-run chinook salmon.*

Hatchery/collection site: All broodstock are currently collected and spawned by WDFW at Voights Creek Hatchery.

Broodstock origin and history

Year founded: Refer to Voights Creek.

Source: Refer to Voights Creek.

Broodstock size/natural population size: Program managers plan to take sufficient broodstock to produce 200,000 sub-yearlings.

Relationship to current natural population: Puyallup River fall-run chinook salmon spawn naturally throughout the Puyallup Basin. Spawning occurs in the mainstem Puyallup River, South Prairie Creek, Carbon River, Wilkeson Creek, Voights Creek, Clarks Creek, and Kapowsin Creek.

Current program goals: The purpose of the program is to produce fish for harvest in commercial and recreational fisheries in the Puget Sound and Northeast Pacific Ocean.

Population genetics: Refer to Voights Creek.

Morphology/behavior/fitness: Refer to Voights Creek.

Category and rationale: Category 2b or 2c. Refer to Voights Creek.

Stock name: *White River spring-run chinook salmon.*

Hatchery/collection site: Hupp Springs, located at RKm 4.8 of Minter Creek; White River Hatchery, located on the White River, near Buckley, Washington.

Broodstock origin and history

Year founded: 1974.

Source: The WDFW began restoration efforts of the White River spring chinook salmon in 1974. From 1974 to 1976, adults were captured at the Buckley trap then transferred to and spawned at one of two WDFW hatcheries (either Garrison Springs Hatchery or Voights Creek Hatchery).

Subsequent events: In 1977, the White River spring chinook salmon brood was released into Minter Creek rather than into the White River. Initially, WDFW and NMFS maintained two complimentary programs: 1) the anadromous broodstock program at Hupp Springs Hatchery, and 2) a captive brood program at the NMFS Manchester net pens complex. The captive broodstock program at the NMFS marine net pens included the 1977-1986 broods. The Manchester operation was discontinued after the 1986 brood and was replaced by a program managed cooperatively by WDFW and the Squaxin Island Tribe at the South Sound Net Pen complex (SSNP), near Olympia, Washington. Through 1986, at least some broodstock for these programs came from adults returning to the Buckley trap, White River Basin. After 1986, all broodstock were collected from adult returns to Minter Creek Hatchery and from the captive brood programs.

In 1989, the anadromous program was expanded into the newly constructed White River Hatchery located on the White River directly opposite the adult trap at Buckley. In 1992 first hatchery fish, 3 year olds from 1989 brood release, first returned to their site of release within the White River watershed. These returning adults provided a third source of eggs for the program.

Adult broodstock collection occurs at the Minter Creek Hatchery fish ladder/trap. Broodstock collection at Minter Creek begins the second week in May (for spring chinook) and continues through the end of the chum run in mid-December. Broodstock are collected at the White Springs Hatchery from May through August (adults intercepted at the White River Hatchery are not transferred to any other facility). In 2002, milt taken from White River Hatchery spring-run chinook salmon were used on spring chinook salmon eggs at Minter Creek (to minimize the genetic divergence between the two stocks).

Broodstock size/natural population size: The current program utilizes all returning White River Hatchery spring-run chinook adults. Returns to Minter Creek Hatchery have ranged from 213 to 495 adults (1991-1999). No natural spawning of the stock occurs in Minter Creek. White River spring chinook average annual returns from 1992 to 1999 range from 170-833 (WDFW White River Hatchery draft HGMP, submitted 3/29/01). Adult returns to Minter Creek, White River Hatchery, and Buckley trap (unmarked natural- and acclimation pond-origin fish) between

1999 and 2001 have averaged 560, 673, and 1341, respectively. According to the Puget Sound TRT (2002), the geometric mean natural spawning abundance from 1987 to 2001 was 329 (natural and hatchery origin fish).

Relationship to current natural population: No naturally produced fish are currently used for broodstock. All hatchery-origin White River spring chinook salmon are coded-wire tagged as juveniles. Only positively identified White River adults are used as broodstock. Naturally produced (unmarked) White River spring chinook salmon are passed above the Mud Mountain Dam and allowed to spawn naturally in the upper White River Basin. White River spring chinook have been identified by the Puget Sound TRT as an independent population (Puget Sound TRT 2001).

Current program goals: Restoration. The goal of this recovery plan is to restore White River spring chinook salmon to the White River watershed. According to the White River HGMP (Section 1.7), the program goal will be achieved when at least 1,000 unmarked spawners per year are observed in three out of four consecutive years with the normal levels of incidental sport, commercial and tribal harvest.

Population genetics: There are no genetic data for the White River spring chinook population prior to the start of the artificial propagation activities in the 1970s. Based on more recent allozyme data, the White River spring chinook stock is genetically the most distinctive stock in Central and South Puget Sound (Marshall et al. 1995). It differs from nearby chinook salmon populations in allozyme frequencies, adult return time, spawn timing, and distribution. It is the only remaining spring chinook salmon population in Southern Puget Sound. According to the Muckleshoot Tribal HGMP for the White River Hatchery (Section 6.2.4), allozyme analysis indicates that there were no statistically significant 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 stock is genetically more closely related to other South Puget Sound stocks (fall runs) than to spring run stocks in Northern Puget Sound (Marshall et al. 1995). As a measure to maintain the integrity of the donor stock, the Hupp Springs and White River hatchery programs have only used returning marked hatchery-origin adults, in order to ensure that other chinook stocks are not inadvertently incorporated. A sample of emigrating wild chinook smolts trapped in the White River in 1995 showed no significant differences from the captive White River population maintained in the hatcheries (WDFW 2001; Anne Marshall, WDFW, pers. comm., March, 2003). Likewise, allozyme data indicated that the naturally spawning adult fish clustered closely with the hatchery juveniles (data from Anne Marshall, WDFW, pers. comm., March, 2003).

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be part of the ESU and essential for recovery.

Category and rationale: Category 2a. This broodstock was founded using native White River spring run chinook salmon for a restoration program. However, there has been little incorporation of NORs into the broodstock since the 1970s, although molecular genetic data suggests that the White River hatchery and natural-origin groups have not appreciably diverged from each other. Since, 1992, the population returning to the Buckley trap and transported upstream has received substantial infusions of surplus White River Hatchery and Hupp Springs Hatchery-origin fish through the White River acclimation pond program. Preliminary mark recovery data for 1999 BY returns of mass marked three year old fish in 2002 indicated that acclimation pond-origin fish were contributing to adult spring chinook returns trapped at Buckley trapped and transported upstream for release (C. Baranski, WDFW, pers. comm., March 4, 2003).

Stock name: *Clear Creek and Kalama Creek fall-run chinook salmon.*

Hatchery/collection site: The Nisqually Tribe operates two facilities on the Nisqually River. Clear Creek Hatchery at RKm 9.6, and Kalama Creek Hatchery, located on left bank tributary at RKm 14.4. Both facilities have the capacity to collect, spawn, incubate, and rear fish. The Nisqually Tribe collects and spawns fall chinook salmon entering the adult collection ponds at Clear Creek and Kalama Creek hatcheries

Broodstock origin and history

Year founded: The earliest recorded releases of fall-run chinook salmon into the Nisqually Basin occurred in 1943.

Source: The Nisqually Hatchery stock is derived from Green River hatchery stocks. Broodstock are collected from adults volitionally returning to fish ladders at Clear Creek and Kalama Creek hatcheries

Subsequent events: The total number of fish released since 1943 has exceeded 65 million. From 1975 to 1990, over 71% of these fish were released into different parts of the river some distance from the hatchery facilities.

Broodstock size/natural population size: The status of natural production in the Nisqually River is unknown. The Nisqually River historically supported strong native populations of chinook salmon. These may have included early-returning and late-returning runs. The combination of dam building, high harvest rates, loss of important marine, estuary, and riverine habitat, and the introduction of hatchery fish from outside of the basin during the last century has most likely led to replacement of the native runs by fall chinook salmon of various origins. Natural spawning currently occurs throughout the main stem up to RKm 64, in the Mashel River, and Ohop Creek. Because glacial turbidity prevents visual observations of spawning fish or redds, the number of natural spawners is unknown. The hatchery fish are unmarked, so the proportion of hatchery-origin spawners in the hatchery broodstock and on the natural spawning grounds is unknown. More than 3,000 fish are spawned in the hatchery each year. According to the Puget Sound TRT (2002), the geometric mean natural spawning abundance (hatchery and natural origin fish) from 1987 to 2001 was 753.

Recent events: The nearby WDFW McAllister Creek Hatchery has recently been closed.

Relationship to current natural population: We do not know if an indigenous stock of chinook salmon remains in the Nisqually River. WDF et al. (1993) considered the Nisqually population to be a mixture of native and introduced fish. The Puget Sound TRT (2001) identified chinook salmon spawning in the Nisqually River as an independent population.

Current program goals: The purpose of the Nisqually tribal program is to produce fish for tribal, commercial, and recreational harvest as well as to support long-term natural production objectives.

Population genetics: Genetic data suggest that fall chinook salmon returning to the Nisqually River are primarily of Green River-hatchery lineage, although hatchery records indicate that at least nine different Puget Sound hatchery stocks have been used in the system (Nisqually Tribal HGMP, Section 6.1).

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be part of the ESU but not essential for recovery.

Category and rationale: Category 2b or 2c. This stock was founded from fish that are considered part of the ESU, but is released outside of its native watershed. This categorization could be revised after more information is obtained about the genetic and demographic relationships between the hatchery and naturally spawning populations in the Nisqually River. Pending a final determination on whether any elements of the native fall-run exists, the precautionary position would be to manage for the protection of a native population and consider this stock as a 2c, or possibly 3c.

Stock name: *Minter and Coulter Creek fall-run chinook salmon.*

Hatchery/collection site: The Minter Creek Hatchery is located on Minter Creek (15.0048) at RKm 0.8. Minter Creek is a tributary to Carr Inlet in South Puget Sound, Washington. Coulter Creek Hatchery is located at RKm 0.4 on Coulter Creek (15.0002), a tributary to Case Inlet in South Puget Sound.

Broodstock origin and history

Year founded: Beginning in 1946, the fall-run chinook salmon stock propagated at Minter Creek Hatchery originated from direct imports of Green River-hatchery stock, and through transfers of Green River-lineage eggs from WDFW's Samish and Tumwater Falls hatcheries (Salo and Noble, 1953). In 1980, Coulter Creek fall chinook releases were initiated using transferred Green River-lineage stock from Minter Creek and Tumwater Falls. The fall-run chinook salmon release program at Coulter Creek was discontinued in 2000.

Subsequent events: As a source for recreational enhancement, Rivers Inlet (coastal British Columbia) stock was introduced into Minter Creek on one occasion in the mid-1970s.

Source: Broodstock source is adult chinook returning to the Minter Creek Hatchery.

Broodstock size/natural population size: Broodstock size is 1,400 adults for the core program. More adults are required if eggs are needed to support the Tumwater Falls or Grovers Creek fingerling chinook salmon programs.

Relationship to current natural population: The Minter Creek HGMP (Section 2.2.1) states that there was no indigenous fall chinook salmon population in Minter Creek. In this watershed, adult chinook salmon returns and any resulting natural production are dependent upon local hatchery program production. The available habitat is not judged to be typical, productive fall chinook habitat and would not likely support a self-sustaining, naturally spawning fall chinook salmon population. Few, if any, returning naturally produced chinook are incorporated into the broodstock as there is negligible natural production in Minter Creek.

Current program goals: Augmentation. The goal of this program is to provide adult fish for harvest opportunity.

Population genetics: Data not available.

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be part of the ESU but not essential for recovery.

Category and rationale: Category 2b. This stock was founded from fish that are considered part of the ESU, but is released outside of its native watershed. Historically, fall-run chinook salmon were not present in Minter Creek.

Stock name: *Tumwater Falls fall-run chinook salmon.*

Hatchery/collection site: Tumwater Falls Hatchery, located at RKm 0.3 miles on Deschutes River (WRIA 13.0028).

Broodstock origin and history

Year founded: 1953

Source: The fall chinook salmon run returning to the Deschutes River was established in 1946 through the release of Green River Hatchery-origin fingerlings into the lower river. The first egg takes at Deschutes resulted from adult returns occurring in 1949 and 1950 (WDF 1949, 1950).

Subsequent events: The existing chinook salmon return was established and sustained by Green River-stock hatchery releases. Since 1992, Deschutes River adult returns have been used exclusively for this program.

Broodstock size/natural population size: Broodstock size is 2,500 adults (which includes adults for the yearling program). Broodstock returns to the hatchery rack were 24,720 (1995), 15,537 (1996), 4,016 (1997), 4,615 (1998), 7,250 (1999), 5,948 (2000), and 5,671 (2001). All excess adult fall chinook are passed upstream and allowed to spawn naturally.

Relationship to current natural population: It is not known how many naturally produced fish were incorporated into the broodstock historically. Hatchery-origin fall chinook salmon have been passed above Tumwater Falls periodically. Recent studies by WDFW (Fuss 2001, 2002) indicate that returning, predominately hatchery-origin fall chinook salmon adults passed upstream to spawn naturally are successfully reproducing in the wild (in 2000 the estimated deposited egg-to-emigrating juvenile survival was 12.5%). However, since hatchery production has not been historically 100% marked, the enumeration of natural-origin vs. unmarked hatchery fish adults has not been possible.

Current program goals: Augmentation. The goal of this program is to provide adult fish for harvest opportunity.

Population genetics: Data not available.

Morphology/behavior/fitness: Data not available.

Category and rationale: Category 2b. This stock was founded from fish that are considered part of the ESU, but is released outside of its native watershed. This categorization could be revised after more information is available concerning the demographic relationship between the hatchery and the naturally spawning population. Historically, chinook salmon could not ascend Tumwater Falls, and it is doubtful that a self-sustaining chinook salmon population existed in the Deschutes River Basin. If new information shows that the stock contains a high proportion of natural origin fish, it could be considered a category 1b.

Stock name: *George Adams Hatchery fall-run chinook salmon.*

Hatchery/collection site: The George Adams Hatchery is located at RKm 1.6 on Purdy Creek (16.0005), a tributary of the lower Skokomish River (16.0001) that flows into Hood Canal in Southwestern Puget Sound near Union, Washington.

Broodstock origin and history:

Year founded: Production of Hood Canal fingerling fall chinook began at George Adams Hatchery in 1961.

Source: George Adams Hatchery fall chinook salmon originated in 1961 from a transfer of Hoodsport Hatchery stock. The Hoodsport stock was founded in 1952 with an introduction of Dungeness spring/summer chinook salmon. This was followed by several years of Soos Creek (Green River) releases until the stock became (largely) self-sustaining at the Hoodsport Hatchery.

Subsequent events: Broodstock fish are collected from fall chinook salmon adults volunteering to the George Adams Hatchery. Adult broodstock collection occurs in Purdy Creek. The trap operates from August 1 for chinook salmon and remains open through the end of the chum salmon run in early December.

Broodstock size/natural population size: For George Adams there is no specific annual program goal for adult broodstock collection, only for an egg take of 4.57 million fall chinook eggs. Assuming a fecundity of 4,500 eggs per female and a 60% male/40 % female sex ratio, and a prespawning mortality of 5%, the number of adults required to meet the egg take goal would be about 2,670. Broodstock levels back to the hatchery rack were 5,687 (1995), 3,184 (1996), 2,243 (1997), 6,354 (1998), 8,469 (1999), 5,520 (2000), and 9,831 (2001). The Puget Sound TRT (2002) reported the 1987 to 2001 geometric mean total natural spawning abundance (hatchery and natural origin fish)in the Skokomish River to be 1500.

Relationship to current natural population: Naturally produced chinook salmon are not intentionally collected for broodstock. However, it is not possible to distinguish wild chinook from unmarked hatchery fish, so if wild chinook enter the trap and adult holding pond, they are likely be spawned. Genetic analysis of naturally spawning chinook salmon in the South Fork Skokomish Rivers indicate that those populations are similar to George Adams Hatchery fish (Marshall 1999, Marshall 2000). Chinook salmon in the Skokomish were identified by the Puget Sound TRT as an independent population (Puget Sound TRT 2001).

Current program goals: Augmentation and mitigation. Hatchery chinook production has been developed to augment harvest opportunities and, in part, to provide partial mitigation for reduced natural production in the Skokomish system, primarily caused by hydroelectric dams on the North Fork Skokomish. The Skokomish Tribe, whose reservation is located near the mouth of the river, has a reserved treaty right to harvest chinook salmon.

Population genetics: A genetic analysis of George Adams chinook was done during 1999. No significant differences were found between George Adams and Hoodsport hatcheries. It did appear that the Hood Canal-area populations were somewhat differentiated from South Puget Sound populations, although not strongly. (memo from Anne Marshall, WDFW, 31 May 2000).

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be part of the ESU but not essential for recovery.

Category and rationale: Category 2b or 3c. Broodstock sources are from within the ESU, but because of the frequent exchange between George Adams Hatchery and Finch Creek (Green River origin) fall-run chinook salmon broodstocks, the George Adams stock is unlikely to be closely related to any native Hood Canal fall-run chinook salmon populations. This categorization could be revised as more information on the genetic and demographic relationship between the hatchery and natural populations becomes available. Pending a final determination on whether any elements of the native fall-run exists, the precautionary position would be to manage for the protection of a native population and consider this stock as a 3c.

Stock name: *Wild Salmon Conservancy fall-run chinook salmon*

Hatchery/collection site: George Adams Hatchery, located at RKm 1.6 of Purdy Creek (16.0005), a tributary of the Lower Skokomish River (16.0001), which flows into Hood Canal in Southwestern Puget Sound near Union, Washington.

Incubation: Lilliwaup Hatchery (Long Live the Kings), located at RM 0.9 on Lilliwaup Creek (16.0230) near the town of Lilliwaup, Washington.

Rearing and release: Rick's Pond (Long Live the Kings), located near the mouth of the Skokomish River, Rkm 4.6 south of Union, Washington.

Broodstock origin and history

Year founded: Production from Rick's Pond and Lilliwaup Hatchery began with the 1996 chinook broodstock.

Source: George Adams Hatchery.

Broodstock size/natural population size: In order to produce a release of 120,000 yearlings and 30,000 fingerlings, and achieve the egg take goal of 165,000 green eggs at George Adams Hatchery, a maximum of 94 fall chinook adults and 1 jack will need to be collected. This assumes a 10 % prespawning mortality, a 91% egg-to-smolt survival (Fuss and Ashbrook 1995), average fecundity of 3,500 eggs per female, and a 1:1 sex ratio.

Relationship to current natural population: See George Adams Hatchery. It is not known if Wild Salmon Conservancy fall-run chinook salmon interbreed with naturally spawning chinook in the Skokomish River.

Current program goals: Augmentation. The goal of the Hood Canal yearling fall chinook is to provide fish for harvest opportunity within Hood Canal and Puget Sound. Sub-yearlings are produced in Regional Fisheries Enhancement Group programs located in adjacent small creeks for educational and fisheries augmentation purposes.

Population genetics: See George Adams Hatchery.

Morphology/behavior/fitness: Data not available.

Category and rationale: Category 2b or 3c. Broodstock sources are from within the ESU, but because of the frequent exchange of George Adams Hatchery and Finch Creek (Green River origin) fall-run broodstocks, the George Adams stock is unlikely to be representative of any of the native Hood Canal fall-run chinook salmon populations. This categorization could be revised as more information on the genetic and demographic relationship between the hatchery and natural populations becomes available. Pending a final determination on whether any elements of the native fall-run exists, the precautionary position would be to manage for the protection of a native population and consider this stock as a 3c.

Stock name: *Finch Creek/Hoodsport fall-run chinook salmon.*

Hatchery/collection site: Hoodsport Hatchery, located at the mouth of Finch Creek (16.0222), which flows into Hood Canal in the town of Hoodsport, Washington.

Broodstock origin and history

Year founded: 1952

Source: Broodstock consists of fall chinook salmon adult volunteering to the Hoodsport Hatchery. The Hoodsport stock was started in 1952 with the initial release of Dungeness Hatchery spring /summer chinook. This was followed by several years of Soos Creek Hatchery (Green River) releases until the stock became (largely) self sustaining.

Subsequent events: Additional inputs include chinook from Tumwater Falls (largely derived from Soos Creek), Voights Creek (Puyallup Basin), Big Beef Creek, Minter Creek, and Trask River (Oregon) hatchery populations. The actual contribution of these individual hatchery stocks to the Hoodsport stock is unclear. Genetic analysis of the Hoodsport population showed similarities to the Marblemount (Skagit) Hatchery fall chinook salmon population, which may reflect the largely Green River origin of both stocks.

Broodstock size/natural population size: For Hoodsport Hatchery, the egg-take goal is 3.6 million fall-run chinook salmon eggs. Assuming a fecundity of 4,500 eggs per female and a 60% male/40 % female sex ratio, and a prespawning mortality of < 5%, the number of adults required to meet the egg take goal would be about 2,100. Adults in excess of escapement goals will be killed and sold.

Relationship to current natural population: Wild chinook are not intentionally collected for broodstock. It is not possible to distinguish wild chinook from unmarked hatchery fish. Hoodsport Hatchery chinook salmon were genetically similar to naturally spawning chinook salmon in the Skokomish River as were the George Adams fall-run chinook salmon.

Current program goals: Augmentation. The goal of Hood Canal fingerling fall chinook production is to provide fish for harvest opportunity.

Population genetics: The Finch Creek/Hoodsport HGMP (Section 6.1) states that genetic analysis of the Hoodsport population showed similarities to the Marblemount (Skagit) Hatchery fall chinook population, which may reflect the mixed origin of both populations.

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be part of the ESU but not essential for recovery.

Category and rationale: Category 2b or 3c. Broodstock sources are from within the ESU but because of the frequent exchange of George Adams Hatchery and Finch Creek (Green River origin) fall-run broodstocks, the George Adams or Hoodsport stock is unlikely to be representative of any of the native Hood Canal fall-run chinook salmon populations. This categorization could be revised as more information on the genetic and demographic relationship between the hatchery and natural populations becomes available. Pending a final determination on whether any elements of the native fall-run exists, the precautionary position would be to manage for the protection of a native population and consider this stock as a 3c.

Stock name: *Hamma Hamma fall-run chinook salmon.*

Hatchery/collection site: John Creek Hatchery, RKm 3,2, WRIA 16.0253 in the Hamma Hamma River Basin. Lilliwaup Hatchery is located further south on Hood Canal, T23N, R03W, Sec.19, also WRIA 16.

Broodstock origin and history

Year founded: Program started in 1995.

Source: From 1995-1999, George Adams Hatchery fall-run chinook salmon were used as broodstock.

Subsequent events: Currently, chinook adults returning naturally to the Hamma Hamma River are a source for half of the program's broodstock. George Adams Hatchery will continue to provide eggs for the other half of the broodstock.

Broodstock size/natural population size: Broodstock collection will be approximately 21 naturally returning pairs to the Hamma Hamma River to collect 60,000 eggs, and 60,000 eggs from chinook pairs at the George Adams Hatchery.

Chinook spawning abundance (WDFW chinook run reconstruction data, 11-4-99; and WDFW files)

Year	Number	Year	Number	Year	Number	Year	Number
2001	248	1993	28	1985	660	1977	317
2000	381	1992	52	1984	309	1976	252
1999	557	1991	30	1983	224	1975	268
1998	172	1990	35	1982	55	1974	108
1997	0	1989	26	1981	26	1973	252
1996	11	1988	66	1980	106	1972	171
1995	25	1987	21	1979	278	1971	425
1994	78	1986	0	1978	36	1970	300

The level of hatchery-origin chinook salmon returning to the Hamma Hamma watershed from 1967-1997 is unknown. Beginning with broodyear 1995, the otoliths of chinook salmon embryos produced in the restoration program were thermally mass-marked (otolith-marked) prior to their release as fingerlings. Examination of otoliths recovered from spawned out adults provides a method to estimate the proportions of hatchery- and natural-origin fish on the spawning grounds. Based on otolith analysis of chinook adults collected on the spawning grounds during 1998, it is estimated that 46% of the age 3 chinook returning to the Hamma Hamma were of hatchery origin (memo from Jeff Grimm, WDFW, to HCSEG, dated May 17, 1999). During 1999, it is estimated that about 77% of age 3 chinook and 97% of age 4 chinook were otolith-marked; overall, 83% of the chinook returning were otolith-marked and of hatchery origin (Thom H. Johnson, WDFW, pers. commun., based on Jeff Grimm memo dated May 26, 2000 and age composition data from scales).

Relationship to current natural population: From 1995-1999, George Adams Hatchery stock has been used as broodstock for this restoration project. The broodstock's relationship to the natural-origin chinook salmon in the Hamma Hamma River is unclear, but genetic samples were collected during 1999, 2000, and 2001. The Puget Sound TRT (2001) was uncertain the historical status of the chinook salmon population in the Hamma Hamma River and other small Hood Canal Rivers.

Current program goals: Restoration. The goal of this program is to restore a healthy, natural, self-sustaining population of fall chinook to the Hamma Hamma River.

Population genetics: Data not available.

Morphology/behavior/fitness: Data not available.

Previous determinations: None, but see George Adams Hatchery fall chinook.

Category and rationale: Category 2b or 3c. Broodstock sources are from within the ESU but because of the frequent exchange of George Adams Hatchery and Finch Creek (Green River origin) fall-run broodstocks, the George Adams stock is unlikely to be representative of any of the native Hood Canal fall-run chinook salmon populations. This categorization could be revised as more information on the genetic and demographic relationship between the hatchery and natural populations becomes available. Pending a final determination on whether any elements of the native fall-run exists, the precautionary position would be to manage for the protection of a native population and consider this stock as a 3c.

Stock name: *Big Beef Creek fall-run chinook salmon.*

Hatchery/collection site: The Big Beef Creek Hatchery is located on the north side of Big Beef Creek, at RKm 0.1. Big Beef Creek is located on the east side of the Hood Canal Basin, in Washington State.

Broodstock origin and history

Year founded: The current HCSEG/UW/WDFW partnership project started during the fall of 1990. Chinook salmon research hatchery operations at Big Beef Creek had been ongoing since 1972 but have declined due to lack of funding.

Source: The fall-run chinook salmon broodstock originally used in the program came from Finch Creek, Hood Canal's Hoodsport Hatchery, in the late 1960s.

Subsequent events: Broodstock returning to Big Beef Creek subsequently became the egg source from 1970 to present, except for 1993, when chinook returns were low and eggs from George Adams Hatchery (which included eggs from Deschutes Hatchery) were transferred to Big Beef (Fish Transfer Records, WDFW).

Broodstock size/natural population size: All returning hatchery chinook are removed at Big Beef Creek weir to prevent impacts to spawning summer chum salmon. A maximum of 70 pairs are needed for broodstock for the project. The total number of fish returning to the weir has ranged from eight to 1,000.

Relationship to current natural population: There have been no documented studies of fall-run chinook successfully spawning in the estuary below the weir. There is no available data regarding the number of natural-origin chinook that were incorporated into the broodstock because the hatchery chinook have not been differentially marked to date. There is no intent to incorporate wild chinook into the broodstock. The intent is to collect localized hatchery-origin broodstock at this location.

Current program goals: The Big Beef Creek project is a harvest augmentation, research, and education program (200,000 sub-yearlings released annually). The goal of this program is to use artificial production to increase harvestable numbers of chinook salmon in an area where the natural freshwater production capacity is limited; provide chinook for research for UW, WDFW, NMFS, and other interested collaborators; and provide an opportunity for salmon education for local communities and schools.

Population genetics: Data not available, but are presumed to be similar to other Green River (Soos Creek Hatchery) derived populations.

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be part of the ESU but not essential for recovery.

Category and rationale: Category 2b. Broodstock sources are from within the ESU but not native to the area in which they are released. There are no natural populations associated with this stock.

Stock name: *Dungeness spring-run chinook salmon.*

Hatchery/collection site: Dungeness Hatchery, Dungeness River (18.0018) RKm 16.8. Hurd Creek Hatchery, Hurd Creek (18.0028) RM .2, tributary to Dungeness River (18.0028) at RKm 4.8. Gray Wolf Acclimation Pond, Gray Wolf River (18.0048) at RKm 1.6, tributary to Dungeness River

Broodstock origin and history

Year founded: 1992

Source: Broodstock collection, from wild chinook salmon redd pumping, for this rebuilding program, ended with the collection of 1997 brood eggs (6 brood years, 1992 through 1997) were collected. Since that time, eggs have been derived from captively reared adults that resulted from the 1992 through 1997 collection of eggs.

Broodstock size/natural population size: The current and future program size is limited by the 300+ remaining captive broodstock (from 1995 to 1997 broodyear classes) currently on hand. It is too early to predict the smolt-to-adult survival rates. The year 2000 brood was the first return of 4-year-old adults to the Dungeness River. They were allowed to spawn naturally in the Dungeness River (no data as of yet). If returning fish congregate in the hatchery outlet channel, they may be trapped and hauled upstream to spawn naturally. The wild spring chinook salmon escapement goal is 925 and is roughly based on the fair to poor habitat status outside the Olympic National Park and historic run size information. The Puget Sound TRT (2002) reported the 1987 to 2001 geometric mean natural spawning escapement in the Dungeness River to be 123.

Relationship to current natural population: The Dungeness River chinook salmon population consists of a wild chinook salmon stock that is considered to be native to the river. The Dungeness Wild Chinook Restoration Committee and SASSI participants concluded it is likely there is a single chinook salmon stock in the Dungeness Basin. The impact of past releases of non-native chinook stocks into the Dungeness River between 1966-1972 is unknown. Native broodstock will not be collected for the remainder of this program. The sole source of eggs will be from the captive brood adults held at Hurd Creek. Data from otoliths and heads recovered on the spawning grounds in 2001 have not yet been analyzed. Preliminary data, from 2000 returns, indicates that ~ 90% were of hatchery origin. The Puget Sound TRT (2001) identified the Dungeness River chinook as an independent population.

Current program goals: Restoration. The goal of this program is the restoration of the indigenous chinook salmon to a self sustaining level in the Dungeness River watershed.

Population genetics: No published genetic analysis is available for either the historic or current populations (NMFS 1999). However, the Puget Sound TRT (2001 citing A. Marshall, WDFW, pers. commun.) noted that chinook in the Dungeness River are distinctive from other stocks in the Puget Sound—they are intermediate in their genetic composition between chinook in Eastern Puget Sound and chinook in the Elwha River.

Morphology/behavior/fitness: Captive brood spawning peaks approximately 1-2 weeks later than wild fish.

Previous determinations: NMFS (1999b) considered this stock to be part of the ESU and essential for recovery.

Category and rationale: Category 1a. This broodstock was recently founded by naturally spawning fish native to the basin, although persistent small run sizes may have result in a moderate levels of divergence from the historical population.

Stock name: *Elwha River summer/fall-run chinook salmon.*

Hatchery/collection site: Elwha Hatchery, Elwha River (18.0272) at RM 2.9.

Broodstock origin and history

Year founded: Chinook salmon releases into the Elwha River started in 1914, but consistent annual releases did not occur until 1953.

Source: Naturally spawning chinook from the Elwha River were the original source of broodstock. The current sources are chinook salmon volunteering into the trap at the Elwha Hatchery and adults collected from the river, which consists of both hatchery and natural-origin chinook. Due to a lack of sufficient attraction water at the hatchery outlet, and low river flows during the adult chinook return period, the location of the hatchery limits homing of returning hatchery fish to the facility.

Broodstock size/natural population size: The total escapement goal to the Elwha River is 2,900 adults, which has not been achieved since 1992. Of these, 2,400 are required for the hatchery program and 500 for wild spawning in the river. A portion of the adult spawners volunteer into the off-river adult trap but this number is normally less than 50% of the needed adults. Additional broodstock is seined from several holding pools, or gaffed off the spawning grounds in the river. The Puget Sound TRT (2002) reported the geometric mean natural spawning abundance from 1987 to 2001 to be 1319, with unknown proportions of natural and hatchery origin fish.

Recent events: Two dams that block access to most of the Elwha Basin are scheduled to be removed in 2007. The removal will open up a great deal of chinook salmon habitat, but will also temporarily result in greatly increased sediment loads in the lower river. These high sediment loads will be detrimental to natural production in the lower Elwha River for at least two broodyears.

Relationship to current natural population: Chinook salmon spawning in the Elwha River have been identified as an independent population by the Puget Sound TRT (2001). Based on the broodstock collection protocols and the limited natural spawning area, there is a high rate of exchange between the natural and hatchery components of the population.

Current program goals: Restoration. The goal of this program is the preservation and restoration of the indigenous chinook salmon population in the Elwha River.

Population genetics: We are unaware of any genetic date comparing natural and hatchery origin chinook salmon in the Elwha River.

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be part of the ESU and essential for recovery.

Category and rationale: Category 2a. The stock is native to the Elwha River, but the proportion of natural origin fish in the broodstock is unknown and probably relatively low because of limited habitat for natural reproduction in the Lower Elwha River. There is no strong evidence for substantial divergence between the hatchery and natural components of the population. If new information shows that in fact a substantial fraction of the broodstock consists of natural origin fish, this stock could be revised to be a category 1a.

Stock name: *Glenwood Springs fall-run chinook salmon.*

Hatchery/collection site: Glenwood Springs is located on the eastern shore of East Sound, Orcas Island, Washington. The facility is located on 300 acres of private property, which includes the springs that supply the water to the hatchery and associated rearing ponds, the entire watershed, and the saltwater bay to which the fish return.

Broodstock origin and history

Year founded: Sub-yearling releases of fall chinook began in 1979. Yearlings are also released in some years. The current fisheries enhancement program began in 1996.

Source: The broodstock source is adult fall chinook salmon returning to the Glenwood Springs facility. The stock was originally founded from Samish Hatchery fish, which was originally derived from transfers from the Soos Creek Hatchery.

Broodstock size/natural population size: 400-1,000 returning adults. No natural population.

Relationship to current natural population: There are no naturally reproducing chinook populations found within the San Juan Islands. There are no appropriate chinook salmon spawning grounds in the vicinity. The most recent recoveries of strays from this program have been into the Skagit River.

Current program goals: Augmentation. The goal of this program is to produce fish for recreational fishers in Puget Sound.

Population genetics: The Glenwood Springs HGMP (Section 6.2.1) states that population genetic analysis identifies this stock as typical of Puget Sound fall chinook.

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1999b) considered this stock to be part of the ESU but not essential for recovery.

Category and rationale: Category 2b. This stock was founded from fish that are part of the ESU, but is not released in its native watershed. Historically, populations of chinook salmon were not thought to be present in the San Juan Islands.

Hood Canal Summer-Run Chum Salmon ESU

Stock name: *Big and Little Quilcene River summer chum salmon.*

Hatchery/collection site: Broodstock are collected at mouth of the Quilcene River and in Quilcene Bay (via beach seine) and/or at a fish trap at the Quilcene National Fish Hatchery (QNFH).

Broodstock origin and history

Year founded: Summer-run chum salmon from Hood Canal were first reared at the QNFH from 1912 to 1937, and at a satellite hatchery, Duckabush River Station, from 1911 to 1942 (Cook-Tabor 1994).

Source: Broodstock are collected as the fish arrive in Quilcene Bay or at the permanent fish trap at QNFH (WDFW/PNPTT 2001). Broodstocks reared at QNFH and Duckabush River Station were collected from various rivers in Hood Canal and released primarily into the Little Quilcene and Big Quilcene Rivers. A release also 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).

Quilcene NFH Summer Chum Program

Broodyear	Natural Escapement	Quilcene NFH Spawn	Total Escapement
1992	320	411	731
1993	97	36	133
1994	349	345	694
1995	4,029	484	4,513
1996	8,479	771	9,250
1997	7,339	535	7,874
1998	2,244	544	2,788
1999	2,981	170	3,151
2000	5,126	398	5,254
2001	5,868	306	6,174
2002	3,662	355	4,017
Average	3,681	396	4,053

Broodstock size/natural population size: Through 2000, over 3,700 summer chum adults have been spawned through the QNFH program, and nearly 3 million fry have been released into the Big Quilcene River (WDFW and PNPTT 2001). Between 1996 and 2002, 40,000 summer chum salmon fry and about 637,000 eggs from QNFH were shipped to Big Beef Creek for the reintroduction project there (WDFW and PNPTT 2001). The Big Quilcene River supplementation program terminates after the 2003 broodyear.

Population genetics: Allozyme or DNA collections of summer chum salmon samples from the QNFH in 2001 and 2002, from the Big Quilcene River in 2000, and samples from the Little Quilcene River were collected in 1999 and 2000, but have not been analyzed (WDFW and PNPTT 2001). Additionally, scales from returning adults have been collected since 1992.

Previous determinations: WDFW believes that all artificially propagated chum salmon in this ESU (including the hatchery fish) should be included in the ESU (J. Ames, WDFW, pers. commun., February 1999). NMFS (1999b) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 1a. This stock was recently founded from a natural population in the ESU and is released in its native watershed.

Stock name: *Lilliwaup Creek summer-run chum salmon.*

Hatchery/collection site: Broodstock collected at weir on Lilliwaup Creek.

Broodstock origin and history

Year founded: 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 1998d). Later, the LLTK group assumed primary responsibility for implementation of this project.

Source: Broodstock fish for this program are collected at a weir on Lilliwaup Creek and transferred into the nearby LLTK facility for ripening and spawning.

Broodstock size/natural population size: 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). Due to continued low returns, 58% and 84% of the total run were removed for artificial propagation in 1997 and 1998, respectively (WDFW 1998d), and in 1999 and 2000, nearly all the summer chum salmon returning to Lilliwaup Creek were included in the supplementation program (WDFW/PNPTT 2001). Through 2001, adult return levels did not improve, with escapements the previous four years each at less than 40 fish In 2002, 100 adult fish returned to the creek, and in 2002, over 700 adults returned to spawn naturally in Lilliwaup Creek.

Current program goals: 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 risk of extinction caused by low abundance.

Previous determinations: WDFW believes that all artificially propagated chum salmon in this ESU (including the hatchery fish) should be included in the ESU (J. Ames, WDFW, pers. commun., February 1999). NMFS (1999c) considered this stock to be in the ESU but not essential for recovery.

Population Genetics: Beginning in 1997, otoliths of summer chum salmon from the reintroduction program have been thermally-marked to distinguish these fish from other summer chum salmon that may return to Lilliwaup Creek (WDFW/PNPTT 2001). GSI allozyme and/or DNA collections of summer chum salmon samples from Lilliwaup Creek were collected in 1999 and 2000 (WDFW/PNPTT 2001). These have not yet been analyzed

Category and rationale: Category 1a. This stock was recently founded from a natural population in the local watershed.

Stock name: *Hamma Hamma River/John Creek summer-run chum salmon.*

Hatchery/collection site: Broodstock fish are hooked or gaffed from spawning ground in Hamma Hamma River.

Broodstock origin and history

Year founded: In 1997, HCSEG and LLTK initiated a program to supplement summer-run chum salmon on the Hamma Hamma River.

Source: Adult spawners are hooked or seined from the spawning grounds, and the resulting eggs are either placed in remote site incubators for hatching, and subsequent rearing to an average of approximately 1 gram in weight in a pond in John Creek, a Hamma Hamma River tributary.

Broodstock size/natural population size: 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 1998d). In 1999, 22 females and 21 males were spawned to produce 51,600 fry, and in 2000, 26 females and 30 males were spawned to produce 55,400 fry. Because of a landslide in 1999 at John Creek remote site incubator site, half of the eggs collected in any brood year are reared at the Lilliwaup Hatchery, and return to John Creek for acclimation and release (WDFW and PNPTT 2001).

Current program goals: Goals of this project are similar to those used in summer-run chum salmon program in the Quilcene River and Lilliwaup Creek (WDFW 1998d).

Population genetics: Beginning in 1997, otoliths of summer chum salmon from the reintroduction program have been thermally marked to distinguish these fish from other summer chum salmon which may return to the Hamma Hamma River (WDFW/PNPTT 2001). Allozyme or DNA collections of summer chum salmon samples from the Hamma Hamma River were collected in 1999 and 2000 (WDFW/PNPTT 2001) but have not yet been analyzed.

Previous determinations: WDFW believes that all artificially propagated chum salmon in this ESU (including the hatchery fish) should be included in the ESU (J. Ames, WDFW, pers. commun. February 1999). NMFS (1999c) considered this population to be in the ESU, but not essential for recovery.

Category and rationale: Category 1a. This stock was recently founded from a natural population in the local watershed.

Stock name: *Big Beef Creek summer-run chum salmon.*

Hatchery/collection site: Broodstock were provided through the USFWS program on the Big Quilcene River from 1996 through 2000. Broodstock are now collected from re-established adult returns at the Big Beef Creek Hatchery weir, located at RKm 0.1.

Broodstock origin and history

Year founded: The native summer-run chum salmon population in Big Beef Creek was extirpated in the early 1980s (WDFW and PNPTT 2001).

Source: A joint project among Point-No-Point Treaty Tribes, WDFW, and USFWS to re-establish 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 1998d). 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.

Broodstock size/natural population size: Between 1996 and 2001, 40,000 summer chum salmon fry and about 637,000 eggs from QNFH were shipped to Big Beef Creek for the reintroduction project there (WDFW/PNPTT 2001). 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 1998d). In 2001 and 2002, nearly 900 summer chum salmon returned to Big Beef Creek (UW 2002, Thom Johnson, WDFW pers. comm. November, 2002). The Big Beef Creek reintroduction project is limited to no more than 12 years duration (commencing in 1996). Beginning in 1998, otoliths of summer chum salmon from the reintroduction program have been thermally-marked to distinguish these fish from natural-origin summer chum salmon which may return to Big Beef Creek, and to differentiate between broodyear release groups for survival assessment purposes (WDFW/PNPTT 2001).

Population genetics: Allozyme or DNA collections of summer chum salmon samples from Big Beef Creek were collected in 2000 (WDFW/PNPTT 2001) but have not yet been analyzed.

Previous determinations: NMFS (1999c) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 1b. The stock was recently founded from natural-origin fish that are part of the ESU, and is being released in a nearby stream in which the native run was extirpated. The historical relationship between summer chum populations in Big Beef Creek and the Quilcene River is unknown.

Stock name: *Salmon/Snow Creek summer-run chum salmon.*

Hatchery/collection site: Broodstock are collected at the WDFW weir on Salmon Creek. Salmon Creek eggs are fertilized and incubated at Dungeness Hatchery, incubated and reared at Houck Creek (through 2001), or in remote streamside incubators for release into Salmon Creek. Prior to 2001, the fry were transferred for further rearing in a seawater net-pen in Discovery Bay before being released.

Broodstock origin and history

Year founded: Prior to the inception of this program, there had been no artificial propagation of summer-run chum salmon in the Strait of Juan de Fuca portion of this ESU. 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.

Broodstock size/natural population size: Through 2002, about 85,000 native summer-run chum salmon fry have been released annually into Salmon Creek or 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, or directly released as unfed fry. Some juveniles were transferred to a net pen in Discovery Bay for short-term saltwater rearing prior to release, but this practice was discontinued in 2001. This is the 11th year of the program, and the Salmon Creek supplementation project is limited to no more than 12 years (J. Ames, WDFW, pers. comm., February, 1999). Analysis of otolith mark recovery data for 1997 through 2000 return year adults (which includes two, three, four, and five year old fish) escaping to Salmon Creek indicates that between 7.9% and 73.4% of the annual spawning population is of hatchery-origin (WDFW and PNPTT 2001).

Previous determinations: NMFS (1999c) considered this stock to be part of the ESU, but not essential for recovery. WDFW believes that all artificially propagated chum salmon in this ESU (including the hatchery fish) should be included in the ESU (J. Ames, WDFW, pers. commun., February 1999).

Category and rationale: Category 1a. This stock was recently founded from a local, natural population.

Stock name: *Chimacum Creek summer chum salmon.*

Hatchery/collection site: Broodstock are collected and spawned at the WDFW weir on Salmon Creek. Salmon Creek eggs are fertilized and incubated at Dungeness Hatchery, incubated and reared at Naylors Creek for release into the Chimacum Creek watershed.

Broodstock origin and history

Year founded: Large returns of summer-run chum salmon to Salmon Creek in brood year 1996 allowed transfer of sufficient eggs to initiate the planned reintroduction program in nearby Chimacum Creek.

Source: In Chimacum Creek, Salmon Creek eggs are incubated in Heath trays at a hatchery site on Naylor's Creek, a tributary. Hatchlings emerge into raceways where they are reared until they reach an individual 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 initiated under the SCSCI (WDFW and PNPTT 2001). Salmon Creek broodstock will continue to be collected to effectuate the Chimacum reintroduction program.

Broodstock size/natural population size: The indigenous Chimacum Creek summer chum population was extirpated sometime in the mid-1980s. The first adult returns resulting from the ongoing reintroduction occurred in 1999, when 38 3-year-old fish escaped to spawn naturally. In 2000, 52 fish escaped to spawn, and in 2001 and 2002, approximately 700 to 900 fish escaped to spawn naturally in Lower Chimacum Creek.

Previous determinations: NMFS (1999c) considered the transferred Salmon/Snow Creek stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 1b. The stock was recently founded from natural-origin fish that are part of the ESU, and is being released into a nearby stream whose native population was extirpated. The historical relationships between the populations in the streams is not known.

Stock name: *Union River summer-run chum salmon.*

Hatchery/collection site: Broodstock fish are collected at a weir in the Lower Union River. Eggs are fertilized and incubated at WDFW's George Adams Hatchery. Eyed eggs or fry are transferred to a remote incubation site on Huson Springs, a tributary to the Union River. Fry are released on-site or trucked to the river mouth.

Broodstock origin and history

Year founded: 2000

Broodstock size/natural population size: Brood year 2000 was the first year of the Union River supplementation program. The otoliths of summer chum salmon embryos produced in the program were thermally mass-marked (otolith-marked) prior to release as fry to distinguish them from naturally spawned summer chum in the Union River. In broodyear 2000, 62 fish, or 8.3% of the naturally-spawning run was removed for the broodstock program.

Current program goals: The Union River supplementation program is a cooperative effort between the HCSEG and WDFW. T he strategy is to boost the abundance of the Union River population to allow for transfers of surplus fish for a reintroduction of summer chum on the Tahuya River using Union River stock. The goal is to reintroduce and restore a healthy, natural, self-sustaining population of summer chum in the Tahuya River. The program is intended to last 12 years, starting in the year 2000. The program will procure no greater than 50 % of the total annual number of returning females when the anticipated spawning population exceeds 250 fish. If the anticipated spawning population is less than 250, broodstock removal criteria set forth by WDFW/Point No Point Treaty Tribes (PNPTT) (2001) for small population sizes will be followed. Goals are to produce a maximum of 86,000 fed fry each year for release into the Union River.

Population genetics: Data not available.

Previous determinations: WDFW believes that all artificially propagated chum salmon in this ESU (including the hatchery fish) should be included in the ESU (J. Ames, WDFW, pers. commun., February 1999).

Category and rationale: Category 1a. This stock was recently founded from a local wild population.

Stock name: *Jimmycomelately Creek chum salmon.*

Hatchery/collection site: Permanent trap in Lower Jimmycomelately (JCL) Creek.

Broodstock origin and history

Year founded: Broodyears 1999 and 2000 were the first two years of the JCL Creek supplementation program.

Source: Currently, the program collects summer chum broodstock at a weir and trap at RKm 0.2 on JCL Creek, with holding and spawning of broodstock at the trap site. Eggs and milt are transferred to WDFW Hurd Creek Hatchery (Dungeness River) for fertilization and initial incubation. Eyed eggs from Hurd Creek Hatchery are moved to remote site incubators at a facility on a spring-fed tributary to JCL Creek with volitional release from remote site incubators into fiberglass tanks. Also, swim-up fry from Hurd Creek Hatchery are transferred to tanks at JCL Creek facility for rearing to ~1 gram for release into JCL Creek near the estuary.

Broodstock size/natural population size: During 1999, there was one difference in that fed fry were transferred from Hurd Creek Hatchery to the remote site on JCL Creek and reared/acclimated for one month prior to release into JCL Creek near the estuary. This was done to optimize the survival of the low number of eyed eggs (4,130) and fry (3,925) available from the very low return of adults (n=7) and also since the remote site was new and untested. Rearing at the remote site went well and 3,880 fry were released at a size of ~1 gram in April.

The otoliths of summer chum salmon embryos produced in the program were thermally mass-marked (otolith-marked) prior to release as fry to distinguish them from naturally-spawned summer chum in JCL Creek and from fish reared in other summer chum supplementation programs. During 1999 and 2000, a trap was operated throughout the summer chum return to enumerate spawners and to collect information on fish origin and age composition. Beginning in 2001, otoliths were recovered from spawned adults. Examination of these otoliths provides a method to separate the number of supplementation (hatchery) fish from the number of naturally spawning (natural) fish and/or strays from other supplementation programs and assist in determining the contribution of the supplementation program to the summer chum population.

In order to preserve the full diversity of the donor population, the program intent is to use 100% of the summer chum returning to JCL Creek as broodstock, at least until population size increases. During broodyear 1999 and broodyear 2000, more than 85% of the summer chum returning to JCL Creek were included in the supplementation program; one and nine summer chum spawned downstream of the trap during 1999 and 2000, respectively.

Current program goals: The goal of the program is to contribute to the restoration of a healthy, natural, self-sustaining population of summer chum that will maintain the genetic characteristic of the native JCL stock. The objectives of the supplementation program are to boost the numbers of naturally produced fish in JCL Creek using the indigenous population as the donor.

Consistent with the standards set in the Summer Chum Salmon Conservation Initiative (WDFW/PNPTT 2001) and HGMP, the expected duration of the program is a maximum of 12 years (three generations), beginning with broodyear 1999. The co-managers will monitor the adult returns from fry released from the supplementation program.

Population genetics: Samples have been collected but not analyzed.

Previous determinations: WDFW believes that all artificially propagated chum salmon in this ESU (including the hatchery fish) should be included in the ESU (J. Ames, WDFW, pers. commun., February 1999).

Category and rationale: Category 1a. This stock was recently founded from a local, wild population.

WASHINGTON COAST RECOVERY DOMAIN

Ozette Lake Sockeye Salmon ESU

Stock name: *Umbrella Creek sockeye salmon.*

Hatchery/collection site: Broodstock are currently collected at a temporary weir on lower Umbrella Creek, a northern tributary to Ozette Lake on the Olympic Peninsula in Washington.

Broodstock origin and history

Year founded: 1982

Source: Eggs from the Quinault River were imported to initiate the Umbrella Creek sockeye salmon release program in 1982. From 1983 through 1998, broodstock were collected from indigenous natural-origin sockeye salmon spawning on Olsen's Beach and Allens Beach in Ozette Lake. Beginning in 2000, and through the present, broodstock fish for the tributary hatchery program are collected only from adult sockeye returns to Umbrella Creek established through the hatchery program.

Broodstock size/natural population size: The HGMP indicates that the most recent 4-year annual mean run size from 1996 to 1999 for this predominately 4-year-old age at return population was 1,598 adults (range 1,133 to 2,076).). This most recent 4- year mean escapement average compares to a mean escapement of 811 for the 4 previous years of the cycle (1992-1995, range ≤267 to 2,548). The 1996-99 mean lake escapements for beach-origin and tributary-origin sockeye were 1,424 and 156, respectively. Sockeye salmon originating from Ozette Lake tributaries (F1 hatchery and/or NORs) comprised an average of 9.8 % of the total escapement in recent years. Sockeye salmon returns to Umbrella Creek in 2001 and 2002 exceeded 2,000 adult fish (NOAA Fisheries 2001).

Subsequent events: A weir and trap on lower Umbrella Creek are used to collect adult sockeye salmon as broodstock in October through December. Prior to 2000, the broodstock used for the tributary program was collected using gill nets from spawning beaches in Ozette Lake. A single transfer of Quinault stock was made in 1982, and a sockeye X kokanee cross group was released in 1 year (Makah 2000). The majority of sockeye salmon returning to Umbrella Creek spawn naturally after passage above the weir. Spawning escapements to the tributary exceeded 2,000 fish in 2001 and 2002, with the excess fish passed upstream to spawn naturally. Hatchery fish are thermally mass marked (otoliths), and a proportion also receive an adipose fin clip.

Umbrella Creek broodstock are also being used to establish a self-sustaining return in Big River, an adjacent Ozette Lake tributary. Measures are applied to minimize the tributary program's potential genetic risks to the listed beach-spawning population and to the kokanee (NOAA Fisheries 2001). The listed beach-spawning sockeye salmon population is not a focus of the supplementation effort, which is designed to produce returns only to the tributaries.

Relationship to current natural population: Adult sockeye salmon used as broodstock for the Umbrella Creek program were derived directly from the indigenous beach-spawning sockeye salmon population in Ozette Lake. Mark recovery data presented in the HGMP indicates that few hatchery-origin fish have strayed to spawn onto beach areas used by listed beach spawning fish.

Program goal: The primary purpose of the proposed tributary hatchery program is to create self-sustaining sockeye salmon populations in Ozette Lake tributaries.

Genetic Data: The HGMP indicates that baseline genetic profiles developed using microsatellite DNA loci reveal genetic differences between Ozette Lake sockeye salmon spawning at different beaches and among spawners returning in different years to the same beach . Preliminary analysis of these profiles indicates that beach spawning sockeye salmon from Olsen's beach and sockeye salmon returning to Umbrella Creek are very similar (K. Currens, NWIFC, pers. comm.., March 2003). There is currently no indication that the tributary sockeye salmon have diverged from the original donor beach-spawning sockeye salmon populations.

Phenotypic data: Data not available.

Previous determinations: NMFS (1999c) considered the transferred Umbrella Creek stock to be part of the ESU but not essential for recovery.

Category and rationale: Category 1a or 1b, or possibly 2a or 2b, depending on fraction of natural origin fish in the broodstock. The broodstock was primarily founded through collection and spawning of native beach-origin sockeye salmon. In two years since the program's inception in 1982, some sockeye salmon (in 1982) and kokanee (in 1991) that did not originate from the Lake Ozette ESU were also used for broodstock. However, this has not been the case since 1991. Also, there is some uncertainty about whether the stock is being released within its native range, because it is unclear if Ozette Lake sockeye salmon originally spawned in tributaries and, if they did, what relationship the tributary-spawning populations had to the beach-spawning populations. We were also unable to find information on the fraction of natural origin fish in the broodstock, leading to uncertainty about whether to classify this stock as category 1 or 2. In any case, the tributary establishment program appears to have resulted in the successful production of NORS from naturally spawning hatchery fish (NOAA Fisheries 2002).

WILLAMETTE AND LOWER COLUMBIA RIVER RECOVERY DOMAIN

Lower Columbia River Coho Salmon ESU

Lower Columbia River coho salmon are not currently listed, but are being reviewed for listing. In an effort to provide consistency to the hatchery review process the status of coho salmon hatchery stocks is being reviewed at this time.

Stock name: *Big Creek coho salmon (ODFW #13).*

Hatchery/collection site: The broodstock is currently collected at the weir at Big Creek Hatchery, on Big Creek, Oregon. Hatchery fish are released into Big Creek and locations in Youngs Bay.

Broodstock origin and history

Year founded: 1938.

Source: This broodstock was founded mostly from natural-origin coho collected in Big Creek.

Broodstock size/natural population size: This broodstock includes several hundred fish annually drawn from a much larger return of hatchery fish. Very few wild fish are currently captured at the weir. The largest capture occurred in 2000, when about 18 wild fish were captured.

Subsequent events: Transfers into this broodstock occurred in 1944 and 1951 from the Klaskanine Hatchery; in 1970 from Sandy River Hatchery; and in 1984 from the Bonneville Hatchery. Otherwise, all broodstock collection occurred at Big Creek. Hatchery fish were not marked so it is not clear how many wild fish may have been retained as broodstock. A temporary weir was utilized just below the hatchery; however, Wallis (1963a) indicates that the weir was removed after the egg quota was achieved. In the 1970s, a permanent weir was installed at the Big Creek Hatchery to stop fish from spawning above the hatchery water intake. Very little natural spawning habitat exists below the weir. The population of natural spawning coho in the Lower Columbia River, declined sharply in the 1970s. It is likely that few, if any, wild fish have been included in the broodstock since that time.

Recent events: Since the late 1990s, all hatchery fish have been marked. Examination of returning adults has revealed that very few wild coho are returning to the Big Creek weir (less than 20 in the best years). There is currently no effort to incorporate wild fish into the broodstock.

Relationship to current natural population: Natural-origin fish have not been incorporated into this broodstock in many years. In general, there are very few unmarked coho in the Lower

Columbia River. It is likely that stray hatchery fish spawn in Lower Big Creek (although there is not much habitat available), but they evidently are not producing many adults. The Willamette and Lower Columbia River Technical Recovery Team (TRT) has not determined historical demographically independent populations for the Lower Columbia River ESU, although the boundaries of such a population would be similar to the Big Creek fall-run chinook salmon DIP (Myers et al. 2002).

Program goal: The Big Creek stock is a candidate for possible reintroductions in the Lower Columbia under the Oregon State Endangered Species Act and Lower Columbia Coho Recovery Plan. The stock has been selected for this use because wild coho in the Lower Columbia are largely extinct and this broodstock is one of the few remaining sources of fish from the historic lower river gene pool. The Big Creek hatchery also provides coho eggs for STEP programs at local High Schools.

Genetics data: The broodstock is clustered within the Lower Columbia River ESU (Weitkamp et al. 1995).

Phenotypic data: Data not available.

Category and rationale: Category 2a, based on the following criteria: the stock was largely founded from Big Creek wild coho, which would have been part of the ESU. It has received few introductions of fish from outside of the ESU, and essentially none since 1950.   There have been some transfers from other populations within the ESU. Genetic data indicate that any imports from outside of the ESU did not have much effect on the genetic profile of the population. The broodstock was founded many salmon generations ago, and has included few, if any, wild fish for many generations, but there is no evidence that is has diverged substantially from nearby naturally spawning populations. In general, the stock is thought to be representative of populations in the smaller tributaries near the mouth of the Columbia River.

Stock name: *Klaskanine River coho salmon (ODFW #15).*

Hatchery/collection site: This stock is currently collected by CEDC (Clatsop Economic Development Council) at a weir on the South Fork Klaskanine River, a tributary to Young's Bay. It is released in the CEDC net pens in Young's Bay.

Broodstock origin and history

Year founded: Coho production started at the North Fork Klaskanine River hatchery in 1911, but the current broodstock likely dates to 1924.

Source: There were substantial transfers from Oregon coastal facilities into this hatchery prior to local broodstock collection and during initial years of broodstock collection. All of the transfers occurred prior to 1940, when hatchery technology was poor. It is not known whether the coastal fish had much influence on the stock. The size of the local wild population in the 1920s is not known, but wild coho were present in Young's Bay subbasins at that time. These fish were likely included in the broodstock. Wallis (1963b) indicates that coho salmon spawned in North Fork Klaskanine River tributaries below the hatchery and above the hatchery trap/water supply dam in those years that coho salmon were passed above the trap. Additionally, coho salmon spawned in the South Fork Klaskanine Rivers.

Broodstock size/natural population size: N/A

Subsequent events: Transfers into the Klaskanine continued into the 1940s, from coastal locations and other Lower Columbia River locations. The only transfers after 1950 were from Cascade and Sandy hatcheries in the 1980s. Otherwise, after 1950, the broodstock was collected locally on the North Fork Klaskanine River. Part of it was transferred to the South Fork Klaskanine in 1982. Hatchery fish were not marked until the late 1990s so it is not known whether wild fish might have been included in the broodstock in early years, and if so, how many. Due to blockage of spawning habitat in the North Fork Klaskanine and to the sharp decline of wild fish in the Lower Columbia River, it is unlikely many wild fish were included after the 1970s.

Recent events: ODFW discontinued the management of this broodstock when Mitchell Act funds were withdrawn in the mid-1990s. However, broodstock collection has been continued by CEDC at a weir on the South Fork Klaskanine.

Relationship to current natural population: Now that all hatchery fish are marked, it is evident that few wild fish are arriving at the South Fork or North Fork hatchery weirs. CEDC does not use wild fish in the broodstock and is required to pass any they catch above the South Fork weir. The extent to which any hatchery fish stray is not known. The Willamette and Lower Columbia River Technical Recovery Team (TRT) has not determined historical demographically independent populations for the Lower Columbia River ESU, although the boundaries of such a population would be similar to the Youngs Bay DIP fall-run chinook salmon population (Myers et al. 2002).

Program goal: This broodstock is used by CEDC in their net pens for the Young's Bay terminal fisheries program. There is no plan to use this stock under the state recovery plan.

Genetics data: No data available.

Phenotypic data: No phenotypic data for comparing hatchery and wild fish is available from this area.

Category and rationale: Category 4. Like many of the Lower Columbia River coho broodstocks, this stock received substantial transfers from out-of-ESU sources through the 1940s. However, it is likely that these did not become established. The releases were largely unfed fry that would have had very poor survival to adults. Unlike some of the other broodstocks, there are no molecular genetics data available for this broodstock. In absence of these data, we have made the precautionary assumption that early out-of-ESU transfers were successful, leading to a Category 4 designation. Genetics analysis could provide evidence that would change this broodstock to a Category 2 or 3, if the analysis indicated that the stock is genetically similar to other Lower Columbia River coho salmon populations.

Stock name: *Tanner Creek coho salmon (ODFW #14.)*

Hatchery/collection site: This broodstock is currently collected and released into Lower Tanner Creek at Bonneville Hatchery, Oregon. It is also released into Young's Bay as part of the net pen program, and is the source of Oregon coho that are being released into the Upper Columbia Basin, including in the Umatilla and Yakima Rivers.

Broodstock origin and history

Year founded: Founded in 1924.

Source: Coho salmon were historically collected in Eagle Creek, Herman Creek, and Tanner Creek, and maintained as three separate broodstocks, although with considerable transfers among them. These were eventually combined into a single broodstock. In addition to several transfers from other hatcheries, including from the Oregon coast, local naturally produced coho were included in these broodstocks. The coastal transfers, and transfers from Klaskanine Hatchery (which also has been influenced by coastal fish) all occurred prior to 1950.

Broodstock size/natural population size: The broodstock has been very large. However, nearby wild populations have been relatively very small since the 1970s.

Subsequent events: Local broodstock collection continued at the three locations, but the three stocks were eventually combined into a single broodstock. Since the 1950s, the only transfers into this stock were from Big Creek and Sandy hatcheries. Hatchery coho salmon were not marked so it is not clear whether any natural-origin fish were being included in the broodstocks. Broodstock collection protocols during the 1960s and early 1970s included the removal of excess early-return coho salmon. It is thought that the early portion of the run has diminished considerably since then. In the 1970s, the three creeks were blocked to prevent fish passage. Very little habitat remained below the weirs. Accessible habitat in most surrounding basins in the Columbia River Gorge is also limited by impassible waterfalls. Natural-origin populations in this area have probably been very small since the 1970s.

Recent events: This broodstock is now exclusively collected from Tanner Creek at Bonneville Hatchery and uses only returning hatchery adults for broodstock. There is no habitat below the hatchery weir in Tanner Creek. Now that all hatchery fish are marked, it is evident that few, if any, wild coho are ever seen there.

Relationship to current natural population: There are very few natural-origin coho along the Oregon side of the Columbia Gorge and there is very little habitat available for them. Most creeks in this area end at high waterfalls within the first mile of the creek. Hatchery fish may stray into these areas. Tanner Creek and Eagle Creek, two of the larger creeks, are both blocked by hatchery weirs. The current broodstock may have a later run-timing relative to the founding population. The Willamette and Lower Columbia River Technical Recovery Team (TRT) has not determined historical demographically independent populations for the Lower Columbia River

ESU, although the boundaries for the population corresponding to this hatchery broodstock would be similar to the Lower Gorge fall-run chinook salmon DIP (Myers et al. 2002).

Program goal: This broodstock is used to provide fish for fisheries. There are no plans to use it under the Oregon State Recovery Plan. It is being used by the Umatilla and Yakama Tribes in reintroduction efforts in the Yakima and Umatilla Basins.

Genetics data: This broodstock clustered within the Lower Columbia River ESU (Weitkamp et al. 1995).

Phenotypic data: There is no phenotypic data that could be used to compare wild and hatchery fish in this area.

Category and rationale: Category 2b. Until the 1940s, out-of-ESU stocks were the primary source of coho for this broodstock, but it is unlikely that these became established. The releases were largely unfed fry that would have had very poor survival to adults. It is not known how many natural-origin coho salmon were present in the system in those years, or whether any were incorporated into the broodstock. The three collection streams were not blocked by hatchery weirs until the 1970s, but have large natural falls within a few miles of their entry into the Columbia. The amount of natural habitat is, therefore, naturally limited. However, hundreds of wild coho were reported in Eagle Creek into the 1950s. The molecular genetics data clearly indicates that this broodstock clusters with other Lower Columbia River coho salmon populations. There are no nearby natural populations with which to compare this stock, so there no evidence for substantial divergence between the hatchery stock and nearby natural populations, leading to a 2b categorization.

Stock name: *Sandy River coho salmon (ODFW #11).*

Hatchery/collection site: This broodstock is collected on Cedar Creek, a tributary of the lower Sandy River at Sandy Hatchery, Oregon. It is currently released into Cedar Creek, and also into Blind Slough as part of a net pen/terminal fisheries program.

Broodstock origin and history

Year founded: This broodstock was founded from natural-origin coho salmon in the Sandy River in 1953.

Broodstock size/natural population size: The average wild population size in this basin, which is counted at Marmot Dam, has been about 500 fish, dropping to as low as 116 fish in some years. Few to no wild fish are seen in Cedar Creek where the broodstock is collected. The broodstock includes several hundred fish.

Subsequent events: The only transfers into this stock were from Bonneville Hatchery in 1951, 1956, and 1967. Otherwise broodstock collection has occurred at Cedar Creek on the Lower Sandy River. The Cedar Creek weir blocks fish passage. The hatchery fish were not marked until the late 1990s, but given the current pattern of wild and hatchery fish distribution in this basin, it is likely that few natural-origin coho were being incorporated into the broodstock.

Recent events: Now that the hatchery fish are 100% marked, it is evident that few wild coho enter Cedar Creek. The hatchery weir currently blocks fish passage. There is currently no effort to add wild fish to this broodstock.

Relationship to current natural population: Nearly all known wild coho in the Sandy Basin pass above Marmot Dam to spawn in the upper basin. Since 2000, hatchery coho salmon have not been allowed to pass the dam. Few hatchery fish are seen at the dam and it is thought that they also did not pass the dam in large numbers prior to the 100% marking. Scale samples from the early 1990s, which was prior to marking, also revealed no hatchery fish in the natural spawning areas. There is no effort or plans to add wild coho to the broodstock. Currently fish are not able to pass above the weir on Cedar Creek. The Willamette and Lower Columbia River Technical Recovery Team (TRT) has not determined historical demographically independent populations for the Lower Columbia River ESU, although the boundaries for the population corresponding to this hatchery broodstock would be similar to the Sandy River late-fall run chinook salmon DIP (Myers et al. 2002).

Program goal: This hatchery stock has been identified in the Oregon State Recovery Plan as a candidate for reintroduction anywhere in the Lower Columbia. It is the only hatchery stock that may be used for this purpose in the Sandy Basin, where a reintroduction is being planned for Cedar Creek above the hatchery weir. There are no plans to supplement the existing wild Sandy population. Currently the stock is used to provide fish for harvest.

Genetics data: This broodstock clusters within the Lower Columbia ESU (Weitkamp et al. 1995).

Phenotypic data: Some data are available, but have not been analyzed.

Category and rationale: Category 2a. The broodstock was founded from the Sandy River wild population and has received few non-ESU fish or transfers from elsewhere in the ESU. Population genetics data indicate the broodstock clusters with other populations in the Lower Columbia ESU. The broodstock was founded many salmon generations ago and has included few, if any, wild fish for a long time. In summary, this is a local stock that has not regularly incorporated a substantial fraction of natural origin fish in the broodstock, and may have moderately diverged from the wild population in the same basin.

Stock name: *Eagle Creek coho salmon.*

Hatchery/collection site: The broodstock collection and hatchery fish release locations are both on Eagle Creek, a tributary of the Lower Clackamas River, Oregon. The Eagle Creek Hatchery is operated by the U.S. Fish and Wildlife Service.

Broodstock origin and history

Year founded: Founded in the 1956.

Source: This broodstock was started by an introduction of Sandy Hatchery stock into Eagle Creek. It was likely mixed with local wild coho salmon.

Broodstock size/natural population size: The naturally spawning population measured at North Fork Dam has averaged 1,600 fish between 1990-2000, dropping to a low of 89 fish in the late 1990s. Few naturally produced coho enter Eagle Creek. The broodstock includes several hundred fish.

Subsequent events: Since the initial founding, the stock has been collected at Eagle Creek National Fish Hatchery (NFH)on the Lower Clackamas River. The coho salmon were not marked during most of the program and it is not clear how many, if any, wild coho were used in the brood. There is little habitat available above the hatchery due to natural barriers.

Recent events: The U.S. Fish and Wildlife Service is now required to release any unmarked coho they capture. There is no effort to use wild fish in the broodstock.

Relationship to current natural population: Starting in 2000, no hatchery coho are allowed above North Fork Dam on the Clackamas River. Since all the hatchery coho have been marked, it is evident that few to no hatchery coho arrive at the dam. Essentially, all wild coho spawn above the dam. Wild fish are not added to the broodstock. The Willamette and Lower Columbia River Technical Recovery Team (TRT) has not determined historical demographically independent populations for the Lower Columbia River ESU, although the boundaries for the population corresponding to this hatchery broodstock would be similar to the Clackamas River steelhead DIP (Myers et al. 2002).

Program goal: This broodstock is used to provide fish for fisheries. There is no plan it use it in the Oregon State Recovery Plan. In addition to on-station releases, the program is providing 555,000 smolts for release into the Clearwater River and 1,000,000 smolts for the CEDC net-pen program in Youngs Bay, Tongue Point, and Blind Slough.

Genetics data: This broodstock is clustered with other populations in the Lower Columbia River ESU (Weitkamp et al. 1995).

Phenotypic data: There may be some phenotypic information available from the North Fork Dam traps and at the hatchery, but it has not been analyzed.

Category and rationale: Category 2c. This broodstock was founded from the Clackamas and Sandy populations, which are part of the ESU. It has received few introductions of non-ESU fish. Population genetics data indicate that the broodstock clusters with other Lower Columbia coho populations. The broodstock was founded many salmon generation ago, has not included any wild fish for a long time, and is not released into its native watershed. The watershed into which it is released contains a native population.

Stock name: *Little White Salmon River coho salmon.*

Hatchery/collection site: The broodstock is collected at Little White Salmon NFH and reared and released at Willard NFH, both located on the Little White Salmon River, Washington.

Broodstock origin and history

Year founded: Founded in 1957.

Source: Coho salmon stocks from a number of sources (including local late-run, early returning Quinalt, Quilcene, Dungeness and Toutle Rivers were initially utilized to establish the run. Most probably, coho salmon transferred to the Little White Salmon River from the Toutle River Hatchery (Cowlitz River Basin) were responsible for sustained runs to the hatchery. Local broodstock collection began in 1957 and may have included wild fish along with the returning hatchery fish. It is not clear whether there were many wild fish in the Little White Salmon River at the time, although there is little available habitat for naturally spawning salmonids in the Little White Salmon River.

Broodstock size/natural population size: N/A.

Subsequent events: Broodstock collection occurred on site, but additional transfers from the Toutle River occurred until 1963. Egg transfers have also been received from the Kalama, Bonneville, Cascade, Speelyai, and Eagle Creek Hatcheries. This stock has a similar history as other Washington Type S coho stocks.

Recent events: None.

Relationship to current natural population: WDFW does not identify a wild population as being present in this basin. The Willamette and Lower Columbia River Technical Recovery Team (TRT) has not determined historical demographically independent populations for the Lower Columbia River ESU, although the boundaries for the population corresponding to this hatchery broodstock would be similar to the Upper Gorge fall-run chinook salmon DIP (Myers et al. 2002).

Program goal: This broodstock is used to provide fish for fisheries.

Genetics data: None available.

Phenotypic data: No data that can be used to compare hatchery and wild fish have been compiled.

Category and rationale: Category 3c. This broodstock was founded from Toutle River and possibly local Little White Salmon River coho adults. Although some out-of-ESU fish were planted into the Little White Salmon historically, these were not used in establishing the current broodstock. The broodstock was founded many salmon generations ago, has not included any wild fish for a long time, and likely consists of a mixture of several historical populations. This categorization makes the precautionary assumption that a native population might exist in the watershed. If there was good evidence that such a population does not exist and there is no divergence between the hatchery stock and any natural spawners, then the categorization could change to 2b.

Stock name: *Type S Toutle River coho salmon.*

Hatchery/collection site: Broodstock collection and release of hatchery fish occurs at North Fork Toutle River Hatchery on the Green River Cowlitz River Basin), Washington.

Broodstock origin and history

Year founded: Founded in the 1950s.

Source: This broodstock was largely founded from native coho salmon in the Toutle River. There was a substantial wild coho salmon run into that basin when the hatchery opened. Possibly some fish from Bonneville Hatchery were transferred into the stock at the time it was started. However, Bonneville Hatchery records also indicate receiving Toutle River stock at that time so it is possible that Toutle River fish were just sent to Bonneville for rearing while the new Toutle River Hatchery was being completed.

Broodstock size/natural population size: The wild population size is not monitored, but is thought to be very small.

Subsequent events: The broodstock was collected at the Toutle River Hatchery after it was founded. The hatchery fish were not marked so it is not known if wild fish were added to it. After the eruption of Mt. St. Helens and the destruction of the hatchery, adults were captured and moved to Grays River Hatchery for rearing and release. Selective marking and subsequent spawning allowed this stock to be kept separate. It was reintroduced into the parent stream following hatchery reconstruction. In the 2001/2002 return year, 15,697 coho returned to the hatchery, with 4,967 being retained for broodstock purposes (WDFW 2003).

Recent events: The hatchery fish are now marked, but there is apparently little information available on wild Columbia River coho salmon in Washington. No other coho hatchery stocks may be transferred into this basin or facility.

Relationship to current natural population (mixing between hatchery and wild): WDFW describes the wild population as depressed, but has no abundance data for it. (WDF et al. 1992). The Willamette and Lower Columbia River Technical Recovery Team (TRT) has not determined historical demographically independent populations for the Lower Columbia River ESU, although the boundaries for the population corresponding to this hatchery broodstock would be similar to the Toutle River fall-run chinook salmon DIP (Myers et al. 2002).

Program goal: The broodstock is used to provide fish for fisheries, and is a Mitchell Act funded program..

Genetics data: Data not available.

Phenotypic data: No data that can be used to compare hatchery and wild fish have been compiled. However, the broodstock is considered to be an "early-run" broodstock, which is apparently similar to the original wild coho in the Toutle River. Broodstock collection occurs in September and October.

Category and rationale: Category 2a. This broodstock meets the following criteria: it was founded from Toutle River coho, and has received few non-ESU or out-of-basin fish since that time. Although there may have been historical releases of non-ESU fish into the Toutle, they were apparently not used to establish the broodstock. The broodstock was founded many salmon generations ago, and has not included any wild fish for some time and may be moderately diverged from any natural populations in the basin.

Stock name: *Type S coho stock complex.*

Hatchery/collection site: This is a group of mixed-origin coho salmon from the Lower Columbia River. It is characterized by an earlier run time (September and October) relative to other Columbia River coho salmon populations (October to December). Records indicate coho salmon from the Toutle River Hatchery were subsequently transferred to other facilities. Local broodstock collection began at those facilities when the hatchery fish returned.

Current broodstock collection and hatchery fish release sites are:

- Chinook River at the Sea Resources Hatchery
- Lewis River at Lewis River Hatchery
- Kalama River at Lower Kalama Salmon Hatchery
- Grays River at Grays River Salmon Hatchery
- Elochoman River at Elochoman Hatchery
-

Broodstock origin and history

Year founded: Founded in the 1950s.

Source: This stock was founded by fish from the Toutle River, then combined with any local fish that were available. Records specifically indicate that a substantial wild coho run was still present in the Lewis River at the time the broodstock was transferred there.

Broodstock size/ natural population size: Data not available, but the abundance of natural-origin spawners relative to hatchery-origin spawners is thought to be quite low in most basins.

Subsequent events: After the initial transfer of fish from the Toutle River, the broodstocks were primarily collected at the local sites from returning adults. However, the hatchery plans for these facilities state that transfers between these sites could occur any time production goals were not met locally. These transfers apparently occurred as needed at least into the mid-1990s, when the hatchery plans were documented. Hatchery fish were not marked until the late 1990s, so it is not known if wild fish were ever used in the broods.

Recent events: Hatchery fish are now 100% marked.

Relationship to current natural population: The inventory data for the Lewis River indicate that the wild population is depressed. There are no data for the other basins, but WDFW describes them as being depressed. Comparisons between the hatchery and natural population should be based on the Type S stocks being of Toutle River origin.

Program goal: These hatchery programs are used to provide fish for harvest.

Genetics data: The early-run coho in Washington, analyzed from the Cowlitz and Lewis, cluster with the Lower Columbia River ESU (Weitkamp et al. 1995).

Phenotypic data: These hatchery fish are specifically considered to be "early-run" coho, and are collected in September and October. On the Lewis and Elochomin, a "late-run" coho stock is also collected (see below). On the Lewis, it is possible the two have been mixed. On the Elochomin, the hatchery trap is closed for a period in late October to separate the run times. This is likely an artificial separation.

Category and rationale: Category 2c or 3c. These broodstocks have the following characteristics: the Type S coho are a mix of populations from the ESU. Historic plants of non-ESU fish occurred in these basins, but it appears that the broodstocks were established from the Toutle River plants. The broodstocks were founded many salmon generations ago, and have not included any wild fish for some time.

Stock name: *Cowlitz River Type N coho salmon stock*

Hatchery/collection site: The broodstock collection location and hatchery fish release site is at Cowlitz Hatchery on the Cowlitz River, Washington.

Broodstock origin and history

Year founded: Founded in the 1950s.

Source: The broodstock was founded with wild Cowlitz River coho salmon. Although hatchery coho salmon from other ESUs were historically released into the Lower Columbia River, including the Cowlitz River, there was a sizeable wild population still present in the basin during the 1950s .

Broodstock size/natural population size: The current wild population is very small.

Subsequent events: The broodstock collection location for this stock has continued to be at Cowlitz Hatchery. According to the hatchery plan for this program, no other coho stock may be added to this broodstock or released into the Cowlitz Basin. Apparently none were transferred in since the broodstock was established. The hatchery coho were not 100% marked so it is not clear how long wild fish continued to be used in the broodstock.

Recent events: No other coho salmon stock may be added to this broodstock or released into the Cowlitz Basin. In the 2001/2002 return year, 73,215 hatchery-origin coho returned to the hatchery, with 5,477 being retained for broodstock purposes (WDFW 2003).

Relationship to current natural population: Inventory data for the Cowlitz indicate that the wild population is depressed. In the 2001/2002 return year, 73,215 hatchery-origin fish and 6,175 natural-origin fish were intercepted at the hatchery (WDFW 2003). The Willamette and Lower Columbia River Technical Recovery Team (TRT) has not determined historical demographically independent populations for the Lower Columbia River ESU, although the boundaries for the population corresponding to this hatchery broodstock would be similar to the Lower Columbia River fall-run chinook salmon DIP (Myers et al. 2002). Some fish are passed above the three mainstem Cowlitz River dams into what may have resembled the Upper Cowlitz, Tilton, and Cispus River spring-run chinook salmon DIPs.

Program goal: This broodstock is used for a reintroduction program in the Upper Cowlitz River, above Cowlitz Falls Dam. N-type coho salmon are also released to support local recreational fisheries programs..

Genetics data: Cowlitz coho cluster with the Lower Columbia ESU (Weitkamp et al. 1995).

Phenotypic data: This broodstock is collected between September and February, but it is considered to be a “late-run” hatchery stock (Type N). Analyses of coho returns to the Cowlitz, Washougal, Lewis, and Elochoman hatcheries indicated a significant delay in return timing, at a rate of approximately 1.7 days/year (Fuss et al. 1998). Although this may be due to selection in the hatchery, it was also suggested by the authors that the timing of in-river harvest could have caused this effect.

Category and rationale: Category 2a. This broodstock meets the following characteristics: it was founded from the local Cowlitz River population, but probably has experienced moderate genetic changes since its time of founding. The broodstock was founded many salmon generations ago, and few or no wild fish have been included in the broodstock in recent times.

Stock name: *Lewis River wild coho salmon*

Hatchery/Collection Site: This stock is reared at the Speelyai Hatchery for release in into Cedar Creek (Malinoski Acclimation Pond – Lewis River Basin) and for remote site incubators in Cedar Creek and Celatchie Creek. This is part of a short term program (5 years beginning with the 2001 brood) in cooperation with Fish First.

Broodstock Origin and History:
Year Founded: Program was started with 2001 brood.
Broodstock size and population size: This is a small program, with 15,000 smolt released annually and 10,000 eggs for each RSI. broodstock are collected from unmarked coho at the trap on Cedar Creek. If collection is not sufficient at this site then unmarked coho are collected at Merwin or Lewis River Hatchery.
Recent events: Eggs are otolith marked and smolts are tagged but not marked with an external fin clip.
Relationship to current natural population: There are no data on natural spawning population in Cedar Creek, but the natural spawning population is probably influenced by hatchery adults returning to the Lewis River Hatchery. Unmarked adults used for broodstock may be of hatchery origin, but poorly marked at the time of juvenile release. The Willamette and Lower Columbia River Technical Recovery Team (TRT) has not determined historical demographically independent populations for the Lower Columbia River ESU, although the boundaries for the population corresponding to this hatchery broodstock would be similar to the North Fork Lewis River steelhead DIP (Myers et al. 2002).

Category and Rationale: Category 2a. The proportion of natural origin fish in the broodstock is not know with certainty due to uncertainty about the status of unmarked fish in the system. There is also some possibility that the stock consists of a mixture of populations. Greater certainty about the status of the natural population and the fish used for broodstock might lead to an alternative categorization.

Stock name: *Type N coho stock complex.*

Hatchery/collection site: This is a group of mixed-origin coho salmon from the Lower Columbia River. It is characterized by a later run time (late October to December). Records indicate coho from the Cowlitz River Hatchery were subsequently transferred to other facilities. Local broodstock collection began at those facilities when the hatchery fish returned.

Current broodstock collection and hatchery fish release sites are:

- Lewis River at Lewis River Hatchery
- Kalama River at Kalama Falls Hatchery
- Elochoman River at Elochoman Hatchery
- Washougal River at Skamania Hatchery

Broodstock origin and history

Year founded: Founded in the 1950s.

Source: The broodstock was founded from wild Cowlitz River coho. The broodstock was subsequently transferred to the other rivers, and broodstock collection began locally. Some local wild fish may have been included in these initial collections, especially in the Lewis River, which was particularly noted as having a substantial wild population at the time of the transfer.

Broodstock size/natural population size: Various, but in general, wild populations on the Washington side of Lower Columbia River are very small. Returns to the hatchery for the 2001/2002 return year are presented in the table below (data from WDFW 2003).

Hatchery	Hatchery-Origin Adults	Natural-origin (unmarked) adults
Elochoman	7,349	36
Kalama Falls/Fallert Creek	16,741	-
Lewis River	60,280	593
Washougal	18,460	-

Subsequent events: After the initial transfer, broodstock collection began in each individual river. However, the hatchery plans for these stocks indicate that transfers between these programs were permitted as needed to meet production goals. The hatchery coho were not 100% marked, so it is not clear if wild fish were used in the broodstock.

Recent events: The hatchery fish are now 100% marked.

Relationship to current natural population: Wild abundance on the Lewis is shown by inventory data to be depressed. No data is available for the other locations, but WDFW considers the populations to be depressed. The Willamette and Lower Columbia River Technical Recovery Team (TRT) has not determined historical demographically independent populations for the Lower Columbia River ESU, any consideration of the relationship of this broodstock with local populations should be based on the Cowlitz River origin of this stock.

Program goal: This broodstock is used to provide fish for harvest.

Genetics data: The stocks that have been analyzed cluster with the Lower Columbia ESU (Weitkamp et al. 1995).

Phenotypic data: Analyses of coho returns to the Cowlitz, Washougal, Lewis, and Elochoman hatcheries indicated a significant delay in return timing, at a rate of approximately 1.7 days/year (Fuss et al. 1998). Although this may be due to selection in the hatchery, it was also suggested by the authors that the timing of in-river harvest could have caused this effect. Additionally, Fuss et al. (1998) could not detect any significant changes in fecundity or size at age among the Type N coho analyzed.

Category and rationale: Category 2c. This broodstock meets the following characteristics: it was founded from the local Cowlitz population, but then transferred to the other nearby basins for subsequent broodstock collection. Mixing of the broodstocks continued to occur in order to meet production needs until the 1990s. Genetic analysis indicates that the stocks cluster with other populations from the Lower Columbia River coho salmon ESU. The broodstock was founded many salmon generations ago, and few, if any, wild fish have been included in the broodstock recently. It is released into areas that might contain native natural coho salmon populations.

Lower Columbia River Steelhead ESU

Stock name: *Skamania Hatchery stock complex, including Skamania summer steelhead/South Santiam stock (24).*

Hatchery/collection site: This is a stock that was founded from fish in the Washougal and Klickitat Rivers, and then transferred to several other facilities where broodstocks are now collected. Releases occur at the collection locations, but also in other areas in the Columbia River including the Kalama, Elochoman, and East Fork Lewis Rivers. The facilities that currently collect Skamania-origin summer steelhead broodstock are:

- South Santiam Hatchery (Oregon), for releases into the Sandy, Clackamas, and Hood Rivers (and other locations outside of this ESU).
- Cowlitz Trout Hatchery (Washington), for releases into the Cowlitz River.
- Merwin Hatchery (Washington), for releases into the Lewis River.
- Skamania Hatchery (Washington), for releases into the Washougal River.

Broodstock origin and history

Year founded: Founded in the 1950s from wild fish in the Washougal and Klickitat Rivers.

Broodstock size/natural population size: In Washington, wild summer steelhead populations are monitored in the Kalama, East Fork Lewis, Washougal, and Wind Rivers. These populations average several hundred steelhead annually. Hood River summer steelhead, the only summer steelhead population that is present in the Oregon portion of this ESU, has had less than 500 steelhead returning annually**.**

Subsequent events: After the original broodstock was established at Skamania Hatchery, it was transferred to other facilities in Washington and Oregon. Independent broodstocks were subsequently collected at those locations. The current broodstock programs rely on returning hatchery adults. Wild summer steelhead were not native to some of the rivers where broodstock collection currently occurs. It is possible that wild Washougal steelhead continued to be incorporated into the broodstock after the initial founding.

Recent events: There has been a decrease in the number of sites from which Skamania summer steelhead are released. Restrictions have been imposed in some basins (Hood, Clackamas, Sandy, and Kalama) to minimize the straying of Skamania summer steelhead into natural steelhead spawning areas. These restrictions include a reduction in the numbers released, location of release (below natural spawning areas), and removal of fish at fish ladders and traps (preventing hatchery steelhead from reaching spawning grounds). Cowlitz and Merwin hatcheries now maintain their Skamania Hatchery-origin summer steelhead as distinct stocks.

Relationship to current natural population: Summer steelhead are not native to many basins where this stock is used. Also, the native population differs from the Skamania stock. The only location where some mixing between one of the original source populations and this broodstock may have occurred in the last few decades is in the Washougal River. The Skamania Hatchery stock has had its spawning time advanced by over 3 months, reducing the risk of hatchery fish interbreeding with natural-origin spawners.

Program goal: This broodstock is used to provide fish for harvest.

Genetics data: Wild summer steelhead in the planted basins generally are distinctive from this hatchery stock (reviewed by Busby et al. 1996).

Phenotypic data: This broodstock has undergone artificial selection for size and spawning time. In the Washougal, the spawn timing has been advanced by over three months. It has been demonstrated to have very poor reproductive success when it spawned naturally in the Kalama and Clackamas Rivers.

Category and rationale: Category 4. This broodstock was substantially founded from Klickitat fish, a population outside of the ESU. Summer steelhead are not native in many of the locations where this stock is currently used.

Stock name: *Sandy wild winter steelhead stock (ODFW #11W).*

Hatchery/collection site: This broodstock is collected at Marmot Dam or Sandy Hatchery and released into the Sandy River, Oregon

Broodstock origin and history

Year founded: Founded in 2000 from wild Sandy River winter steelhead, collected at Marmot Dam on the Sandy River.

Broodstock size/natural population size: Broodstock sizes in the first three years have ranged from 68 to 77 females plus an unknown number of males. The average wild population size between 1990 and 2000 has been 780 fish. Based on the determinations of the WLC TRT (Myers et al. 2002) the Sandy River winter steelhead DIP would be the corresponding natural population for this hatchery broodstock.

Subsequent events: This broodstock is still in initial founding stages. Hatchery fish are 100% marked.

Recent events: N/A.

Relationship to current natural population: The broodstock is currently 100% wild fish.

Program goal: This broodstock is used to provide fish for harvest. Hatchery-origin fish are identified by an adipose fin clip and removed from the fish ladder at Marmot Dam and returned to the Sandy River. It is presumed that this selective marking program will prevent hatchery fish from entering the natural spawning areas.

Genetics data: Data not available.

Phenotypic data: Not currently applicable. However, the program is producing large yearling smolts, which means many juvenile phenotypes are being changed, and age at spawning will likely be changed.

Category and rationale: Category 1a. This broodstock meets the following characteristics: it is from the native local population that inhabits the basin of release. Only wild fish have been used in the broodstock.

Stock name: *Clackamas wild winter steelhead (ODFW # 122).*

Hatchery/collection site: Broodstock are collected at either Clackamas Hatchery or North Fork Dam (Faraday trap) on the Clackamas River. All releases are into the Lower Clackamas River, Oregon.

Broodstock origin and history

Year founded: Founded 1991 from wild Clackamas River winter steelhead captured at North Fork Dam (Faraday trap).

Broodstock size/natural population size: The broodstock size from 1991 to 1998 ranged from six to 16 females (plus an unknown number of males). Between 1999 and 2000, it ranged from 31 to 90 females, plus males. The average wild population size between 1990 and 2002 was 750 fish.

Subsequent events: Since 1998, the broodstock has included both naturally produced Clackamas River winter steelhead and returning hatchery adults. The hatchery fish are 100% marked.

Recent events: None.

Relationship to current natural population: The broodstock still includes between 30% and 50% naturally produce fish each year. Since in 2000, hatchery fish are not supposed to be passed above North Fork Dam into the natural spawning areas, although some incidental passage still occurs. Based on the determinations of the WLC TRT (Myers et al. 2002) the Clackamas River winter steelhead DIP would be the corresponding natural population for this hatchery broodstock.

Program goal: This broodstock is used to provide fish for harvest. It is not intended to supplement natural spawning populations above North Fork Dam.

Genetics data: Some of the wild fish collected for this broodstock have been used to establish a wild Clackamas genetic baseline. Natural-origin broodstock were genetically distinct from Big Creek Hatchery-and Eagle Creek steelhead (P. Moran, NMFS Northwest Fisheries Science Center, 27 February 2003, pers. commun.).

Phenotypic data: Juveniles are being released as large, yearling smolts, which means that many juvenile characteristics and adult age at first spawning are being changed.

Category and rationale: Category 1a. This broodstock meets the following characteristics: it is from the native local population that inhabits the basin of release. It was founded fairly recently (1991). Naturally produced native fish are still a substantial part of the broodstock and there is no reason to believe the stock has diverged more than minimally from the natural population.

Stock name: *Hood River winter steelhead (ODFW #50).*

Hatchery/collection site: The broodstock is collected at Powerdale Dam on the Lower Hood River. Hatchery fish are released into the Hood River.

Broodstock origin and history

Year founded: Founded in 1991 from wild Hood River winter steelhead collected at Powerdale Dam on the Hood River.

Broodstock size/natural population size: The broodstock size from 1992 to 1998 ranged from 36 to 56 fish. The wild population size has ranged from 228 to 699 fish.

Subsequent events: The broodstock was maintained using 100% naturally produced fish until 1996. It included some returning hatchery adults in 1996-99 in an effort to increase the broodstock size. In 2000, it returned to using 100% naturally produced fish (Kostow et al. 2000).

Recent events: See above.

Relationship to current natural population: The broodstock has been maintained through the use of 50% to 100% naturally produced fish each year. Hatchery adults are allowed to pass Powerdale Dam, but they can make up no more than 50% of the run above the dam. Based on the determinations of the WLC TRT (Myers et al. 2002) the Hood River winter steelhead DIP would be the corresponding natural population for this hatchery broodstock.

Program goal: This broodstock is used to increase the size of the naturally produced Hood River winter steelhead. It is also being used in an experiment to study the reproductive success of newly founded hatchery fish on natural spawning grounds.

Genetics data: This entire population, including the broodstock, is being pedigreed (Kathryn Kostow, ODFW, pers. commun.).

Phenotypic data: A number of phenotypic changes, including extensive proximate changes in juvenile characteristics and adult age at spawning, have been observed. There has also been some change in adult run time and adult size of younger males (Kathryn Kostow, ODFW, pers. commun.).

Category and rationale: Category 1a. This broodstock meets the following characteristics: it was founded recently from the native local population into which it is released, and the broodstock continues to consist entirely or mostly wild fish. There is no reason to believe the stock has diverged more than minimally from the natural population.

Stock name: *Hood River summer steelhead (ODFW #50).*

Hatchery/collection site: This broodstock is collected at Powerdale Dam on the Lower Hood River. Hatchery fish are released into the Hood River, Oregon.

Broodstock origin and history

Year founded: Founded in 1997-98 from naturally produced Hood River summer steelhead captured at Powerdale Dam

Broodstock size/natural population size: Early broodstock sizes have been between 25 and 30 fish. In the 1990s, the naturally produced population ranged between 79 and 492 fish (Kostow et al. 2000).
Subsequent events: The broad run and spawning times for these summer steelhead, coupled with the very small naturally produced population size, has made the initial brood collection and successful spawning for this stock challenging. It continues to be maintained through the spawning of all naturally produced fish.

Recent events: Not applicable.

Relationship to current natural population: This broodstock is based on 100% naturally produced fish. Returning hatchery adults are allowed to pass above Powerdale Dam at no more than 50% of the run. Based on the determinations of the WLC TRT (Myers et al. 2002) the Hood River summer steelhead DIP would be the corresponding natural population for this hatchery broodstock.

Program goal: This broodstock is used to increase the size of the naturally spawning Hood River summer steelhead population. It has also been identified for use in an experimental study of natural spawning success by first generation hatchery fish. However, the future of this project is uncertain.

Genetics data: The genetics data for the Hood wild population suggests that it may have been influenced by previous Skamania Hatchery summer steelhead introductions, or that it has some natural similarity to the fish that made up the Skamania stock. Given the location of the Hood (midway between the Washougal and Klickitat, and on the upstream boundary of the ESU), a natural similarity would not be surprising (reviewed by Busby et al. 1996).

Phenotypic data: Juveniles are being released as large yearling smolts, which results in phenotypic changes in juvenile characteristics and may influence the age at first spawning.

Category and rationale: Category 1a. This stock meets the following characteristics:
It is from the native, local population that inhabits the basin of release. It was founded starting in 1997-98. It is still maintained with 100% naturally produced fish, and there is no reason to believe that it has diverged more than minimally from the natural population.

Stock name: *Eagle Creek winter steelhead.*

Hatchery/collection site: This broodstock is currently collected at Eagle Creek NFH on Eagle Creek in the Lower Clackamas Basin. The hatchery fish are released into Eagle Creek.

Broodstock origin and history

Year founded: Founded in the late 1960s from winter steelhead from the ODFW Big Creek stock at Big Creek Hatchery in the Lower Columbia River (outside of the ESU), which were transferred to the Clackamas River. Subsequent broodstock collection using returning hatchery adults occurred at Eagle Creek NFH. Some local naturally produced steelhead were likely to have been included in early years of the broodstock collection.

Broodstock size/natural population size: N/A.

Subsequent events: After the initial transfer, broodstock collection continued at Eagle Creek NFH. However, ODFW still continued to release Big Creek stock into the Lower Clackamas River when production goals were not being met. The Big Creek releases continued into the early 1990s. Some local naturally produced steelhead have likely been included in this stock since there is apparently some natural spawning in Eagle Creek, although the naturally spawning population in Eagle Creek is a late-winter steelhead, similar to the Clackamas River late-winter run. Very few naturally produced fish are thought to have been included in the hatchery broodstock.

Recent events: ODFW discontinued releases of Big Creek stock into the Clackamas in the early 1990s. Since in 2000, Big Creek/Eagle Creek fish have not been allowed to pass above North Fork Dam. All hatchery fish are marked.

Relationship to current natural population: Only returning hatchery adults are supposed to be used for this stock. The stock is not allowed to enter natural spawning areas above North Fork Dam. Straying into natural areas below North Fork Dam is likely occurring. Based on the determinations of the WLC TRT (Myers et al. 2002) the Clackamas River winter steelhead DIP would be the corresponding natural population for this hatchery broodstock.

Program goal: This broodstock is used to provide fish for harvest.

Genetics data: Genetics data demonstrate that this broodstock is quite different than the naturally produced winter steelhead that pass above North Fork Dam (Myers et al. 2002).

Phenotypic data: The stock differs from naturally produced phenotypes because juveniles are released as large yearling smolts.

Category and rationale: Category 4. This broodstock meets the following characteristics: the broodstock was mostly founded from populations outside of the ESU. Genetics data demonstrates that the broodstock is quite different than the naturally produced winter steelhead that pass North Fork Dam.

Stock name: *Chambers Creek/Lower Columbia River winter steelhead complex.*

Hatchery/collection site: This is a complex of hatchery stocks originally derived from Chambers Creek Hatchery in Puget Sound. They were transferred to several rivers in the Lower Columbia River Basin where broodstocks are now collected. The locations that collect and release fish from this complex are:

- Cowlitz Hatchery on the Cowlitz River;
- Merwin Hatchery on the North Fork Lewis River;
- Skamania Hatchery on the Washougal River;
- Kalama Falls Hatchery on the Kalama River.

Broodstock origin and history

Year founded: The original Chambers Creek stock was started in 1945. The stock was transferred to Columbia Basin facilities in 1958 (Elochoman Hatchery) and 1967 (Cowlitz Hatchery). The Cowlitz Trout Hatchery began operation in 1967. Other programs received Chambers Creek and Cowlitz Hatchery broodstock in the 1970s.

Source: This complex is a group of early-timed winter steelhead stocks that were derived from mixtures of steelhead from Chambers Creek Hatchery (located in Puget Sound near Tacoma, Washington) and native Lower Columbia River winter steelhead. The stock is characterized by an early run and spawn time. Fish from these stocks are released into more locations than the broodstock collection locations.

The Cowlitz Trout Hatchery began operation in 1967. The winter steelhead stock at this hatchery was developed in the late 1960s from a mixture of Chambers Creek and native Cowlitz River stocks (Tipping 1984).

Merwin Hatchery maintains a separate broodstock originating from a mixture of Chambers Creek Hatchery steelhead and native Lower Columbia River winter steelhead.

The Skamania winter steelhead stock was developed primarily from a combination of Elochoman River, from the Lower Columbia, and Cowlitz Trout Hatchery stock. Skamania Hatchery fish are also released in the Big White and Coweeman Rivers and Salmon Creek. Cowlitz Trout Hatchery stock was originally a mixture of Chambers Creek Hatchery stock and Cowlitz River winter steelhead. Some native Washougal River winter steelhead were also included in the Skamania winter broodstock in some broodyears (Crawford 1979). Broodstock is now collected from fish returning to the Skamania Hatchery.

Broodstock size/natural population size: Varies.

Subsequent events: The broodstocks is now collected at the four locations. Hatchery fish have been marked since at least the 1980s and broodstock collection consists of returning hatchery adults.

Recent events: This stock is not allowed to pass above Kalama Falls on the Kalama River (based on external marks applied at the hatchery).

Relationship to current natural population: The broodstocks currently use only returning hatchery adults. However, some naturally produced fish, especially from the Cowlitz River, have been historically incorporated into the broodstocks since their founding. There is currently no effort to mix naturally produced fish into these broodstocks. In the Cowlitz and Kalama Rivers, separate local broodstocks are maintained. Recent studies suggest that the Chambers Creek origin early-run winter steelhead exhibit relatively low reproductive success in the wild.

Program goal: These broodstocks are used to provide fish for harvest.

Genetics data: The broodstock in the Cowlitz River includes fish that have a Puget Sound chromosome count (60 chromosomes). Among the Cowlitz River Hatchery steelhead, only 34% of the fish exhibited the 58 chromosome count expected for the Lower Columbia River steelhead (Thorgaard 1983). The early-run winter steelhead are genetically distinct from native late-run steelhead in the Cowlitz and Clackamas Rivers (Myers et al. 2002).

Phenotypic data: These stocks are recognized to be a group of early-run winter steelhead. Records indicate that the fish were selected for early run and spawn time, mostly in an effort to produce uniform yearling smolts. Recent observations indicate that while peak run time is earlier than that of naturally produced “native” fish, there is still some spawn time overlap with wild winter steelhead.

Category and rationale: Category 4. These broodstocks include the following characteristics: the broodstocks are a mix of local fish and fish from populations outside of the ESU. Some chromosome data indicate Puget Sound chromosome counts are still present in some of the broodstocks.

Stock name: *Cowlitz River late-winter steelhead.*

Hatchery/collection site: This broodstock is collected at Cowlitz Trout Hatchery on the Cowlitz River and is released into Blue Creek, immediately below the hatchery, but also into areas above dams on the Cowlitz River, Washington.

Broodstock origin and history

Year founded: 1973

Source: The Cowlitz River late winter steelhead stock was developed from naturally produced Cowlitz winter steelhead in the late 1960s. The broodstock specifically targeted April and May spawners to avoid the incorporation of Chambers Creek fish. However, some mixing of the Cowlitz and Chambers Creek stocks likely occurred because there is some overlap in spawning time.

Broodstock size/natural population size: The naturally produced population size is not being monitored in the Cowlitz. River. In the 2001/2002 return year, 4,641 hatchery-origin and 501 natural-origin (unmarked) late-winter steelhead returned to the hatchery (WDFW 2003).

Subsequent events: Broodstock collection has continued at Cowlitz Hatchery, depending mostly on returning hatchery adults. The hatchery is located just below dams on the Cowlitz River, with no natural passage above that location. Most of the fish returning to just below the dam are hatchery fish. Broodstock collection still targets April and May spawners. However, there is spawning time overlap between the Chambers Creek fish and the Cowlitz "native" fish. Even though peak spawning differs, it is possible that some Chambers Creek fish have been included in the broodstock.

Recent events: Fish from this broodstock are now also being released above the Cowlitz River dams.

Relationship to current natural population: Information on the naturally produced late-winter steelhead population is lacking in this basin. The hatchery is located at the base of the Cowlitz River dams. Hatchery fish are likely concentrate in the area below the hatchery. This hatchery stock was evaluated relative to natural origin fish identified in the Lower Cowlitz River DIP (Myers 2002).

Program goal: This broodstock is used to provide fish for harvest. It is also being used as the source of winter steelhead that are being planted above the Cowlitz River dams in an effort to re-establish some natural production there.

Genetics data: Recent WDFW genetic data indicate that this hatchery stock clusters most closely with late-spawning wild winter steelhead from the Clackamas River, Oregon. (Myers et al. 2002). When tested in 1974, this stock exhibited the 58 chromosomes typical of native

Columbia River Basin steelhead while the Puget Sound steelhead have 59 or 60 chromosomes. (see Thorgaard 1983).

Phenotypic data: Broodstock collection specifically targets April and May spawners, which is likely a more narrow spawn time distribution than what naturally occurs among wild fish. The juveniles are released as large yearling smolts, which changes juvenile characteristics and some adult characteristics.

Category and rationale: Category 2a. The broodstock has the following characteristics: It was founded from the native, local population. It was founded in the 1970s, and few naturally produced fish have been included in broodstock in recent years. Moderate genetic changes have probably occurred due to the hatchery practices.

Stock name: *Kalama River winter steelhead.*

Hatchery/collection site: The broodstock is collected at Kalama Falls, RKm 17. Hatchery fish are released into the Kalama River.

Broodstock origin and history

Year founded: Founded in 1998 from naturally produced (wild) Kalama River winter steelhead at Kalama Falls.

Broodstock size/natural population size: The broodstock size has ranged from 24 to 38 fish, while the naturally produced population over the same time ranged from 437 to 1,393 fish.

Subsequent events: The broodstock is maintained using 100% naturally produced fish, and is still collected at Kalama Falls. Juveniles are released above the barrier. Returning hatchery adults, which are marked, are not currently passed above Kalama Falls.

Recent events: N/A

Relationship to current natural population: The broodstock is still maintained using 100% naturally produced fish. It is not currently being passed above Kalama Falls. This hatchery stock would be evaluated relative to the population in the Kalama River winter steelhead DIP (Myers et al. 2002).

Program goal: This broodstock is used to provide fish for harvest.

Genetics data: N/A.

Phenotypic data: Phenotypic data are available but have not been compiled (Cam Sharpe, WDFW, pers. commun.).

Category and rationale: Category 1a. This broodstock meets the following characteristics: it is from the native, local population that that inhabits the basin of release. It was founded in 1998, and uses only naturally produced fish in the broodstock. There is no reason to believe the stock has diverged more than minimally from the natural population.

Stock name: *Kalama River summer steelhead.*

Hatchery/collection site: This broodstock is collected at Kalama Falls (RKm 17) on the Kalama River. Hatchery fish are released into the Kalama River, Washington.

Broodstock origin and history

Year founded: 1998
Source: Founded in 1998-99 from naturally produced Kalama River summer steelhead collected at Kalama Falls.
Broodstock size/natural population size: The broodstock has ranged from 36 to 48 fish while the naturally produced population size over the same time ranged from 181 to 507 fish. In the 2001/2002 spawning season, 430 returning natural-origin summer steelhead were collected at the Kalama Falls Hatchery.

Subsequent events: This program continues to use 100% naturally produced Kalama River summer steelhead collected at Kalama Falls. The fish are 100% marked. Unmarked, naturally produced summer steelhead and some hatchery (indigenous) summer steelhead are allowed above the falls to spawn naturally. Marked Skamania-origin summer steelhead are not allowed above the falls.

Recent events: N/A.

Relationship to current natural population: The broodstock program is maintained using 100% naturally produced fish. The returning hatchery adults are allowed to pass into natural spawning areas above Kalama Falls, making up about 50% of the fish passed. This hatchery stock was evaluated relative to the population in the Kalama River summer steelhead DIP (Myers et al. 2002).

Program goal: This broodstock is used to provide fish for harvest. It is also being used in an experimental supplementation study of the natural spawning success of first generation hatchery fish.

Genetics data: This broodstock and the wild population are being pedigreed (Cam Sharpe, WDFW, pers. commun.).

Phenotypic data: Phenotypic data are available but have not yet been compiled (Cam Sharpe, WDFW, pers. commun.).

Category and rationale: Category 1a. This broodstock meets the following characteristics: it is from the native, local population that inhabits the basin of release. It was founded in 1998-99 and uses 100% naturally produced fish. There is no reason to believe the stock has diverged more than minimally from the natural population.

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 a considerable exchange of eggs collected during the more than 100 years that hatcheries have been in operation. In general, there are three types of fall chinook salmon reared in the ESU: lower river tules, lower river brights, and Rogue River brights.

Stock name: *Sea Resources fall-run chinook salmon.*

Hatchery/collection site: Chinook River.

Broodstock origin and history

Year founded: 1982.
Source: Multiple Lower Columbia River (LCR) fall-run chinook salmon stocks.
Broodstock size/natural population size: N/A.

Subsequent events: None.

Recent events: N/A.

Relationship to current natural population: N/A.

Current program goals: Education and restoration.

Population genetics: No data available.

Morphology/behavior/fitness: No data available.

Previous determinations: NMFS (1999) considered this stock part of the ESU, but not essential for recovery. The USFWS considered this stock to be part of the ESU, but not essential for recovery (Hillwig 1998).

Category and rationale: Category 2b. This stock was 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. There is considerable uncertainty as to whether a run of fall-run chinook salmon once existed in this relatively small basin (see Myers et al. 2002). If a native population once existed, it would have been extirpated long ago.

Stock name: *Abernathy Salmon Culture and Technology Center fall-run chinook salmon.*

Hatchery/collection site: Collected and released at Abernathy Creek.

Broodstock origin and history

Year founded: Founded in 1959 from widely mixed sources, mostly Spring Creek NFH. This facility was constructed in 1959 on Abernathy Creek. The hatchery is located 4.8 Km upstream of the confluence of Abernathy Creek and the Columbia River at the site of 3-meter high falls, which were laddered.

Source: Returning adults were 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 substantial releases of Spring Creek Hatchery fall-run chinook salmon. The present stock is considered to be widely-mixed (WDF et al. 1993).

Recent events: This program has been terminated, but fish from the program may return in limited numbers through 2004.

Relationship to current natural population: There is some doubt whether fall chinook salmon are native to Abernathy Creek (Marshall et al. 1995). With the termination of production, the existing naturally spawning population may decline to a point where it is only sustained by strays from other hatchery programs. Abernathy Creek is not considered a typical chinook salmon stream (Don Campton, USFWS, pers. commun.). The Abernathy SCTC broodstock was evaluated relative to naturally spawning fish in the Mill Creek fall-run chinook salmon DIP (Myers et al. 2002).

Population genetics: Genetic analysis of Abernathy SCTC fall-run chinook salmon indicated similarities between this stock and the founding Spring Creek NFH population. Natural origin juveniles recovered from Abernathy Creek were genetically more similar to Cowlitz Hatchery, and Washougal and North Fork Lewis fall-run chinook salmon than Abernathy Creek SCTC origin fish (Marshall 1997).

Morphology/behavior/fitness: No data available.

Previous determinations: WDFW did not consider this broodstock to be part of the ESU (Crawford 1998). The USFWS considered this stock to be part of the ESU, but not essential for recovery (Hillwig 1998). NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2b. This stock was founded from populations in the ESU, but is not native to the watershed in which it was released. Many of the contributing populations come from ecologically distinct regions of the ESU (for example Spring Creek NFH). It is also an old stock, with little or no recent incorporation of wild fish. However, there is no reason to believe that the stock is substantially diverged from the natural population in Abernathy Creek, mostly because the natural population was probably highly influenced by strays from the hatchery.

Stock name: *Grays River Hatchery fall-run chinook salmon.*

Broodstock origin and history

Year founded: The Grays River Hatchery began operations in 1961.

Source: 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 of marginal quality. Spring Creek NFH 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.

Recent events: This program has been terminated, but fish will continue to return to the site through 2004 or 2005.
Relationship to current natural population: There is no information available to indicate the relative degree to which natural-origin adults were integrated into the broodstock or the contribution of hatchery fish to natural spawners, although at approximately 40% of the naturally spawning fish were known to be Grays River Hatchery strays (Myers et al. 2002). Natural-origin fish would be considered part of the Grays River fall-run chinook salmon DIP (Myers et al. 2002).
Population genetics: No data.

Morphology/behavior/fitness: Fuss et al. (1998) found no change in average age at maturation for fall-run chinook salmon from the Elochoman, Grays, Kalama, Cowlitz, and Washougal hatcheries.

Previous determinations: Due to the mixed nature of the broodstock, WDFW did not consider it to be part of the ESU (Crawford 1998). They added that there are naturally spawning fish present in the Grays River, but that these fish are hatchery strays or the progeny of hatchery strays. The USFWS considered this stock to be part of the ESU, but not essential for recovery (Hillwig 1998). The NMFS (1999) considered this stock to be in the ESU, but not essential for recovery.

Category and rationale: Category 2b. This stock was founded from populations that are considered part of the ESU, but are not native to the watershed in which the stock is released. It is also an old stock, and has received little or no wild fish into the broodstock in recent times. However, due to high stray rates of this stock into local natural spawning areas, the level of divergence between the hatchery stock and local natural population is probably not substantial. This program has been terminated.

Stock name: *Elochoman Hatchery fall-run chinook salmon.*

Hatchery/collection site: Elochoman Hatchery.

Broodstock origin and history

Year founded: 1954.

Source: 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 a different ESU—released from Young's Bay) comprise a large portion of the returning adults collected for broodstock.

Recent events: This program is trying to develop a local broodstock for the Elochoman River by not selecting for size, run timing and spawning time in the fall-run chinook salmon retained for broodstock and out of basin transfers will not occur except in extreme situations and only after regional approval. This program incorporates naturally produced fall-run chinook salmon into the broodstock because not all hatchery fall-run chinook salmon are marked.

Relationship to current natural population: Spawner surveys indicate that at least 80% of the naturally spawning chinook salmon were from the Elochoman Hatchery, 10% were from the Big Creek Hatchery, and 10% were of unknown, potentially natural, origin (Myers et al. 2002).

Population genetics: Fuss et al. (1998) found no change in average age at maturation for fall-run chinook salmon from the Elochoman, Grays, Kalama, Cowlitz, and Washougal hatcheries.

Morphology/behavior/fitness: No data.

Previous determinations: WDFW did not consider this broodstock to be part of the ESU (Crawford 1998). The USFWS considered this stock to be part of the ESU, but not essential for recovery (Hillwig 1998). The NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2b. This stock was founded from populations that are considered part of the ESU, but is not native to the watershed in which it is released. It is also an old stock, and has received little or no wild fish into the broodstock in recent times. However, because the local natural population consists of a high fraction of hatchery fish, there is no reason believe that the hatchery and natural populations are substantially diverged from each other.

Stock name: *Cowlitz Salmon Hatchery fall-run chinook salmon.*

Hatchery/collection site: Broodstock collected and released at the Cowlitz Salmon Hatchery.

Broodstock origin and history

Year founded: 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).

Source: 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 (WDFW et al. 1993). Recent returns to the hatchery have been well below the mitigation goal of 8,300 fall-run fish for the hatchery. However, the hatchery has been able to maintain the run using predominantly locally returning fish. There have been only four introductions of non-native fish since 1951 (WDF et al. 1993, Marshall et al. 1995).

Relationship to current natural population: Habitat conditions in the lower Cowlitz River may limit the successful reproduction of naturally spawning fall-run fish. In contrast to the data form 1980, in recent years nearly, 80% of the naturally spawning fish were of unknown, presumably natural, origin fish (Myers 2002). The WLC TRT has identified area of hatchery releases as part of the Lower Cowlitz River fall-run chinook salmon DIP (Myers et al. 2002).

Population genetics: Cowlitz River fall-run chinook salmon are similar to other Lower Columbia River ESU fall-run and spring-run chinook salmon. No comparative study of hatchery and naturally produced fall-run chinook salmon in the Cowlitz River has been undertaken (Marshall et al. 1995).

Morphology/behavior/fitness: Fuss et al. (1998) determined that the date of 50% return to the hatchery trap and the median spawning date at the Cowlitz, Toutle, and Kalama hatcheries had significantly increased since 1953. This increase resulted in an overall delay in return of 15 days and an overall delay in spawning of 27 days from 1953. It is not known whether this change is due to hatchery selection or changes in environmental conditions in the rivers. Additionally, Fuss et al. (1998) found no change in average age at maturation for fall-run chinook salmon from the Elochoman, Grays, Kalama, Cowlitz, and Washougal hatcheries.

Previous determinations: WDFW considered this broodstock to be part of the ESU, but not essential for recovery (Crawford 1998). The USFWS considered this stock to be part of the ESU, but not essential for recovery (Hillwig 1998). The NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2a. The broodstock was founded from captures of natural fish in the watershed in which it is released, although eggs from other sources have been imported to the hatchery as well. The naturally spawning populations in the Cowlitz River Basin may have contributed genes to the hatchery population, although the current relationship between the hatchery stock and the local natural population is uncertain.

Stock name: *Cowlitz Salmon Hatchery spring-run chinook salmon*.

Hatchery/collection site: Collected and released at the Cowlitz Salmon Hatchery.

Broodstock origin and history

Year founded: The present Cowlitz Salmon Hatchery was completed in 1967. Prior to that date, there was a hatchery program for chinook and coho salmon operating out of the Clear Fork of the Cowlitz River, which operated until 1950 (Hymer et al. 1992).

Source: The completion of Mayfield Dam in 1963, and Mossyrock Dam in 1968, eliminated the entire historical spawning habitat for spring-run chinook salmon in the Cowlitz River. With the exception of a 12.8-Km stretch of river below the hatchery, the production of spring-run chinook salmon in the Cowlitz River is completely dependent on artificial propagation.

Subsequent events: The Toutle Hatchery received its spring-run chinook salmon stock from the Cowlitz Hatchery through 2001. Although the program has been discontinued, adults will continue to return until 2006. Currently 500,000 parr are released above Cowlitz Fall Dam in an effort to reestablish natural production above the dam. Additionally, beginning in 1999, adult spring-run chinook salmon were transferred above the Cowlitz Falls Dam. Spring-run chinook salmon from the Cowlitz Salmon Hatchery are also released at the Deep River net-pen site to support local recreational harvest.

Relationship to current natural population: Historically, demographically independent populations of spring run chinook salmon existed in the Tilton, Cispus, and Upper Cowlitz River spring-run. These populations were homogenized into a single hatchery stock, which is primarily released into the Lower Cowlitz River (where spring-run chinook salmon were probably not historically present in any number).Recent returns to the hatchery have been well below the mitigation goal for the hatchery of 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). 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.

Population genetics: The Cowlitz River Hatchery spring-run chinook salmon population is genetically similar to spring-run fish from the Kalama and Lewis Rivers (which have received numerous transfers from the Cowlitz Hatchery) (Marshall et al. 1995, Myers et al. 1998), and to the Cowlitz River fall-run chinook salmon population (Marshall et al. 1995).

Morphology/behavior/fitness: Fuss et al. (1998) determined that the date of 50% return to the hatchery trap for Cowlitz River spring-run chinook salmon had increased an average of 3 days per year since 1967. Additionally, Fuss et al. (1998) found no change in average age at maturation for spring-run chinook salmon from the Cowlitz Salmon Hatchery.

Previous determinations: This stock was considered part of the ESU by WDFW (Crawford 1998). The USFWS was unsure of the status of this stock (Hillwig 1998). The NMFS (1999) considered this stock to be part of the ESU and essential for recovery.

Category and rationale: Category 2a. This stock was founded by Cowlitz River spring-run chinook salmon. There have been relatively few introductions of fish from outside of the basin. However, few, if any, natural-origin fish have been incorporated into the broodstock in recent years. Dam construction has eliminated access to the historical spring-run spawning habitat. However, 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.

Stock name: *Toutle Salmon Hatchery fall-run chinook salmon.*

Broodstock origin and history

Year founded: As a result of the Mitchell Act, the Toutle Salmon Hatchery was constructed in 1956 on the North Fork of the Toutle (Green) River.

Source: 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.

Subsequent events: The program is trying to develop a Green River/Toutle River local broodstock that is similar to the natural spawning population by not selecting for size, run timing and spawning timing in the fall-run chinook salmon retained for broodstock and out of basin transfers into the hatchery will not occur except in extreme situations and only after regional approval. This program incorporates naturally produced fall-run chinook salmon into the broodstock, although since not all hatchery fish are marked the level of incorporation is unknown.

Relationship to current natural population: The hatchery stock was evaluated relative to the Toutle River fall-run chinook salmon DIP (Myers et al. 2002). Spawner surveys in the Green River (a tributary to the Toutle River) indicate that nearly 80% of the naturally spawning fish were of unknown, potentially natural-origin (Myers et al. 2002).

Population genetics: No data.

Morphology/behavior/fitness: Fuss et al. (1998) determined that the date of 50% return to the hatchery trap and the median spawning date at the Cowlitz, Toutle, and Kalama hatcheries had significantly increased since 1953. This increase resulted in an overall delay in return of 15 days and an overall delay in spawning of 27 days from 1953. It is not known whether this change is due to hatchery selection or changes in environmental conditions in the rivers. Additionally, Fuss et al. (1998) found no change in average age at maturation for fall-run chinook salmon from the Elochoman, Grays, Kalama, Cowlitz, and Washougal hatcheries.

Previous determinations: WDFW considered this broodstock to be part of the ESU, but not essential for recovery (Crawford 1998). The USFWS considered this stock to be part of the ESU, but was unsure of whether it was essential for recovery or not (Hillwig 1998). The NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2c. This stock was founded from nearby populations that are considered part of the ESU, but it is not native to the watershed in which it is released. It is also an old stock and has received little or no wild fish into the broodstock in recent times. A native natural population may exit in the basin.

Stock name: *Kalama River fall-run chinook salmon.*

Hatchery/collection site: Lower Kalama Salmon Hatchery, Kalama Falls Hatchery, and Gobar Ponds.

Broodstock origin and history

Year founded: Hatchery production in the Kalama River Basin began in 1897 using adults returning to the river.

Source: There are two facilities in the Kalama River Basin that release fall-run chinook salmon: Kalama Falls Hatchery, and the Lower Kalama Hatchery. Broodstocks for these facilities are captured at the Modrow Trap (RKm 5); however excess broodstock fish are passed upstream, leaving 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.
Recent events: This program incorporates naturally produced fall-run chinook salmon into the broodstock, the degree of incorporation is unknown since many hatchery fish are released unmarked.
Relationship to current natural population: Recent spawner surveys indicate that only 40% of naturally-spawning fish are of unknown origin (potentially natural origin). The majority of the naturally-spawning fish in the Kalama River were from one of the Kalama River hatcheries (Myers et al. 2002).

Population genetics: The stock closely resembles Cowlitz and Lewis Salmon Hatchery fall-run fish (Marshall et al. 1995, Myers et al. 2002).

Morphology/behavior/fitness: Fuss et al. (1998) determined that the date of 50% return to the hatchery trap and the median spawning date at the Cowlitz, Toutle, and Kalama hatcheries have significantly increased since 1953. This increase resulted in an overall delay in return of 15 days and an overall delay in spawning of 27 days from 1953. It is not known whether this change is due to hatchery selection or changes in environmental conditions in the rivers. Additionally, Fuss et al. (1998) found no change in average age at maturation for fall-run chinook salmon from the Elochoman, Grays, Kalama, Cowlitz, and Washougal hatcheries.

Previous determinations: As of 1998, 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 considered this stock to be part of the ESU, but was unsure of whether it was essential for recovery or not (Hillwig 1998). The NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2a. Due to limited introductions, this broodstock may still retain some characteristics of the founding population and there is no reason to believe that there is substantial divergence between the hatchery stock the natural population in the basin. However, few wild fish have been incorporated into the broodstock in recent years.

Stock name: *Kalama River spring-run chinook salmon.*

Hatchery/collection site: Kalama Falls Hatchery.

Broodstock origin and history

Year founded: Since 1958, 18 different stocks have been released from this hatchery (NRC 1996).

Source: There are three facilities in the Kalama River Basin that release spring-run chinook salmon: Kalama Falls Hatchery, Lower Kalama Hatchery, and Gobar Ponds. The Kalama River probably had a relatively small spring-run chinook salmon population 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). Water flows during the chinook salmon spring run allow the adults to return directly to Kalama Falls Hatchery.

Relationship to current natural population: Naturally spawning spring-run chinook salmon are observed in the upper Kalama River, and are considered part of the Kalama River spring-run chinook salmon DIP (Myers et al. 2002).

Population genetics: Genetically this stock most closely resembles the Cowlitz Salmon Hatchery spring run and the Lewis River spring run (which has been largely derived from Cowlitz Salmon Hatchery transfers [WDF et al. 1993]).

Morphology/behavior/fitness: No data.

Previous determinations: This broodstock was neither considered part of the ESU by WDFW and USFWS, nor essential for recovery (Crawford 1998, Hillwig 1998). The NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2b. This stock was founded mostly from nearby populations that are considered part of the ESU, but not native to the watershed in which the stock is released. It is also an old stock and has received little or no wild fish into the broodstock in recent times. The existing naturally-spawning spring-run chinook salmon population is similar to the hatchery population, and is probably not native to the basin.

Stock name: *Lewis River spring-run chinook salmon.*

Hatchery/collection site: Lewis River Salmon Hatchery and Merwin Dam.

Broodstock origin and history

Year founded: Following the construction of Merwin Dam, attempts by this hatchery in the 1930s to save the indigenous Lewis River spring chinook salmon stock met with limited success.

Source: The current broodstock originated from indigenous Lewis River fish heavily infused with introductions from the 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 1990a). In the Lewis River Basin, natural spawning occurs below Merwin Dam and in Cedar Creek (Howell et al. 1985a). 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.

Relationship to current natural population: A few naturally spawning spring-run chinook salmon are observed in the Lewis River; however, because all spawning habitat suitable for spring-run chinook salmon is inaccessible, it is assumed that all spring-run chinook salmon are of hatchery origin.

Population genetics: 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).

Program goal or use of broodstock: Spring-run chinook salmon from the Lewis River Hatchery are released as mitigation for the impacts of the Lewis River dams. Fish are also released as part of cooperative projects in the Lewis River Basin.

Morphology/behavior/fitness: No data.

Previous determinations: WDFW considered this population part of the ESU, but not essential for recovery (Crawford 1998). The USFWS did not consider this stock to be part of the ESU, or essential for recovery (Hillwig 1998). The NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2a or 2b. 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. It is possible that some of the characteristics of the founding native Lewis River spring run remain in the stock.

Stock name: *Washougal River fall-run chinook salmon.*

Hatchery/collection site: Washougal Salmon Hatchery.

Broodstock origin and history

Year founded: The Washougal Hatchery is located on the Washougal River (RKm 32) and began operations in 1959.

Source: The hatchery collects its broodstock from adults returning to the hatchery. Fall-run chinook salmon are native to this basin (WDF et al. 1993). 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).
Recent events: The program is being modified to develop a broodstock that is more similar to the natural population. The program incorporates some naturally produced fish, although the relative contribution of naturally produced is unknown, because many hatchery fish are released unmarked.
Relationship to current natural population: Approximately 90% of the naturally spawning chinook salmon in the Washougal River were of hatchery origin (Washougal Hatchery) (Myers et al. 2002).

Population genetics: Washougal river fall-run chinook salmon are most genetically similar (based on allozyme analysis) to Lewis River late fall-run chinook salmon (Marshall et al. 1995, Myers et al. 1998).
Morphology/behavior/fitness: Fuss et al. (1998) found no change in average age at maturation for fall-run chinook salmon from the Elochoman, Grays, Kalama, Cowlitz, and Washougal hatcheries.

Previous determinations: As of 1998, the ESU status of this broodstock was 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 (Hillwig 1998). The NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2a or 2b. Although initially founded by adults native to the Washougal River Basin, this hatchery has received numerous transfers from other hatcheries in the ESU. 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. There is no reason to believe that the current hatchery stock and the current natural population are substantially diverged from each other.

Comanager comments: The USFWS (2003) believes that a Category 2 score is appropriate.

Stock name: *Carson NFH spring-run chinook salmon.*

Hatchery/collection site: Carson NFH; has been transferred to numerous other hatcheries.

Broodstock origin and history

Year founded: Historically, the Wind River did not have a run of spring chinook salmon. Shipherd Falls at RKm 4, blocked 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 the 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.

Source: The majority of these fish were presumably returning to spawning grounds in the Snake River Basin and other Columbia River tributaries above Bonneville Dam (Hymer et al 1992). Carson stock or Carson stock derivatives have also been released, or are currently being released from the Little White Salmon/Willard NFH complex (WDF et al. 1993).
Relationship to current natural population: Spring-run chinook salmon were not historically present in the Wind River Basin. Any naturally-spawning fish in the river would be of hatchery origin or the descendants of hatchery origin fish..

Population genetics: Genetically, Carson NFH spring chinook salmon most closely resemble fish from the Upper Columbia and Snake River Basins (Myers et al. 1998, Campton and Marshall 2000, Ford et al. 2002).

Morphology/behavior/fitness: No data.

Previous determinations: This broodstock was not considered part of the ESU by WDFW and USFWS, nor essential for recovery (Crawford 1998, Hillwig 1998). NMFS (1999) did not consider this population part of the Lower Columbia River spring chinook salmon ESU.

Category and rationale: Category 4. This stock was founded entirely by populations that are not considered part of the Lower Columbia River spring chinook salmon ESU. See the section on Upper Columbia River spring chinook salmon ESU for more discussion of this stock and its derivatives.

Stock name: *Little White Salmon NFH fall-run chinook salmon.*

Broodstock origin and history

Year founded: This hatchery began operations in 1898. Production programs utilizing Lower Columbia River tule stocks were discontinued in the 1980s and were replaced with an upriver bright fall-run stock from Bonneville Hatchery (see Bonneville Hatchery Upriver Bright Fall-Run Stock).
Relationship to current natural population: Upriver bright (URB) fall-run chinook salmon were not historically present in the Little White Salmon River, or the Upper Gorge fall-run chinook salmon DIP (Myers et al. 2002) that it is part of. Naturally spawning URB chinook salmon are observed, but are thought to be first-generation hatchery strays. There is a self-sustaining URB population below Bonneville Dam, although it is not considered part of the Lower Columbia River ESU (Schiewe 1999).

Population genetics: This stock clusters with other upriver bright (URB) fall-run populations from the Upper Columbia River summer- and fall-run chinook salmon ESU (Myers et al. 1998).

Morphology/behavior/fitness: No data.

Previous determinations: This broodstock was not considered part of the ESU by WDFW or USFWS, nor essential for recovery (Crawford 1998, Hillwig 1998). NMFS (1999) did not consider this stock to be part of the ESU.

Category and rationale: Category 4. This stock was founded entirely from populations that are not considered to be part of the Lower Columbia River chinook salmon ESU.

Stock name: *Spring Creek NFH fall-run chinook salmon.*

Hatchery/collection site: Collection and release at hatchery.

Broodstock origin and history

Year founded: The Spring Creek NFH began operations in 1901 with adult fall-run chinook salmon collected from the White Salmon River (Howell et al. 1985a).

Source: Returning adults captured at the hatchery and at a weir on the White Salmon River have provided sufficient numbers of gametes to meet production needs in all but a few years. Since 1976, fish from Little White Salmon NFH, Abernathy NFH, Toutle Hatchery, and Bonneville Hatchery have occasionally been released from Spring Creek NFH (NRC 1996). In many cases the hatcheries that provided these transfers were initially founded by transfers from Spring Creek NFH.

Relationship between natural and hatchery populations: The naturally spawning population in the White Salmon River was effectively eliminated with the construction of Condit Dam and the filling of the Bonneville Pool. Strays from the Spring Creek NFH contribute to naturally spawning populations in the Little White Salmon, Wind, and Hood River. Naturally-spawning chinook salmon would be considered as part of the Upper Gorge fall-run chinook salmon DIP, although historically Spring Creek fall-run chinook salmon belonged to the Big White Salmon River fall-run chinook salmon DIP (Myers et al. 2002).

Population genetics: Genetically, Spring Creek NFH fall-run chinook salmon are distinct from other lower river chinook stocks, but still cluster more closely with chinook salmon populations from the Lower Columbia River ESU than to other ESUs (Myers et al. 1998).

Morphology/behavior/fitness: No data.

Previous determinations: WDFW did not consider this broodstock to be part of the ESU, nor essential for recovery (Crawford 1998). The USFWS considered this stock to be part of the ESU, but not essential for recovery (Hillwig 1998). NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2a. It is not known to what extent artificial propagation activities or recent introductions from outside the ESU have caused this stock to diverge from the founding White Salmon River tule fall-run population. Genetically, this stock is more similar to other populations in the ESU than to populations outside of the ESU, although it is an outlier (as would be expected by it geographic position in the ESU). There is no reason to believe the stock is substantially diverged from the local natural population, but few if any natural fish are regularly incorporated into the broodstock.

Comanager comments: USFWS (2003) believes that a Category 2 score is appropriate due to the limited extent of introduction from outside and the relatively unique genetic profile.

Stock name: *Klickitat Hatchery fall-run chinook salmon.*[3]

Broodstock origin and history

Year founded: The current Klickitat Hatchery was built in 1949, although a hatchery operated on the river during the turn of the century (Delarm and Smith 1990a).

Source: 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 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). Although a hatchery broodstock was established, there were subsequent introductions of Lower Columbia River "tule" stocks that 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 Hatchery and Bonneville Upper River Bright (URB) stocks (WDF et al. 1993). There is no capture of fall-run chinook salmon adults at Klickitat Hatchery, eggs are imported yearly from Priest Rapids, Little White Salmon, or Bonneville hatcheries. A naturally spawning population of fall-run chinook salmon exists in the Klickitat River, it appears to be a hybrid of tule and upriver bright stocks, and exhibits some life history traits from each of the original stocks (Marshall et al. 1995).

Population genetics: Genetically, this stock most closely resembles Hanford Reach fall-run and Upper Columbia River summer-run chinook salmon (Marshall et al. 1995, Myers et al. 1998).

Morphology/behavior/fitness: No data.

Previous determinations: This broodstock was not considered part of the ESU by WDFW and USFWS, nor essential for recovery (Crawford 1998, Hillwig 1998). NMFS (1999) did not consider this population to be part of the ESU.

Category and rationale: Category 4. This stock originates from populations not considered to be part of the Lower Columbia River chinook salmon ESU.

[3] The Klickitat River is not part of the Lower Columbia River ESU, but this hatchery has been included because it uses a population partially derived from Lower Columbia River fall-run populations.

Stock name: *Young's Bay net pens spring-run chinook salmon.*

Broodstock origin and history

Year founded: Spring chinook salmon have been released from these net pens since 1990. Eighty-two percent of the liberated fish were of Willamette River stock (NRC 1996).

Source: Broodstock are not collected at this site, rather fish are acquired from hatcheries in the Upper Willamette River ESU. The eggs are transferred to the Gnat Creek Hatchery and released in Young's Bay, Tongue Point, and Blind Slough net pens.
Relationship to current natural population: Historically, spring-run chinook salmon did not spawn in the Coastal Ecozone of the Lower Columbia River (Myers et al. 2002). Suitable spawning habitat for spring-run fish does not exist in this basin.

Population genetics: Fish from the Young's Bay net-pen program have not been specifically sampled. However, analysis of fish from the source hatcheries for this program indicates that they do not belong to the Lower Columbia River ESU, but to the Upper Willamette River ESU.

Morphology/behavior/fitness: No data.

Previous determinations The USFWS did not consider this stock to be part of the ESU, nor essential for recovery (Hillwig 1998). NMFS (1999) did not consider this stock to be part of the ESU.

Category and rationale: Category 4. This stock is perpetuated from populations that are not considered part of the ESU.

Stock name: *Big Creek Hatchery fall-run chinook salmon stock (ODFW #13).*

Broodstock origin and history

Year founded: This facility began operation in 1941.

Source: Fall-run chinook salmon are native to this basin, with 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). A weir was place just below the hatchery; however, Wallis (1963) indicates that the weir was removed after the egg quota was achieved. Currently, adults are collected in Big Creek for broodstock, and 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, eight 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 have been excluded from Oregon tule hatchery programs (Kostow 1995). Naturally spawning fish are not intentionally included in the broodstock, although not all Big Creek tule fall chinook are marked. Thus, naturally produced fall chinook could have been included in the broodstock. This is especially true of years where adults are collected at Plympton Creek.

Subsequent Events: Big Creek Hatchery is designed to prevent returning adults from passing upstream above the facility. There is 100% capture of all returning adults. The adult tule fall chinook salmon selected for the broodstock are retained at the facility until they are spawned. Excess fall-run chinook salmon adults are disposed of. Any wild fall collected at Big Creek could not be identified or separated from returning hatchery fall chinook. No fall chinook salmon collected at Big Creek are released alive to natural spawning areas. In years when the Plympton Creek trap is operating, fall-run chinook salmon not needed for broodstock are released back to Plympton Creek.

Relationship to current natural population: There is some natural spawning below the hatchery weir in Big Creek, it is thought that the majority of these fish are of hatchery origin.

Current Program Goals: The hatchery produces fish for harvest. Some chinook salmon fry are also provided to local schools for STEP activities.

Population genetics: Big Creek fall-run chinook salmon most closely resemble fall-run chinook salmon from the Spring Creek NFH and Abernathy NFH (Myers et al. 1998).

Morphology/behavior/fitness: No data.

Previous determinations: The USFWS considers this stock to be part of the ESU, but was unsure of whether it was essential for recovery (Hillwig 1998). NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 3b. There have been numerous transfers from other hatcheries within the ESU. Also, the stock is an old stock which is likely to have diverged from the ancestral and current natural fall chinook populations in the area. If further analysis indicates that there has been substantial introgression by Rogue River fall-run chinook salmon, then the stock would be considered Category 4.

Stock name: *Rogue River fall-run chinook salmon stock (ODFW # 52).*

Hatchery/collection site: Big Creek Hatchery, Klaskanine Hatchery, and Young's Bay net pens.

Broodstock origin and history

Year founded: 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).

Source: Currently, broodstock for the Big Creek hatchery Rogue fall chinook program are collected from adult fall chinook salmon returns trapped at Klaskanine Hatchery, while some rearing is done at the Big Creek Hatchery. Historically, the broodstock program was established at Big Creek Hatchery in 1983 with eggs obtained from Cole Rivers Hatchery on the Rogue River. The last transfer of eggs from Cole Rivers Hatchery was in 1990. Smolt releases were limited to Big Creek and Youngs Bay. Smolt releases from Big Creek resulted in recoveries that strayed into Washington streams below Longview, Washington. For the same broods, the majority of strays from Young's Bay releases were recovered in Oregon tributaries (Big Creek and Klaskanine River only). In 1997, smolt releases were eliminated at Big Creek Hatchery and relocated to Klaskanine Hatchery in Young's Bay.

Broodstock size/natural population size: Several hundred to a few thousand adults returned to the Big Creek facility annually. Rogue River fall-run chinook salmon have been observed spawning in Big Creek and nearby small tributaries.

Recent events: 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).

Relationship to current natural population: The Rogue River fall chinook were selected for use in this program because they have characteristics that are desirable for accomplishing fisheries objectives. They are a south-turning stock that specifically contributes to Oregon coastal fisheries.

Big Creek and Klaskanine hatcheries were designed to prevent returning adults from passing upstream above the facility and there is 100% capture of all returning adults. The adult fall chinook salmon selected for the broodstock are retained at the facility until they are spawned. Excess fall chinook adults are disposed of. Rogue fall chinook collected at Big Creek are identified and separated from returning hatchery tule fall chinook. No fall chinook collected at Big Creek and Klaskanine are released alive to natural spawning areas.

Population genetics: Fall-run chinook salmon from the Rogue River program resemble their founding population in the Oregon Coast and are distinct from Lower Columbia River populations (Marshall 1997).

Morphology/behavior/fitness: No data.

Previous determinations: The USFWS did not consider this stock to be part of the ESU, nor essential for recovery (Hillwig 1998). The NMFS (1999) did not consider this population to be part of the Lower Columbia River ESU.

Category and rationale: Category 4. This stock was founded from a population that is not considered part of the Lower Columbia River ESU.

Stock name: *Klaskanine Hatchery fall-run chinook salmon (ODFW Stock #15).*

Hatchery/collection site: Klaskanine Hatchery.

Broodstock origin and history

Year founded: The Klaskanine Hatchery program began operations in 1911.

Source: 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 no eggs were taken at the hatchery (due to low water conditions) and imports of eggs (primarily from the Big Creek Hatchery and Spring Creek NFH/White Salmon River) were used.

Recent events: The tule fall-run chinook salmon program has been terminated, and production will focus on Rogue River fall-run chinook salmon.

Relationship to current natural population: Naturally-spawning fall-run chinook salmon would be included in the Young's Bay fall-run chinook salmon DIP (Myers et al. 2002). There is limited information available regarding the abundance of naturally-spawning fish, and the majority of these fish are thought to be of hatchery origin.

Population genetics: No data.

Morphology/behavior/fitness: No data.

Previous determinations: The USFWS considers this stock to be part of the ESU, but did not report on whether it was essential for recovery (Hillwig 1998). The NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2b. This stock was founded from populations that are considered part of the ESU, but is not native to the watershed in which it is released. There is little information on the status of any naturally-spawning chinook salmon in the Klaskanine River, although it is unlikely that any native elements remain. It is an old stock and has received few or no wild fish into the broodstock in recent times. However, because majority of the local natural spawners may be of hatchery origin, there is little reason to believe that there is substantial divergence between the natural and hatchery populations.

Stock name: *Klaskanine Hatchery spring-run chinook salmon.*

Broodstock origin and history

Year founded: The hatchery was first operated in 1911. Spring chinook salmon (Upper Willamette River origin) were released from the site as early as 1912. The most recent program began releases of Upper Willamette River fish in 1989 and releases continued through 1995. Spring-run chinook salmon releases at the CEDC South Fork Klaskanine Facility are expected to resume with the 2002 broodyear, with fish from the South Santiam Hatchery.

Source: Since 1989, 85% of the liberated fish were of Willamette River stock (NRC 1996). This program is operated to maintain a terminal fishery in the Young's Bay area. Fish are transferred annually from Willamette River Basin hatcheries.
Relationship to current natural population: The Klaskanine River Basin does not contain spawning habitat suitable for spring-run chinook salmon, and the Basin did not historically contain a spring-run population. It is most likely that all of the returning spring-run chinook salmon are of hatchery origin.

Population genetics: See fish sources (Upper Willamette River spring-run chinook salmon hatcheries).

Morphology/behavior/fitness: No data.

Previous determinations: The USFWS did not consider this stock to be part of the ESU, and not essential for recovery (Hillwig 1998). The NMFS (1999) did not consider this stock to be part of the ESU.

Category and rationale: Category 4. This stock was founded from populations that are not part of the Lower Columbia River chinook salmon ESU.

Stock name: *Bonneville Hatchery upriver bright fall-run chinook salmon (ODFW Stock #95).*

Broodstock origin and history

Year founded: 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.

Source: 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. When returns to this facility did not produce enough fish to meet program goals, eggs from the Priest Rapids stock have been included in the production. Over the last 9 years, the Bonneville URB fall chinook broodstock has been composed entirely of returns to Bonneville Hatchery. During this time, eggs have been transferred out to other facilities. These include: Umatilla, Klickitat, Little White Salmon, Irrigon, and Big Creek hatcheries. Small number of eggs were also transferred out to research facilities at University of Idaho and the Oregon State University.

Relationship to current natural population: Naturally spawning fish are not intentionally included in the broodstock. The URB fall chinook produced by Bonneville Hatchery are not 100% marked. However, local naturally produced "native" fall chinook in the area of Bonneville Hatchery spawn earlier and so mixing of tule fall run fish into the URB broodstock is not likely. There is a large spawning aggregation of URB chinook salmon that spawn below the Bonneville Hatchery in the vicinity of Ives Island. These fish are the descendants of URB fish returning to the Bonneville Hatchery, and are not included in the Lower Columbia River ESU (Schiewe 1999).

Population genetics: Distinct from Lower Columbia River tules and Lower Columbia River brights (Myers et al. 1998).

Morphology/behavior/fitness: No data.

Previous determinations: The USFWS did not consider this stock to be part of the ESU, not essential for recovery (Hillwig 1998). The NMFS (1999) did not consider this stock to be part of the ESU.

Category and rationale: Category 4. This stock was founded from populations that are not part of the Lower Columbia River chinook salmon ESU.

Stock name: Sandy River endemic spring-run chinook salmon (ODFW stock #011)

Broodstock origin and history: Spring-run chinook salmon are native to the Sandy River Basin, with current natural production limited to areas above Marmot Dam. Spring-run chinook salmon from the Clackamas Hatchery and other Upper Willamette River spring-run chinook salmon hatcheries have been released into the Sandy River Basin since the 1960s. These releases were to mitigate for production lost to the dams on the Bull Run river and the mainstem Sandy and Little Sandy Rivers. The release of Clackamas Hatchery spring-run chinook salmon trapped at Marmot Dam in 2002. 2002 was the first year that all returning Clackamas Hatchery spring-run chinook salmon were externally marked for separation and removal at Marmot Dam. Only unmarked spring-run chinook salmon will be used during the development of this broodstock.

Relationship to current natural population: Broodstock are collected from unmarked spring-run chinook salmon intercepted at Marmot Dan. All returning Clackamas Hatchery fish are marked and removed at Marmot Dam. These unmarked fish would be considered part of the Sandy River spring-run chinook salmon DIP (Myers et al. 2002).

Program goal or use of broodstock: Program goal is to provide fish for fisheries, as mitigation for hydro development in the Sandy River Basin.

Population genetics: The 23 December 1998 memo from M. Schiewe (page 15) identified that the Sandy River population was genetically intermediate between Lower Columbia River populations (Lewis River spring run) and Upper Willamette River populations. Microsatellite DNA data indicated that the allele frequencies in the Sandy River spring-run chinook salmon population were statistically different from those in the Clackamas Hatchery; however, the degree of differentiation was much smaller than that between spring runs in the Sandy and Yakima Rivers. Dentzen et al. (1998) concluded from these data that, although some interbreeding between the Upper Willamette River and Sandy River populations had presumably occurred, the Sandy River population still retained some of its ancestral genetic characteristics. Therefore, the BRT reiterated its conclusion that the naturally spawning population in the Sandy River is part of the Lower Columbia River ESU. This conclusion was the primary reason to develop an endemic spring-run chinook salmon population to meet mitigation obligations.

Morphology/behavior/fitness: No data.

Previous determination: None, new program.

Category and Rationale: Category 1a. The broodstock was recently founded from unmarked, presumably naturally produced fish. It is unclear how much the existing population has diverged from the spring-run chinook salmon historically found in the Sandy River.

Stock name: *Hood River spring-run chinook salmon (ODFW Stock #66).*

Broodstock origin and history

Source: Spring-run chinook salmon were native to the Hood River Basin, but have been extirpated (Kostow 1995). Fish from a number of different hatcheries have been released in the Hood River Basin to re-establish a spring run. From 1985 to 1992, over 1 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) were released in the Hood River. In 1997, adults returning to the Hood River were used as broodstock for future releases. In 1999 and 2000, spring-run chinook salmon returns were so low that all returning adults were allowed to spawn naturally. In 2001 and 2002, returning hatchery adults were used for broodstock. Low returns are expected in 2003, and all returning spring chinook salmon will be released to spawn naturally.
Broodstock size/natural population size: Since 1991, all smolts released have been from the Deschutes River Round Butte spring-run chinook salmon broodstock. The vast majority of returning fish are the descendants of the Round Butte Hatchery population and not the native spring run that existed in the Hood River.

Population genetics: Deschutes River spring-run chinook salmon are distinct from Lower Columbia River chinook salmon populations (Myers et al. 1998).

Morphology/behavior/fitness: No data.

Current program goals: The goals are to reintroduce spring chinook salmon into the Hood River subbasin. The program is jointly implemented by the Oregon Department of Fish and Wildlife and the Confederated Tribes of the Warm Springs.

Previous determinations: The NMFS (1999) did not consider this population to be part of the Lower Columbia River chinook salmon ESU.

Category and rationale: Category 4. This stock was founded from the Deschutes River population, which is not considered to be part of the Lower Columbia River chinook salmon ESU.

Columbia River Chum Salmon ESU

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

Stock name: *Sea Resources Chinook River chum salmon.*

Hatchery/collection site: Chinook River.

Broodstock origin and history

Year founded: 2000

Source: Grays River
Subsequent events: In recent years, the only hatchery releases of chum salmon in this ESU have been from the cooperatively run Sea Resources Hatchery. 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 the mainstem Columbia River. It has propagated 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 four females) were trapped and spawned at the Sea Resources Hatchery. Fry from these crosses were to have been genetically tested in 1999 to determine their ancestry (Wolf Dammers, WDFW, pers. commun., January 1999). No chum salmon were to have been released from the Sea Resources Hatchery in 1999 (S. Schroeder, WDFW, pers. commun., February 1999).

In 2000, the Sea Resources facility became part of the Lower Columbia River Chum Restoration Program. Eggs from the Gorley Creek population were used to start this program (Sea Resources 2001).
Relationship to current natural population: The cessation of the Willapa Bay chum salmon program resulted in the removal of almost all chum salmon from the watershed. The reestablishment of the program using Gray River chum salmon will eventually result in naturally spawning chum salmon. Currently, there is no natural population in the Chinook River; however, the Chinook River is included in the Grays River chum salmon DIP which contains over one thousand naturally spawning chum salmon.

Population Genetics: See Grays River chum salmon.

Previous determinations: NMFS (1999) did not consider this stock to be part of the ESU, but that determination was based on the old program that utilized a broodstock from outside of the ESU.

Category and rationale: Category 1a. Fish that are part of the new (Grays River) broodstock would be considered Category 1a because the Grays River and Chinook River Basins are part of the same historical demographically independent population (Myers et al. 2002) and the new broodstock consists of entirely natural origin fish. It is unlikely that there will be a significant number of returning 5-year-old fish from the Willapa Bay-based program. Any that do return would be considered Category 4.

Stock name: *Grays River/Gorley Creek chum salmon.*

Hatchery/collection site: Gorley Creek and Grays River Hatchery.

Broodstock origin and history

Year founded: 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, and transported to the Grays Harbor Hatchery where they were spawned. From these fish, approximately 126,000 eggs were collected. The fry are volitionally released either from the Grays River Hatchery. At the hatchery, the fish are marked by thermal-treatment of their otoliths.
Relationship to current natural population: The Grays River contains several hundred to a few thousand naturally-spawning chum salmon. The relatively small size of the broodstock program likely to have had relatively effect on the natural population.

Program goal: 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).

Population Genetics: Chum salmon from the Grays River are most closely related to those spawning in Hamilton and Hardy Creeks (the only other samples from within the ESU); however, the two populations are distinct from one another (Phelps et al. 1995, Myers et al. 2002). Due to the recent initiation of this program, it is unlikely that there would be any difference between hatchery-origin and naturally spawning chum salmon in the Grays River Basin.

Previous determinations: NMFS (1999) considered this stock to be part of the ESU.

Category and Rational: Category 1a, due to the stock's recent founding from a local, wild population.

Stock name: *Washougal River/Duncan Creek chum salmon*

Hatchery/Collection Site: Adult broodstock are collected from the mainstem Columbia River. Eggs and juveniles are reared at the WDFW Washougal Hatchery.

Broodstock Origin and History
Year founded: Founded in the 2002.
Source: This broodstock is maintained through the collection of naturally spawning chum salmon from the Ives Island area of the mainstem Columbia River. In 2002, 120,000 eggs were obtained for release in May 2003. Additionally, 50 adult chum salmon have been collected in 2001 and 2002, transported to Duncan Creek and allowed to spawn naturally within the confines of the spawning channel.
Recent events since 1990:
Relationship to current natural population (mixing between hatchery and wild): Since broodstock are taken from the natural population and there is no recent history of artificial propagation in the area, the broodstock should be representative of the natural population.
Program goal or use of broodstock: The purpose of this program is to reestablish a spawning population in Duncan Creek, a basin that historically supported chum salmon. Chum salmon adults and fingerlings released into Duncan Creek are from adjacent spawning aggregations, namely Columbia River (Ives Island).
Genetics Data: Genetic samples have been collected from 50 or more fish each from Hamilton Creek, Hardy Creek, and the Ives Island Area. Electrophoretic analysis indicates a close relationship between these geographically proximate locations.
Phenotypic Data: Not applicable

Category and Rational: Category 1a – recently founded from the local natural population.

Stock name: *Various Lower Columbia River WDFW 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 broodstocks 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).

Category and rationale: Unknown.

Willamette River Steelhead ESU

Stock name: *Skamania/South Santiam summer steelhead stock (ODFW# 24).*

Hatchery/collection site: The broodstock is collected at South Santiam Hatchery on the South Fork of the Santiam River, Willamette River, Oregon. Releases occur into the Santiam, McKenzie, and Middle Fork Willamette Rivers. Releases also occur into the Lower Columbia ESU.

Broodstock origin and history

Year founded: Founded in the 1950s.

Source: This broodstock was founded from several Southwest Washington rivers, including the Washougal and Klickitat Rivers. In the early 1970s, the broodstock was transferred from Washington to South Santiam Hatchery and isolated from the original Skamania Hatchery stock.

Recent events:

Relationship to current natural population: Summer steelhead are not native to the Willamette Basin, and there is limited information on the reproductive success of summer steelhead in the Upper Willamette River Basins.

Program goal: This broodstock is used to provide fish for harvest.

Genetics data: Genetic analysis indicates that the South Santiam summer-run steelhead are similar to their parent Skamania Hatchery population, but distinct from locally-derived winter-run steelhead stocks in the Upper Willamette River Basin (Myers et al. 2002).

Phenotypic data: N/A.

Category and rationale: Category 4. The broodstock was founded entirely from populations outside of the ESU.

Upper Willamette River Spring-Run 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 lists 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 1998), but Nicholas (1995) states that "conceivably, genetic differences may have existed between some indigenous spring chinook populations located in geographically distinct portions of the Willamette basin." Beginning in 2000, all interbasin transfers have been eliminated as prescribed in the NOAA Fisheries Biological Opinion on the impacts from the collection, rearing, and release of listed and non-listed salmonids associated with artificial propagation programs in the Upper Willamette spring chinook and winter steelhead ESUs, dated July 10, 2000. All juvenile fish releases are now from broodstock collected within the local subbasins.

Stock name: *North Fork Santiam River spring-run chinook salmon (ODFW Stock #21).*

Hatchery/collection site: Marion Forks Hatchery, Minto Dam Trap.

Broodstock origin and history

Year founded: Spring-run 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.

Source: 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, including some introductions of spring chinook salmon from the Carson Hatchery (1.5 million in total) that were probably not successful.

Broodstock for the Santiam River spring chinook salmon program is collected from adult chinook salmon returning to Minto Dam, on the North Santiam River. Fish returning to the collection facility are mixed and randomly selected for spawning.

Historical records show that the Santiam Basin supported approximately 33% of the naturally produced spring chinook salmon above Willamette Falls. Prior to the construction of Detroit Dam, spawning ground surveys showed that 71% of this production occurred in areas above Detroit Dam (Wevers et al. 1992). The construction of Detroit Dam blocked fish from passing upstream, and effectively eliminated this area for natural production. Broodstock for the North Santiam stock No. 21 was initiated by collecting the wild adults that returned to the base of the dam. Unlike some other Willamette spring chinook hatchery programs, there have been few transfers into this broodstock from other programs. For the past 10 years, the broodstock has been comprised entirely of adult returns to Minto Pond. With the exception of the 1992 broodyear, all adults spawned were used for Marion Forks Hatchery production goals. For the 1992 broodyear, 1.7 million viable eggs were transferred to the Clackamas, McKenzie, and Willamette hatcheries to compensate for egg-take shortages.

Subsequent events: Until 1996, only a relatively small proportion of hatchery-reared spring chinook salmon were marked with an adipose fin clip, thus naturally produced fish may have been incorporated into the brood. Since 1996, all hatchery-reared juveniles have been adipose fin clipped, and a portion (~30,000 annually) have been coded wire tagged (CWT). Beginning in 1999, adult returns will provide valuable information needed to assess the proportion of natural production and hatchery production in the basin. The percentage of naturally spawning spring chinook salmon that were finclipped fish, based on carcasses recovered in the North Santiam River above Stayton Island, was 86% in 2001 and 73% in 2002 (Firman et al. 2002). The estimated number of spring chinook passing upper and lower Bennett dams on the North Santiam River, May-October 2002, was 1,233 unmarked fish and 6,536 finclipped fish (Firman et al. 2002).

Relationship between hatchery and natural population: There is little information on the incorporation of natural origin fish into the hatchery broodstock, due primarily to low marking rates prior to 1996. Habitat conditions probably limit the success of naturally spawning adults and suggests that hatchery-origin fish have had a substantial influence on the composition of spring run fish in the North Santiam River spring run chinook salmon DIP (Myers et al. 2002).

Recent events: In 2002, 0.7% of the broodstock spawned at Marion Forks hatchery were unmarked, wild-origin chinook (Firman et al. 2002).

Population genetics: Fish obtained from the North Santiam River were somewhat distinct from fish reared at the Marion Forks Hatchery on the North Santiam: however, both samples were generally similar to other Upper Willamette River spring-run chinook salmon and the differences due to sample year may explain much of the difference between in-river and hatchery fish in the North Santiam (Myers et al. 1998, Myers et al. 2002).

Morphology/behavior/fitness: In 2002, Firman et al. (2002) reported spring chinook sampled from the Minto Dam trap were significantly longer in length (825.7 ± 6.9 mm) than fish collected at other Willamette hatcheries, except McKenzie hatchery. The difference between wild chinook and hatchery chinook could not be evaluated at Minto Dam because of the small sample size of wild chinook (n=5). However, of all the wild and hatchery chinook measured collectively from Willamette Basin hatcheries, the mean fork length of wild chinook (823.4 ± 10.5 mm) sampled from the traps was significantly higher than hatchery chinook (800.0 ± 2.2 mm).

Previous determinations: NMFS (1999) considered this stock to be part of the ESU but not essential for recovery.

Category and rationale: Category 2a or 2b. This stock was founded from populations that are considered part of the ESU. It has probably incorporated limited numbers of naturally produced

North Santiam River spring-run chinook salmon. Decades of transfers between hatcheries in the Upper Willamette River have reduced or nearly eliminated within ESU diversity. There appears to be little data available on the current relationship between the natural population in the Santiam River and the hatchery population.

Stock name: *Middle Fork Willamette River spring-run chinook salmon (ODFW Stock #22).*

Hatchery/collection site: Willamette Hatchery, Dexter Rearing Pond.

Broodstock origin and history

Source: Broodstock for this stock are 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-1970s, but these have been reduced in recent years with reliance on locally returning adults as broodstock.

Adults used for broodstock purposes are collected throughout the run from May to October. Adults are collected in representative numbers with most broodstock gathered in the middle of the run. Over the past 10 years, only adults returning to Dexter Pond have been used for Willamette broodstock collection. Adults used for brood are mixed and randomly selected (from early, mid, and late returns).

Subsequent events: Beginning in 1993, a portion of the adults collected at Dexter Pond were transferred to McKenzie Hatchery and spawned. Of those eggs collected at McKenzie Hatchery in 1993, 1994, and 1995, nearly two-thirds were transferred to Willamette Hatchery for rearing and ponding. The remaining eggs were ponded at McKenzie Hatchery and reared to smolt size, they were then transferred to the Clatsop Economic Development Committee (CEDC) net pen rearing and release programs at Young's Bay. Since 1996, this rearing program has been transferred from the McKenzie Hatchery to Gnat Creek Hatchery. Currently, Gnat Creek Hatchery receives eyed eggs from Willamette Hatchery and rears the fish for subsequent transfer to and release from the CEDC net pens in the Lower Columbia River.

Relationship to current natural populations: There are reports of small numbers of naturally spawning spring-run chinook salmon in the Fall Creek Basin, the only remaining accessible portion of the Middle Fork Willamette River. Prior to broodyear 1997, not all hatchery-reared spring chinook were marked, therefore, the degree to which wild fish were incorporated into the broodstock is unknown. However, except for the Fall Creek area, wild fish are rare in the Middle Fork Willamette River, making their incorporation into the broodstock unlikely. In 2002, Firman et al. (2002) reported 928 natural-origin spring chinook salmon were collected at the Dexter hatchery trap. Fifty-four of these natural-origin fish were spawned for broodstock (approximately 3.3% of the total broodstock).

Population genetics: Genetic analysis of fish from the Willamette Hatchery indicates a close association between this and other spring-run hatchery stocks from the Upper Willamette River

ESU (Myers et al. 1998). There is no available genetic analysis comparing naturally produced and hatchery spring-run chinook salmon from this area.

Morphology/behavior/fitness: In 2002, Firman et al. (2002) reported spring chinook sampled from the Dexter Dam trap were significantly shorter in mean fork length than fish collected at any other Willamette hatchery. Wild chinook (823.4 ± 19.1mm) were significantly longer than hatchery chinook (779.6 ± 2.9mm) sampled from the Dexter trap in 2002.

Previous determinations: The NMFS (1999) considered this stock to be in the ESU but not essential for recovery.

Category and rationale: Category 2b or 2c. This stock was founded from populations that are considered part of the ESU. It is an old stock, and has incorporated unknown but probably small numbers of wild fish into the broodstock in recent times. Transfers of broodstocks between hatcheries in the Upper Willamette River have been substantial, reducing or nearly eliminating within-ESU diversity. Most of the historical spawning habitat is inaccessible due to dam construction. The relationship between this hatchery stock and the small remaining natural population in the same watershed is unknown.

Stock name: *McKenzie River spring-run chinook salmon (ODFW Stock #23).*

Hatchery/collection site: McKenzie River Hatchery.

Broodstock origin and history

Source: ODF&W identified the McKenzie River stock as being the most unique of the Willamette River Basin stocks (Kostow 1995). 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 a considerable amount of transfer of eggs and fish between hatcheries in the Willamette River Basin and out to the Bonneville and Klaskanine Hatcheries (Wallis 1961). Currently, the McKenzie River Hatchery collects returning adult hatchery fish and some naturally produced adults.

Broodstock for the McKenzie River spring chinook program originated from spring chinook salmon collected at Leaburg Hatchery, and from reaches and tributaries of the McKenzie River. Relatively few transfers into this broodstock from other Willamette Basin spring chinook broodstocks have occurred.

Relationship to current natural populations: Adults collected for broodstock include both naturally produced and hatchery-origin fish. The 1998 Willamette Basin Fish Management Plan calls for incorporating 10% to 25% of wild fish into annual broodstock. Prior to 1996, not all hatchery spring chinook were marked, so the number of wild fish actually used was unknown. Since 1996, the percentage of the broodstock that was known to be wild-origin spring chinook ranged from 9% to 25% (L. Kruzic, pers. commun. NOAA Fisheries, January 8, 2003). In 2002, 4,104 unmarked (presumed natural-origin) fish passed above Leaburg Dam (ODFW 2003).

Population genetics: Genetic analysis of fish from the McKenzie Hatchery indicates a close association between this and other spring-run hatchery stocks from the Upper Willamette River ESU (Myers et al. 1998). Spring-run chinook salmon from the McKenzie hatchery most closely resemble fish spawned from natural spawning sites in the McKenzie River (Myers et al. 2002). No information is available about genetic and ecological differences between the McKenzie hatchery fish and wild fish.

Morphology/behavior/fitness: In 2002, Firman et al. (2002) reported no significant differences between the fork length of wild (816.3 ± 14.2mm) and hatchery chinook (821.5 ± 4.8mm) collected at McKenzie Hatchery. Adults used for broodstock purposes are collected throughout the run: from May to October. In 1996 and 1997, adults captured upstream at Leaburg Dam were added to the adult broodstock collection pool (50 in 1996 and 26 in 1997).

Previous determinations: The NMFS (1999) considered this stock to be part of the ESU but not essential for recovery.

Category and rationale: Category 2a. This hatchery stock was founded from a mixture of populations that are considered part of the ESU. Until recently, the proportion of natural fish incorporated into the stock since its founding was unknown; recently data suggests that a moderate proportion of natural origin fish are incorporated into the broodstock. The McKenzie River Hatchery is different from the other hatcheries in that a relatively large naturally spawning population is thought to still exist in the McKenzie River Basin (Nicholas 1995). Recent information suggests that naturally produced fish constitute 75% of the run counted at Leaburg Dam.

Stock name: *South Fork Santiam River spring-run chinook stock (ODFW Stock #24).*

Hatchery/collection site: South Santiam Hatchery, volunteer trap at Foster Dam.

Broodstock origin and history

Year founded: 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. In conjunction with the construction of Foster Dam, the hatchery was moved.

Source: 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 (Willis 1961). 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 Creeks. This stock is considered a substock of Santiam River spring chinook salmon (Kostow 1995).

Relationship to current natural population: Historical records show that the Santiam subbasin supported approximately 33% of the naturally produced spring chinook above Willamette Falls. Historically, 85% of the spring chinook production in the South Santiam subbasin occurred above Foster Dam (Santiam River FMP 1992). Reservoir mortality, along with limited fish passage at Foster Dam, contributed to declining fish runs in the upper basin. Broodstock for the South Santiam stock No. 24 was initiated by collecting the wild adults that returned to the base of the dam. However, in some years spring chinook have been transferred into South Santiam from other Willamette Basin spring chinook hatcheries. For the past 10 years, the broodstock has been comprised entirely of adult returns to Foster Dam. Currently, all eyed eggs taken to meet South Santiam spring chinook salmon production goals are transferred to the Willamette Hatchery for rearing. In the past, eggs were transferred to alternate facilities, such as Bonneville and McKenzie Hatcheries to provide sufficient rearing.

Adults collected for broodstock may include both naturally produced and hatchery-origin fish. Before 1996, not all hatchery spring chinook were marked, hence, naturally produced fish may have been included during broodstock collection and spawning.

Recent events: In 2002, 4.3% (77 fish) of the broodstock spawned at South Santiam Hatchery were wild, unmarked chinook salmon. The estimated run of natural-origin fish in the South Santiam was 965 fish in 2002 (Firman et al. 2002).

Program goal or use of broodstock: Spring-run chinook salmon from the South Santiam Hatchery are released into the South Santiam River as part of a mitigation program for dams constructed in the basin. Additionally, fish from the South Santiam Hatchery are releases from the Clackamas Hatchery, Sandy Hatchery, and at Powerdale Dam in the Hood River. Releases into the Sandy River are scheduled to be terminated in 2003.

Population genetics: Information about genetic and ecological differences between hatchery and wild fish is not currently available.

Morphology/behavior/fitness: In 2002, Firman et al. (2002) reported wild chinook to have significantly higher mean fork length (845.0 ± 27.2mm) than hatchery chinook (800.6 ± 4.1mm) sampled at South Santiam hatchery.

Previous determinations: The NMFS (1999) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2b. This stock was founded from a mixture of populations that are considered part of the ESU, but some of which are not native to the watershed in which it is released. It is also an old stock, and has received few wild fish into the broodstock in recent times. Transfers of broodstocks between hatcheries in the Upper Willamette River have been substantial, reducing or nearly eliminating within-ESU diversity.

Stock name: *Clackamas River spring-run chinook salmon (ODFW Stock #19).*

Hatchery/collection site: Clackamas Hatchery.

Broodstock origin and history

Year founded: 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.

Source: Several hatcheries have reared spring-run chinook salmon in the Clackamas River Basin, although only two hatcheries are currently or have been recently propagating spring-run chinook salmon. 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 made 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 re-established 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.

Subsequent events: 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.

Recent events: Clackamas Hatchery spring-run chinook salmon are released into the Sandy River Basin, although this program is slated to be terminated in favor of using fish from the indigenous Sandy River population. Releases are made from two acclimation sites: Marmot Dam and a series of net pens. There are no collection facilities for adults in the Sandy River Basin.

Broodstock for the Clackamas Hatchery spring chinook program are collected from adult spring chinook salmon returns trapped at Clackamas hatchery. Over the last 10 years, the Clackamas Hatchery spring chinook salmon broodstock has been composed entirely of returns to Clackamas Hatchery.

Relationship to current natural population: Naturally spawning fish are not intentionally included in the broodstock. Prior to the 2002 return year, not all hatchery spring chinook were marked. Thus, naturally produced spring chinook could have been included in the broodstock.

Clackamas Hatchery relies on voluntary swim-in by returning adult spring chinook salmon. The trap does not block upstream migration in the Clackamas River, thus hatchery and wild fish can freely migrate past the hatchery. Returning hatchery fish will be distinguished by a fin clip mark and/or CWT. The adult spring chinook selected for the broodstock are retained at the facility until they are spawned. As mass marked adult spring chinook return (first year of mass marking was the 1997 broodyear), the proportion of hatchery fish at North Fork Dam can be more accurately monitored and all of the hatchery fish can be removed at the dam. In 2002, 2,281 unmarked chinook adults were passed above the North Fork Dam, while 3,048 hatchery-origin fish were returned to the lower river for additional sport fishing opportunity (Schroeder et al. 2002, ODFW 2003).

Population genetics: Genetic analysis of fish from the Clackamas Hatchery indicates a close association between this and other spring-run hatchery stocks from the Upper Willamette River ESU (Myers et al. 1998). Fish obtained from the North Fork Clackamas River were somewhat distinct from fish reared at the Clackamas Hatchery: however, both samples were generally similar to other Upper Willamette River spring-run chinook salmon and the differences due to sample year may explain much of the difference between in-river and hatchery fish in the Clackamas River (Myers et al. 1998, Myers et al. 2002).

Morphology/behavior/fitness: No data.

Previous determinations: This broodstock was not considered part of the ESU by USFWS, nor was it considered 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. This stock was considered part of the Upper Willamette River chinook salmon ESU by NMFS (1999).

Category and rationale: Category 2b or 2c. The stock was founded by populations from within the ESU, but not native to the basin. There are few data available on the current demographic relationship between the hatchery stock the natural spawning population.

INTERIOR COLUMBIA RIVER BASIN RECOVERY DOMAIN-STEELHEAD

Middle Columbia River Steelhead ESU

Stock name: *Deschutes River summer-run steelhead (ODFW Stock #66).*

Hatchery/collection site: Round Butte Hatchery, Pelton Trap. Round Butte Hatchery is located on the Deschutes River at the base of Round Butte Dam, 16 Km west of Madras, Oregon. It 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 1996).

Broodstock origin and history

According to ODFW (1986) , 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 NFH, located at RKm 14.4 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.

Year founded: 1972.

Source: Local, native Deschutes steelhead.

Broodstock size/natural population size: Data not available.

Subsequent events: 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).

Recent events: 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).

Relationship to current natural population: As of the early 1990s, hatchery fish were mated only with other hatchery fish (Christianson 1993). 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.

Current program goals: Production goals for summer steelhead at this hatchery call for 162,000 smolts (18,400 Kgs.) for release into the Deschutes River.

Population genetics: Data not available.

Morphology/behavior/fitness: Data not available.

Previous determinations: ODFW (R. Hooton, pers. commun., February 1999) did not consider this hatchery population to be in the ESU, or to be essential for recovery. NMFS (1999c) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2a or 2c. 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 might argue for a Category 2c designation. In addition, this stock has been under artificial propagation for many years and it is probable that there has been at least moderate divergence from the natural population in the Deschutes River.

Comanager comments: USFWS (2003) suggested a Category 2 designation, arguing that the stray issue in the Deschutes River (and the collection of unmarked broodstock) did not become an issue until the Snake River steelhead programs increased production in the late 1980s and early 1990s. It is, therefore, likely that the unmarked fish were of Deschutes River origin.

Stock name: *Umatilla River summer-run steelhead, (ODFW Stock #91)*

Hatchery/collection site: Umatilla Hatchery, Minthorn Springs, Bonifer Pond, and Pendleton Pond. Between 1980 and 1990, ODFW Stock #91 was reared in most years at Oak Springs Hatchery and transferred to Bonifer Pond, on Meacham Creek, for acclimation and release. Minthorn Springs is located 6.4 Km 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. Bonifer Pond is located on Meacham Creek, which flows into the Umatilla River at RKm 126.4, and Thornhollow is located on the Upper Umatilla River at RKm 117.6, both above Pendleton, Oregon. Bonifer Pond and the Pendleton Pond facility serve as acclimation and release sites for Umatilla River hatchery summer steelhead (Rowan 1997).

Broodstock origin and history

Year founded: 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.

Source: 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).

Broodstock size/natural population size: Christianson (1993) stated that only naturally spawned (unmarked) 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 CWT) as broodstock for this program (B. Zimmerman, Confederated Tribes of the Umatilla Indian Reservation, pers. commun., February 1999).

Subsequent events: This stock was also reared at Irrigon Hatchery in 1988, and Bonneville Hatchery in 1988 and 1989 (Olsen et al. 1992, Rowan 1997).

Recent events: 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 transferred to Minthorn Springs, Bonifer Pond, and Pendleton Pond for acclimation and release (Montgomery Watson 1996a, Rowan 1997).

Relationship to current natural population: Only unmarked fish are used for broodstock.

Current program goals: Fiscal Year 2003 production goals for summer steelhead program are 150,000 smolts for acclimation and release (Montgomery Watson 1996a).

Population genetics: Data not available.

Morphology/behavior/fitness: Data not available.

Previous determinations: ODFW (R. Hooton, pers. commun., February 1999) did not consider this hatchery population to be in the ESU, or to be essential for recovery. NMFS (1999c) concluded that this stock was in the ESU but was not essential for recovery.

Category and rationale: Category 1a. The stock consists of a large fraction of naturally produced (unmarked) returning adults each year, and there is no reason to believe that it has diverged more than minimally from the local natural population. However, there is some concern that in some years, large numbers of the unmarked fish may have actually been hatchery strays rather than natural steelhead.

Stock name: *Dayton Ponds (WDFW), Lyons Ferry summer steelhead.*

Hatchery/collection site: Dayton Pond is located on the Touchet River (Walla Walla River tributary), located in the Middle Columbia River steelhead ESU. No adults are collected or spawned here.

Broodstock origin and history

Year founded: 1987.

Source: Lyon's Ferry Hatchery.

Broodstock size/natural population size:

Subsequent events: Releases have included fish from Wells Dam, Wallowa, and Snake River.

Recent events: This program is being phased out in preference for the endemic population hatchery program.

Relationship to current natural population: No local natural fish are used for broodstock.

Current program goals:

Population genetics: See Lyon's Ferry summer steelhead.

Morphology/behavior/fitness: Data not available.

Category and rationale: Category 4. This stock was derived primarily from populations that are not considered to be part of the Mid-Columbia steelhead ESU.

Stock name: *Dayton Pond (WDFW) Touchet River summer steelhead.*

Hatchery/collection site: Dayton Trap Facility (RKm 85.8), which is located on the Touchet River (Walla Walla River tributary).

Broodstock origin and history

Year founded: 2000.

Source: Locally collected steelhead from the Touchet River, Dayton Facility Trap, or by hook and line above the city of Waitsburg.

Broodstock size/natural population size: The program is designed to take no more than 88 steelhead, relative to the nearly 250 natural-origin fish that spawn in the Touchet River. No more than 35% of the broodstock collected will be first generation hatchery-origin endemic stock.

Subsequent events: N/A.

Recent events:

Relationship to current natural population:

Current program goals: At full production (in 2005), 150,000 endemic summer steelhead should be acclimated and released into the Touchet River annually.

Population genetics: Data not available.

Morphology/behavior/fitness: Given the recent founding of this population, the high proportion of natural-origin fish incorporated annually and spawning protocols that try to be representative of the entire run, it seems unlikely that there will be any significant differences between the hatchery-origin and wild-origin fish.

Category and rationale: Category 1a. The stock was recently founded from a natural population in the watershed in which the stock is released.

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 (Lyon's Ferry Hatchery stock) Rivers. Broodstocks for these programs are collected outside of the ESU, and juvenile rearing prior to release occurs in hatcheries outside of the ESU.

Previous comments: Crawford (1999) listed the above transplantation programs in the White Salmon, Klickitat, and Walla Walla Rivers and stated that these hatchery fish should not be considered part of the Middle Columbia River ESU. NMFS (1999c) did not consider this stock essential for recovery.

Category: Category 4. These releases are from stocks that were derived primarily or entirely from populations that are not considered part of the Mid-Columbia River steelhead ESU.

Upper Columbia River Steelhead ESU

Grand Coulee Fish Maintenance Project (GCFMP) summary.

Under the GCFMP, all steelhead bound for the Upper Columbia River between 1939 to 1943 were trapped at Rock Island Dam and either trucked to hatchery holding ponds (primarily at the Leavenworth NFH), or released in racked areas of Nason Creek (Wenatchee River) or the Entiat River. As a result, few, if any, adult steelhead reached their native spawning areas in the Wenatchee, Entiat, Methow, or Okanogan Rivers during this time (Chapman et al. 1994). The GCFMP extensively mixed and redistributed steelhead stocks above Rock Island Dam. Some non-native stocks were introduced about this time, but were not thought to have had much of an impact due to the small size at release (Chapman et al. 1994).

Between 1960 and 1981, adults for all Upper Columbia River steelhead programs were collected at Priest Rapids Dam (except 1974-1976, and 1979 at Wells Dam), thus continuing the mixing of stocks begun during the GCFMP. After 1982, most Upper Columbia River broodstock have been collected at Wells Dam. Therefore, homogenization of local stocks in this ESU has occurred over a long time period (Chapman et al. 1994). Due to the greater availability of fish at Priest Rapids Dam, proposals were developed in the mid-1990s to collect the majority of steelhead stock for Upper Columbia River hatchery operations at Priest Rapids Dam instead of Wells Dam. In addition, efforts were made to halt the progression toward early spawning in the hatchery stock (WDFW. Assessment & Development Division/Mid-Columbia Projects, Memo of 12 July 1996).

The Biological Assessment and Management Plan (BAMP) (NMFS et al. 1998) developed during HCP negotiations with Middle and Upper Columbia Public Utilities Districts (PUDs) provided some further recommendations for reform of the steelhead program. One of the recommendations was to develop subbasin localized stocks. As an implementation of this recommendation, the Wenatchee River steelhead program (Eastbank Hatchery) has been developed from broodstock collected only in the Wenatchee River since 1998. In 1997, broodstock was from Wenatchee River collections and unmarked, presumably natural-origin steelhead collected at Priest Rapid. Steelhead releases above Wells Dam are progeny of broodstock collected at Wells Dam. However, the Confederated Tribes of the Colville Reservation (CCT) proposed a new program for 2003. The program would collect broodstock, primarily natural origin, if possible, from Omak Creek to initiate the development of an Okanogan Basin-specific stock.

Stock name: *Wells Hatchery summer-run steelhead stock (WDFW, Douglas Co. PUD).*

Hatchery/collection site: The current collection site is Wells Dam. Various rearing and release sites are in the Methow and Okanogan Watersheds.

Broodstock origin and history

Year founded: The Wells Hatchery stock was originally developed in the 1960s from wild steelhead crossing Priest Rapids Dam (WDFW 2002). Currently, several hundred adult steelhead are captured for broodstock at the Wells Dam fish ladder and at Wells Hatchery. This hatchery was constructed in 1967 by Douglas County PUD and is currently operated by WDFW.

Source: Original source was fish crossing Priest Rapids Dam.

Broodstock size/natural population size: From 1981-1993, about 670 adults per year were taken for broodstock. In their 2002 permit request, WDFW (2002) estimated that 372 natural and hatchery-origin steelhead would be trapped for broodstock at Wells Dam.

Subsequent events: During the early years, when the broodstock was collected at Priest Rapids and Wells dams, no attempt was made to discriminate between hatchery and naturally produced adults. Wells stock has also recently been planted into the Okanogan Watershed.

Recent events: In the early 1990s approximately 10% of the broodstock was composed of naturally spawning fish (Chapman et al. 1994). WDFW currently prioritizes releases of crosses involving wild fish into the Methow River, crosses involving only hatchery fish into the Okanogan River (Hulett 2002). Recent SARs for Wells Hatchery steelhead were 0.33% and 0.36% for 1996 and 1997, respectively (WDFW 2002). The program is maximizing the inclusion of natural-origin steelhead in broodstock collection and mating protocols (WDFW 2002).

Relationship to current natural population: From 1998 to 2001, the total steelhead run size to Wells Dam ranged from 2,668 to 18,483, and consisted of 4.7% to 11.3% adipose-present fish.

Current program goals: The goal of the program is to “augment and enhance the numbers and success of naturally-spawning steelhead in upper Columbia tributaries” (WDFW 2002). As of 2002, production goals for the stock include release of 348,000 smolts associated with Wells Hatchery itself (into the Methow and Okanogan Watersheds), release of 100,000 Wells stock smolts from Winthrop Hatchery, and 180,000 smolts from Ringold Springs Hatchery (WDFW 2002).

Population genetics: Recent collections do not indicate any genetic contribution from Skamania stock (Crawford 1997). There are strong similarities between hatchery and wild populations, and between populations in the different basins in this ESU—Okanogan, Methow, Entiat, and Wenatchee Rivers (Hersberger and Dole 1987, Chapman et al. 1994). However, the sampling for genetic analysis in the Upper Columbia River has not been extensive (Phelps et al. 1997). Ford et al. (2001) reanalyzed the data summarized by Chapman et al. 1994 and concluded there was little evidence for (or against) significant population structure of steelhead in the Upper Columbia River ESU.

Morphology/behavior/fitness: Brown (1995) and WDFW (1997) describe data which suggest that the average spawn timing of the Wells stock has been accelerated compared to the spawn timing of natural-origin Upper Columbia River steelhead. The natural spawner-to-natural origin recruit ratios for the Upper Columbia River populations suggest that the Wells stock cannot sustain itself in the Upper Columbia River environment (Brown 1995). It is unclear if this is due to poor genetic fitness of the Wells stock or simply the result of poor survival due to habitat, passage, or harvest effects.

Previous Determinations: NMFS (1997) considered this stock to be in the ESU and essential for recovery.

Category and rationale: Category 2b. The stock was established from a mixture of natural populations that are considered part of the ESU, but due to widespread outplanting and incorporation of some natural origin fish into the broodstock, there is little evidence for genetic differentiation between the Wells stock and natural Upper Columbia River steelhead. There has been potential for considerable domestication since the time of founding, due to the relatively small number of natural-origin fish incorporated into the broodstock and efforts to select for earlier spawn timing. The relationship between the hatchery stock and natural population in the ESU also remains somewhat unclear due to uncertainties about the natural spawning fitness of the Wells stock. There is some possibility of genetic differences in time of spawning between the Wells stock and natural Upper Columbia steelhead.

Stock name: *Wenatchee steelhead* stock.

Hatchery/collection site: Natural and hatchery-origin broodstock are collected at Tumwater and Dryden dams on the Wenatchee River and spawned and reared at various locations in the Upper Columbia River area, including Wells Hatchery, Eastbank Hatchery, Chelan Falls Hatchery, Turtle Rock Hatchery, Ringold Springs Hatchery, and the Chiwawa Acclimation Ponds (WDFW 2002). Prior to 1998, the program predominately used Wells Hatchery stock collected at Wells Dam. The stock is released into the Wenatchee River and its tributaries.

Broodstock origin and history

Year founded: The current supplementation program began in 1989.

Source: The original broodstock source was Wells stock (see above).

Broodstock size/natural population size: The estimated spawning escapements for the Wenatchee and Entiat River combined averaged 2,372 from 1976 to 1996 (Ford et al. 2001). The broodstock collection goals is 208 steelhead from the Wenatchee River (WDFW 2002).

Subsequent events: Since 1998, all broodstock have been collected from the Wenatchee River at Drydan or Tumwater Dams.

Recent events: The current broodstock is limited to Wenatchee River steelhead to develop a local broodstock (Crawford 1997).

Relationship to current natural population: Fish reared at this facility are released in the Wenatchee River Basin (WDFW 2002). From 1976 to 1996, the proportion of hatchery-origin steelhead (primarily Wells stock) in the natural population has ranged from 48% to 87% (Ford et al. 2001).

Current program goals: The goal of the program is to “augment and enhance the numbers and success of naturally-spawning steelhead in upper Columbia tributaries” (WDFW 2002). In total, the Wenatchee steelhead program is designed to release 400,000 smolts as mitigation for both Rock Island and Rocky Reach dams (WDFW 2002).

Population genetics: See discussion under Wells stock.

Morphology/behavior/fitness: See discussion under Wells stock.

Previous determinations: NMFS (1997) considered the Wells Hatchery stock to be part of the ESU and essential for recovery.

Category and rationale: Category 1b. The stock that is released into the Wenatchee River consists of substantial fraction of natural origin fish, and there is little reason to believe that there has been much divergence between the natural and hatchery populations. Hatchery X hatchery crosses of known Wells stock origin should be considered 2b.

Snake River Steelhead ESU

Stock name: *Wallowa Hatchery, "Grande Ronde" stock (ODFW stock # 56).*

Hatchery/collection site: Broodstock are captured and spawned at the Wallowa Hatchery. Incubation and early rearing of fish takes place at the Irrigon Hatchery, before they are returned to Wallowa River or Big Canyon sites for release (Sampson 1998).

Broodstock origin and history

Year founded: The Wallowa Hatchery broodstock was founded by adults collected at Ice Harbor Dam in 1976, and at Little Goose Dam from 1977-78. After 1980, Snake River, Oxbow, Pahsimeroi, and Skamania hatchery fish were sometimes used as well (USFWS 1998). These sources are unlikely to contain many fish originating from the Grande Ronde River system (USFWS 1998). Currently, summer steelhead from the Imnaha River are also reared at the Wallowa Hatchery, but the two stocks are not mixed and the Imnaha River summer steelhead are released back in the Imnaha River. The Wallowa Hatchery was constructed in 1920 as a resident trout rearing facility. The current program began in 1976 (USFWS 1998).

Source: See above.

Broodstock size/natural population size: The broodstock was founded on collections of 35-50 females/year for 4 years. At the Wallowa Hatchery, broodstock size has ranged from 85 to over 500 females (USFWS 1998). The spawning escapement in Deer Creek (one of the adult collection sites) ranged from ~25 to ~250 adults from 1987 to 1997, and ranged from 0% to 99% hatchery-origin fish over the same time period (USFWS 1998).

Subsequent events: N/A.

Recent events: In the future, the goal of the program may change to emphasize conservation instead of production (USFWS 1998). If this happens, it is likely that the non-local broodstock would be replaced (USFWS 1998).

Relationship to current natural population: No natural fish are used for broodstock. See Deer Creek information above. Some straying into natural spawning areas throughout the Grande Ronde basin occurs but is not well quantified (USFWS 1998).

Current program goals: The Wallowa Hatchery steelhead program is part of the Lower Snake River Compensation Plan. The primary goal of this program is mitigation for Lower Snake River hydro projects. Current goals are to collect 2.3 million eggs for transfer to Irrigon Hatchery, then acclimate 612,000 smolts from the Irrigon facility for release from the Wallowa Hatchery and 375,000 Irrigon smolts for release from the Big Canyon facility (ODFW 2002). In 1999, the program was reduced to a total release of 870,000 smolts.

Population genetics: This hatchery stocks show an intermediate relationship to other Snake River steelhead populations, consistent with its mixed origin(Paul Moran, NMFS, pers. commun., Waples et al. 1993).

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1997) did not identify this stock as a part of the Snake River steelhead ESU.

Category and rationale: Category 3c. The stock was derived primarily from a mixture populations that all are considered part of the Snake River steelhead ESU. Since its founding, the stock has incorporated few wild fish, and is not associated with any particular natural population. It is released in watersheds that contain native natural populations.

Stock name: *Cottonwood Acclimation Pond summer steelhead (Wallowa stock derivative).*

Hatchery/collection site: A satellite of Lyon's Ferry Hatchery, the Cottonwood Pond is located on the Grande Ronde River (near Asotin) and operated by the Washington Department of Fish and Wildlife.

Broodstock origin and history

Year founded: 1984.

Source: The program was founded with Wallowa stock (see above).

Broodstock size/natural population size: Data not available.

Subsequent events: N/A.

Recent events: Data not available.

Relationship to current natural population: Because hybridization with Wallowa Hatchery fish is likely (since 1983), the Grand Ronde River naturally spawning stock has been categorized as being of "mixed" heritage (having a non-native component) (WDFW et al. 1993). The current Cottonwood Ponds hatchery escapement has been self supporting for several years. It is unknown to what degree local indigenous populations have been incorporated into the broodstock or vice versa.

Current program goals: 200,000 smolts from eggs collected at Cottonwood, reared at Lyon's Ferry Hatchery, and returned to Cottonwood Pond from final acclimation and release.

Population genetics: Samples from three different return years indicated considerable temporal variability relative to most other Grande Ronde and Imnaha populations (Paul Moran, NMFS, pers. commun.).

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1997) did not identify this stock as part of the Snake River Steelhead ESU.

Category and rationale: Category 3c. This stock was derived from a mixture of several population, all of which are considered part of the Snake River steelhead ESU. Until the relationship between the stock and the natural population in the watershed is better understood, we believe a category 3c designation is appropriate.

Stock name: *Imnaha River Hatchery summer steelhead, (ODFW stock # 29).*

Hatchery/collection site: Broodstock are collected at a weir on Little Sheep Creek. Eggs are eyed at Wallow Hatchery, hatched and reared at Irrigon Hatchery, and acclimated and released in Little Sheep Creek.

Broodstock origin and history

Year founded: Collection facilities have existed since 1982, with permanent facilities constructed in 1988. Little Sheep Creek is operated as a satellite of the Wallowa Hatchery.

Source: The stock was founded from fish returning to the Little Sheep Creek Weir in the Imnaha River subbasin (USFWS 1998).

Broodstock size/natural population size: From 1985 to 1997, over 90% of the return to the weir has been hatchery origin. Total escapements above the weir have ranged from <100 to nearly 2,000 fish over the same time period (USFWS 1998).

Subsequent events:

Recent events:

Relationship to current natural population: From 1987 to 1997, 81%-97% of the broodstock, and most of the escapement into Little Sheep Creek has been of hatchery origin (USFWS 1998).

Current program goals: This program operates as part of the Lower Snake River Compensation Plan, whose purpose is to mitigate for the Lower Snake River hydro projects (USFWS 1998). The specific release goal is 330,000 smolts (USFWS 1998).

Population genetics: Genetic analysis indicates that the hatchery stock is very similar to the naturally produced ("wild") population (Waples et al. 1993, Paul Moran, NMFS, pers. commun.).

Morphology/behavior/fitness: Hatchery-origin fish exhibit a significantly lower reproductive success rate than natural-origin spawners, but it is unknown whether or not this difference is genetic or environmental in origin (Paul Moran, NMFS, pers. commun.).

Previous determinations: NMFS (1997) considered this stock to be part of the Snake River steelhead ESU, but not essential for recovery.

Category and rationale: Category 2a. This stock was derived from the local, natural population that inhabits its basin of release. However, since its founding, a relatively small proportion of the broodstock has consisted of natural-origin fish. Genetic analysis suggests that the stock may not be as successful at spawning in the wild as the local wild population.

Stock name: *Oxbow Hatchery summer-run A steelhead (IPC, IDF&G).*

Hatchery/collection site: Adult fish are trapped at the Hell's Canyon Dam ladder, held over winter until mature, and then spawned in the spring. After eyeing, eggs, and in some cases, buttoned up fry, are transported to Niagara Springs for rearing. Oxbow Hatchery is located 44.8 Km above Hells Canyon Dam.

Broodstock origin and history

Year founded: The Oxbow Hatchery began operating in 1966 to mitigate for fishery losses caused by Idaho Power Company's dams on the Snake River. The hatchery is used mainly for trapping and holding sufficient numbers of returning adult steelhead and spring chinook to fulfill Idaho Power Company's anadromous fish mitigation requirements (Hutchison 1993, Delarm and Smith 1990b). From 1966 - 1970, all of the steelhead eggs taken at Hells Canyon were released at Pahsimeroi Hatchery. In the 1970's, all of the "Oxbow" stock was propagated at Pahsimeroi. In the 1980, releases began again at Oxbow from eggs taken at Pahsimeroi. In other words, the Pahsimeroi stock founded at Oxbow, moved to Pahsimeroi, and then transferred back (Herb Pollard, NMFS, pers. commun. March 27, 2003). Note that the Wallowa and Lyons Ferry stocks were both founded in the 1970's during at time when most hatchery fish returning to the Snake River were of Pahsimeroi stock. All four of these stocks -- Oxbow, Pahsimeroi, Wallowa and Lyons Ferry -- are expected to be fairly similar, although in each case some local wild fish may have also been included in the broodstock.
Source: Returns to Hell's Canyon Dam provide the current source. Anadromous runs were eliminated from the Boise and Burnt Rivers around 1900, and from the Payette River by 1934. Only the Weiser and Powder Rivers had steelhead production by 1958. When the Oxbow Hatchery collection began, the majority of the steelhead production was in Pine and Wildhorse Creeks (although it is not known how many of the returning adults in these creeks were the descendants of refugees from the other systems).

Broodstock size/natural population size: With the loss of anadromous passage, there is no naturally spawning counterpart to this stock. This broodstock may, therefore, be one of the few remaining genetic reserves of populations that once existed above Hell's Canyon Dam.

Subsequent events:

Recent events: Through the fall of 2002, there were 637 cumulative steelhead returns to the Oxbow/Hell's Canyon ladder (IDF&G 2003).

Relationship to current natural population: Between 1987 to 1997, 22,270 steelhead were trapped at the Oxbow trap. Of the total trapped, 289 were unmarked and thought to be naturally produced strays from other Snake River populations. The natural populations from which this stock was derived all had spawning areas that are no longer accessible to anadromous fish.

Current program goals: Data not available.

Population genetics: Data not available.

Morphology/behavior/fitness: Data not available.

Previous determinations: NMFS (1997) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 3c. This stock was derived from a mixture of populations that are part of the Snake River steelhead ESU. It has received few natural-origin fish into the broodstock since its founding, and is no longer associated with any particular natural populations. The status of natural populations in the areas in which the stock is released is uncertain; if native natural populations exist in these areas, it seems likely that the hatchery stock will be substantially diverged from them.

Stock name: *Sawtooth Hatchery summer steelhead stock (IDF&G).*

Hatchery/collection site: The Sawtooth Hatchery is located on the Upper Salmon River, Idaho. Rearing primarily occurs at the Hagerman NFH.

Broodstock origin and history

Year founded: The hatchery was constructed in 1985 as part of the Lower Snake River Compensation Program (LSRCP).

Source: Adult steelhead are trapped at the Sawtooth Hatchery site and a collection station on the East Fork Salmon River. The original broodstock was mainly derived from Pahsimeroi stock (A-strain) that were released into the river during the 1970s and 1980s (Mealey 1997). Since the late 1980s, the Sawtooth Hatchery has been self supporting relative to egg take needs.

Broodstock size/natural population size: Historically, few steelhead returned to the Upper Salmon River, where the hatchery is located (Herb Pollard, NMFS, pers. commun.). In recent years, the number of natural fish returning to the area has typically been less than 100. From 1992 to 2002, natural returns ranged from 4 to 95, and averaged 22 fish. Hatchery returns ranged from 500 to 7000, averaging ~1700 (Sawtooth HGMP, 2003).

Subsequent events:

Recent events:

Relationship to current natural population: Naturally spawned fish are released upstream to spawn (Hutchison 1993). From 1985 through 1997, there were 14,196 steelhead trapped. Of the total trapped, only 4% were naturally produced (Bowles 1997). During the first year of adult trapping operations, only 8% of the adults were from naturally spawning adults (Bowles 1997).

Current program goals: The hatchery was designed to incubate 4.5 million steelhead eggs for hatcheries in the Hagerman Valley. Eggs are incubated, shipped to rearing facilities, and then returned (as smolts) to the Sawtooth and East Fork Salmon River sites for releases. Excess fry have been planted directly into Salmon River tributaries (Delarm and Smith 1990b). Approximately 500,000 eggs are placed annually in egg boxes for planting in the Upper Salmon River.

Population genetics: No data available. There is an IDF&G/USGS study in progress.

Morphology/behavior/fitness: No data available.

Previous determinations: NMFS (1997) did not identify this stock as being part of the Snake River steelhead ESU.

Category and rationale: Category 3c. This stock was derived from a mixture of populations, all of which are part of the Snake River steelhead ESU. The stock has used very few natural-origin fish of its history. The status of natural populations in the areas in which the stock is released is uncertain; if native natural populations exist in these areas, it seems likely that the hatchery stock will be substantially diverged from them.

Stock name: *Pahsimeroi Hatchery summer steelhead stock (IDF&G, IPC).*

Hatchery/collection site: Pahsimeroi Fish Hatchery, located near the town of Ellis, Idaho, is 1 mile upstream of the confluence of the Pahsimeroi and Salmon Rivers. The facility traps adult steelhead in February to late April, incubates the eggs to the eyed stage, and then transfers them to Niagara Springs for hatching and rearing.

Broodstock origin and history

Year founded: The Pahsimeroi Hatchery broodstock was originally developed from fish collected at Hell's Canyon Dam between 1966 and 1970 and released in the Salmon River Basin. In 1957, Brownlee Dam was completed, and from that point on the steelhead populations spawning in tributaries above the reservoir were probably substantially depressed. Therefore, by 1966, the bulk of the remaining steelhead runs were probably located in Pine Creek and Indian Creek, just below the Oxbow Dam site, and Wildhorse River, just below Brownlee Dam (H. Pollard, NMFS, pers. comm.). Pine Creek and Wildhorse River were estimated to have been producing approximately 2,000 adults in the 1960s and are the likely source of the Pahsimeroi founder stock (H. Pollard, NMFS, pers. comm.). These fish mixed with the indigenous Salmon River steelhead to produce the current Pahsimeroi Hatchery broodstock (Busby et al. 1996). The Pahsimeroi Hatchery was constructed in 1967 to mitigate for Snake River Dams. Hatchery collections were probably strongly influenced by releases of Oxbow Hatchery fish from adults collected at Hell's Canyon Dam that began in 1967. Refer to notes on the Oxbow Hatchery for further details.

Source: Mainstem Snake River and an unknown number of Salmon River fish.

Broodstock size/natural population size: As early as 1969, only 6% of the steelhead trapped at the Pahsimeroi Hatchery were believed to be of natural origin (Bowles 1997). However, during the early years, released fish were not marked and the return rate was rather poor, so the proportion of naturally produced steelhead incorporated may have been higher. From 1974 to 1983, Dworshak NFH B-run summer steelhead were also released from the hatchery. It is possible that there was some mixing of the two stocks. A and B-run steelhead were often separated according to female length. According to IDF&G (2003), a counting weir has recently been put in place.

Subsequent events: Excess eggs are supplied to other basin hatcheries, including Niagara Springs, Magic Valley, and Hagerman NFH.

Recent events: In recent years, unmarked fish are passed upstream of the hatchery weir for natural spawning. Only fish of hatchery origin are used for broodstock (Hutchison 1993). Prior to 1989, the number of hatchery-derived adults passed above the weir frequently outnumbered the number of naturally spawning adults (Bowles 1997).

Relationship to current natural population: In recent years, wild fish are passed upstream for natural spawning, and only hatchery-origin fish are used for broodstock (Hutchison 1993). From

1985-1997, there were 30,409 steelhead trapped at this facility, of which 1,233 (4%) were naturally produced (Bowles 1997).

Current program goals: The hatchery was constructed in 1967 by Idaho Power Company (IPC), which owns and funds the hatchery. Hatchery operations and management is the responsibility of the IDF&G. The summer chinook and summer steelhead programs are IPC's mitigation obligation under the Federal Energy Regulatory Commission (FERC) for anadromous fish losses caused by the construction and operation of the Hell's Canyon Complex (Brownlee, Oxbow, and Hell's Canyon Dams) on the Snake River. One of the original program goals was to relocate dam-blocked Snake River steelhead to the Salmon River drainage (Hutchison 1993). The current program's operations trap adult steelhead and produce 2.0 million steelhead eggs, incubate to the eyed stage, and transport eyed eggs to Niagara Springs Hatchery for rearing to smolt size.

Population genetics: Based on limited samples, the stock is genetically similar to Indian Creek and Lower Hat Creek populations. There is also some affinity to Lyon's Ferry Hatchery steelhead (Waples et al. unpubl.).

Morphology/behavior/fitness: No data available.

Previous determinations: NMFS (1997) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 3c. This stock was derived from a mixture of populations, all of which are part of the Snake River ESU. The stock has incorporated very few natural-origin fish since its time of founding. The status of natural populations in the areas in which the stock is released is uncertain; if native natural populations exist in these areas, it seems likely that the hatchery stock will be substantially diverged from them.

Stock name: *Dworshak NFH summer steelhead (USFWS).*

Hatchery/collection site: North Fork Clearwater River.

Broodstock origin and history

Year founded: The broodstock was developed from native North Fork Clearwater River B-strain steelhead stock. The Dworshak NFH began operation in 1969 to mitigate the loss of spawning habitat caused by dams in the Clearwater River Basin and to provide eggs for other LSRCP hatcheries in Idaho (Shelldrake 1993).

Source: Wild B-strain steelhead were collected in the late 1960s at the base of Dworshak Dam on the North Fork Clearwater River.

Broodstock size/natural population size: The total return to Dworshak NFH in the 2002/03 return year was 7,797 steelhead. Of these, 990 females and 888 males were spawned. Over 3,119 excess fish were returned to the river for the sport fishery. A total of 2.6 million eyed eggs were produced for Dworshak NFH. This will result in a release of approximately 2.15 million smolts in the spring of 2003 (Source USFWS web site: http://dworshak.fws.gov/spawning/).

Subsequent events:

Recent events:

Relationship to current natural population: The North Fork Clearwater is no longer accessible to anadromous migration. Dworshak Hatchery steelhead are the last genetic reserve of North Fork Clearwater steelhead. Adults are captured throughout the run from February to May. Some eggs are shipped for incubation and rearing to the Hagerman NFH, Clearwater, and Magic Valley IDF&G hatcheries, and Kooskia NFH. Currently, all unmarked fish are returned to the river, only hatchery-origin fish are used for broodstock.

Current program goals: Mitigation for the Dworshak Dam.

Population genetics: Based on allozyme analysis, this is one of the most distinctive Snake River steelhead populations (Waples et al. 1993). Analysis of a number of natural populations outplanted with Dworshak Hatchery steelhead or suspected of being affected by Dworshak strays has found little or no evidence for genetic introgression (Robin Waples, NMFS, pers. commun.). Dworshak steelhead genetically resemble North Fork Clearwater River resident/residual rainbow trout above Dworshak Dam.

Morphology/behavior/fitness: No data comparing natural and hatchery fish of this stock is available. The stock has suffered low survivals due to IHN virus.

Previous determinations: NMFS (1997) considered this stock to be part of the ESU, but not essential for recovery. The USFWS (2003) considers this to be a Category 2 stock.

Category and rationale: Category 2a. This stock was collected from a natural population (or possibly a mixture of populations) that is part of the Snake River steelhead ESU. The stock has been in hatchery culture since 1969 with few to no introductions of wild fish into the broodstock over that time. The stock is no longer associated with any particular natural spawning population.

Stock name: *Lyon's Ferry Hatchery summer steelhead stock (WDFW).*

Hatchery/collection site: Lyon's Ferry Hatchery, on Snake River.

Broodstock origin and history

Year founded: The Lyons Ferry Hatchery was constructed in 1982 as part of the LSRCP. Releases began in 1983.

Source: The program was founded with Wallowa Hatchery steelhead. This hatchery also has released considerable numbers of fish from Skamania, Wells, Wallowa, Pahsimeroi, and Lyon's Ferry hatchery steelhead stocks.

Broodstock size/natural population size: In the Tucannon River, where many of the releases occur, natural escapements have ranged from 71 to 525 adults in the period from 1988 to 1999 (Lyon's Ferry HGMP Section 2.2.2).

Subsequent events: Returning adults are currently used to provided gametes. Additional eggs are obtained from the Wallowa Hatchery (ODFW) to make up shortfalls. Wells Hatchery stock and Pahsimeroi Hatchery stock have also been incorporated in some years.

Recent events: Due to concerns about the status of the endemic Tucannon River steelhead population, a local Tucannon stock was developed in 2000.

Relationship to current natural population: Hatchery-origin fish typically make up more than 50% of the spawning escapement in the Tucannon River (Lyon's Ferry HGMP Section 2.2.2).

Current program goals: Steelhead smolts are planted into various Southwest Washington streams as mitigation under the LSRCP.

Population genetics: Waples et al. (1993) examined allozyme variation among samples of Snake River steelhead, including natural-origin fish from the Tucannon River and samples from the Lyon's Ferry stock. They found that despite decades of outplanting of the Lyon's Ferry stock into the Tucannon River, the natural fish samples remained genetically distinct from the Lyon's Ferry stock.

Morphology/behavior/fitness: No data available.

Previous determinations: NMFS (1997) did not identify this stock as a part of the Snake River steelhead ESU. The USFWS (2003) believes that the stock should be considered a category 3.

Category and rationale: Category 3c or 4. The history of this stock is complex, and includes introductions from a stock (Wells Hatchery) that is not part of the Snake River steelhead ESU, as well as frequent introductions of Wallowa and Pahsimeroi stocks, which are not native to the areas in which the stock is released. Allozyme data from 1990 indicate that, at that time, the stock clustered genetically with other Snake River steelhead stocks (Waples et al. 1993).

Stock name: *Tucannon Hatchery (WDFW) Tucannon River summer steelhead.*

Hatchery/collection site: Lyon's Ferry Hatchery, Snake River in Franklin County, Washington (RM 58); Tucannon Hatchery, RM 36 on the Tucannon River (WRIA 35); temporary adult trap, RM 11 on the Tucannon River (WRIA 35); and permanent adult trap, RM 36.5 on the Tucannon River (WRIA 35).

Broodstock origin and history.

Year founded: According to the Lyon's Ferry HGMP (Section 6.2), mitigation production releases into the Tucannon River began in 1983. Broodstock origin was from the Wells Hatchery (Upper Columbia) and/or the Wallowa Hatchery (Snake River) programs through 1986. Beginning in 1987, a newly developing Lyon's Ferry Hatchery stock was used as the primary source for releases. Lyon's Ferry Hatchery stock was built from adult returns of Wells and Wallowa-origin releases at the hatchery. Lyon's Ferry Hatchery suffered a complete loss of the broodyear 1989 production because of IHNV. This caused the release of Idaho-origin (Pahsimeroi Hatchery) steelhead in 1990. From 1991 to 1999, only Lyon's Ferry Hatchery-origin broodstock were used for Tucannon River releases. Starting in broodyear 2000, a new broodstock was developed that consisted entirely of endemic, naturally reared fish.

Source: The current program will use 40 pairs of naturally produced steelhead collected from the Tucannon River (HGMP Section 6.1).

Subsequent events: N/A.

Recent events: N/A.

Relationship to current natural population: The proposed program is to use 40 pairs of steelhead for broodstock. This number is between 15% and 112% of the estimated natural fish escaping to spawn in the Tucannon since 1989. The collection is targeted to produce a viable yearly release group of artificially propagated, appropriate Tucannon River steelhead smolts without jeopardizing natural production (Lyon's Ferry HGMP).

Estimated natural and hatchery adult steelhead escapement into the Tucannon River, according to Section 2.2.2 of the HGMP for Lyon's Ferry Complex (Lyon's Ferry Hatchery and Tucannon Hatchery [submitted by WDFW 29 September 2000]) .

Year	Natural	Hatchery
1988	525	787
1989	319	388
1990	416	343
1991	210	256
1992	166	513
1993	94	475
1994	151	96
1995	147	230
1996	71	322
1997	no data	no data
1998	no data	no data
1999	85	340

Current program goals: According to Section 1.7 of the HGMP for Lyon's Ferry Complex (Lyon's Ferry Hatchery and Tucannon Hatchery [submitted by WDFW 29 September 2000]), the current program goals are:

1. **Conservation:** Artificially maintain and/or increase numbers of naturally reproducing Tucannon River steelhead that successfully produce viable progeny, which contribute to the conservation and recovery of the Tucannon River population and Snake River ESU.
2. **Mitigation:** Provide mitigation under the LSRCP for losses to Tucannon River steelhead due to construction of Snake River dams while meeting conservation and recovery criteria established for the Tucannon River population and Snake River ESU. Provide harvest opportunities established under *US v Oregon* for tribal and recreational fisheries.

Population genetics: According to the HGMP (Section 6.2.1), broodstock collected in 1999-2000 were taken at random from the indigenous population, so no direct or unintentional selection is believed to have occurred. DNA samples from the broodstock collected in 2000 and from juvenile populations throughout the basin are to serve as a baseline to measure potential future genetic changes. See Lyon's Ferry stock for additional discussion of genetic data from the Tucannon River.

Morphology/behavior/fitness: Data not available.

Category and rationale: Category 1a. This stock was recently founded from the local, natural population in the area in which it is released.

Stock name: *East Fork Salmon River steelhead stock (IDF&G).*

Hatchery/collection site:

From the HMGP:
Sawtooth Fish Hatchery – The Sawtooth Fish Hatchery is located on the Upper Salmon River approximately 8.0 km south of Stanley, Idaho. The RKm code for the facility is 503.303.617. The hydrologic unit code for the facility is 17060201.

East Fork Salmon River Satellite – The East Fork Salmon River Satellite is located on the East Fork Salmon River approximately 29 km upstream of the confluence of the East Fork with the main stem Salmon River. The RKm code for the facility is 522.303.552.029. The hydrologic unit code for the facility is 17060201.

Magic Valley Fish Hatchery – The Magic Valley Fish Hatchery is located adjacent to the Snake River approximately 11.2 km northwest of Filer, Idaho. There is no river kilometer code for the facility. The hydrologic unit code for the facility is 17040212.

Broodstock origin and history

Year founded: 2001.

Source: Broodstock fish for this stock were first collected as wild fish at the East Fork Salmon River weir in 2001 and 2002.

Broodstock size/natural population size: The number of natural fish caught in the East Fork Salmon River trap has ranged from two to 45 from 1985 to 2002 (HGMP). Broodstock levels are provided below.

Past and proposed level of natural fish in broodstock (From the HGMP, Section 6.2.3).

East Fork Salmon River weir information.

Return Year	No. of unmarked female steelhead trapped	No. of unmarked female steelhead spawned	No. of unmarked male steelhead trapped	No. of unmarked male steelhead spawned
2000	4	0	2	0
2001	8	3	3	3*
2002	19	10	8	8*

Subsequent events: N/A.

Recent events: N/A.

Relationship to current natural population: The current broodstock consists only of natural-origin fish.

Current program goals: Supplementation and supplementation research (HGMP).

Population genetics: Data not available.

Morphology/behavior/fitness: No data available.

Previous determinations: N/A.

Category and rationale: Category 1a. This stock is still in the process of being founded from a native, natural population.

INTERIOR COLUMBIA RIVER BASIN RECOVERY DOMAIN-CHINOOK SALMON

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 were 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 spring-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 Leavenworth, Entiat, and Winthrop NFHs, and transplanted into the Wenatchee, Methow, and Entiat Rivers (Fish and Hanavan 1948). Furthermore, a number of spring-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 substantially homogenized within-ESU diversity. Recent genetic analysis (Utter et al. 1995, Myers et al. 1998, Campton 2000) indicates that genetic differences exist among populations in this ESU. Most or perhaps all of these differences have presumably arisen during the last 60 years and may be important to the viability of the ESU (Ford et al. 2000).

Five hatcheries release spring chinook salmon within or near the boundaries of the Upper Columbia River ESU: Leavenworth, Entiat, and Winthrop NFHs, the Eastbank Hatchery and associated rearing collection and acclimation sites, and Methow State Fish Hatchery and associated collection, rearing and acclimation sites.

Stock name: *Leavenworth NFH spring chinook salmon.*

Hatchery/collection site: Leavenworth NFH on Icicle Creek, a tributary of the Wenatchee River at river kilometer 42.

Broodstock origin and history

Year founded: First releases occurred in 1941.

Source: From 1941-1944, broodstock was primarily from fish collected at Rock Island Dam as part of the GCFMP. In 1942, ~200,000 fish from the McKenzie River were also released. Between 1944 and 1971, releases only occurred sporadically, particularly in 1948 when ~800,000 subyearling progeny of fish returning to Icicle Creek were released, and in 1967 and 1968 when ~300,000 yearlings of Clackamas River-origin(Eagle Creek NFH) were released. From 1971 to 1993, production consisted of large-scale releases (1 million or more yearlings annually) of stock transferred primarily from Carson and Wind River NFHs, as well as returns to Icicle Creek. Since 1994, the broodstock has been comprised entirely of returns to Icicle Creek. (Data sources: NRC 1996, Mullan et al. 1992, Chapman et al. 1995, Cooper et al. 2002).

Broodstock size/natural population size: Since 1980, adult returns to Leavenworth NFH have ranged from ~500 to ~7,000 (Cooper et al. 2002). In 2000 and 2001, 975 and 859 fish were spawned, respectively. Little natural production occurs in Icicle Creek (Mullan et al. 1992); natural run sizes of spring chinook salmon to the Upper Wenatchee River have ranged from less than 100 to greater than 6,000.

Subsequent events: None.

Recent events: In 2001, 487 Leavenworth NFH adults were planted into Peshastin Creek to spawn naturally.

Relationship to current natural population: Few Leavenworth NFH tags have been recovered in the primary natural spawning areas of the Wenatchee River (Ford et al. 2001). Since 1971, the broodstock has consisted of either stock transfers from other hatcheries (primarily Carson stock) and returns to Icicle Creek. The proportion of the naturally produced Wenatchee River fish in the broodstock has probably been zero.

Current program goals: The current program calls for an annual release of 1.6 million spring chinook yearlings. The program is primarily aimed at providing mitigation for production lost to hydropower projects.

Population genetics: Genetic studies of interior Columbia River stream-type chinook salmon have generally found relatively low levels of genetic differentiation among populations (Mathews and Waples 1991, Utter et al. 1995, Myers et al. 1998). In studies based on samples from the late 1980s and early 1990s, samples from Leavenworth, Entiat, and Carson NFHs were nearly indistinguishable from each other, but significantly different from natural population samples from the Wenatchee and Methow River Basins (Marshall 1994, cited in Waknitz et al. 1995, Utter et al. 1995, Campton 2000). This pattern of variation has been interpreted as evidence that Carson-origin stocks have not contributed significantly to natural production in these tributaries (NMFS 1999, Campton 2000).

Previous determinations: In previous comments, WDFW and USFWS did not consider this broodstock to be part of the ESU (Crawford 1998, Hillwig 1998). In the 1999 listing determination, the NMFS did not consider Leavenworth NFH stock to be a part of the Upper Columbia River spring chinook salmon ESU (NMFS 1999).

Category and rationale: Category 3c or 4. Both the broodstock history and the population genetic data indicate that the Leavenworth NFH stock was derived primarily from Carson NFH-origin stocks. Based on the location of broodstock collection, the Carson NFH stock was derived from a mixture of what are now considered to be several ESUs (see Carson NFH discussion below). Genetically, the Carson-derived stocks have allele frequencies intermediate between those typical of Snake and Upper Columbia River populations (Campton and Marshall 2000).

Stock name: *Entiat NFH spring chinook salmon.*

Hatchery/collection site: Entiat NFH, on the Entiat River at river kilometer 10.

Broodstock origin and history

Year founded: First releases occurred in 1941.

Source: Releases in 1941, 1942, and 1943 all originated from collections at Rock Island Dam as part of the GCFMP. After 1943, no releases of spring chinook occurred until 1973, 1975, and 1976, when stock was imported from the Klickitat and Cowlitz Rivers. From 1977 until 1992, releases consisted primarily of stock imported from Carson, Leavenworth, and Winthrop NFHs and returns to the Entiat NFH. From 1995 to the present, only volunteers to the Entiat NFH rack have been used for broodstock, (Data sources: NRC 1995; Mullan et al. 1992; Chapman et al. 1995; Cooper et al. 2002).

Broodstock size/natural population size: In 2000 and 2001, 402 and 304 fish were used for broodstock, respectively. Total hatchery returns to the Entiat River in those years were 1,919 and 2,666, respectively (Cooper et al. 2002). Redd counts in the RKm 33.6 to 44.8 index area have ranged from one to 326 redds since 1962. Typical counts ranged between 100 and 200 (Hamstreet and Carie 2002). In 2001, total abundance was estimated at 485 naturally spawning adults, based on 144 redd counts in the index area, 58 redd counts outside of the index area, and an assumption of 2.4 spawners/redd (Hamstreet and Carie 2002).

Recent events: The natural population declined dramatically in the mid-1990s. Index area redd counts between 1994 and 2000 were: 24, 1, 8, 20, 15, 6, 28 (Hamstreet and Carie 2002).

Relationship to current natural population: In 2001, 22 out of 100 sampled natural spawners were of hatchery origin as determined by an adipose fin clip and/or scale patterns analysis (data from Matt Cooper, USFWS, pers. commun.).

Current program goals: The current program goal is to release 400,000 yearling spring chinook annually (Cooper et al. 2002).

Population genetics: Several allozyme studies have included samples from Entiat NFH (Waknitz et al. 1995, Utter and Marshall 1995), but did not include samples of naturally produced Entiat River spring chinook. The allozyme studies found that samples from the Entiat NFH were essentially indistinguishable from samples from Carson, Leavenworth, and Winthrop NFHs. Recently, Ford et al. (2002) analyzed microsatellite variation among samples of Entiat River natural spawners, naturally produced Entiat River smolts, and samples from Carson, Entiat, and Winthrop NFHs. They found that the samples of naturally produced salmon were more similar to the Carson-origin stocks than they were to samples of natural spring chinook salmon from the Wenatchee River.

Previous determinations: In previous comments, WDFW and USFWS did not consider this broodstock to be part of the ESU (Crawford 1998, Hillwig 1998). In the 1999 listing determination, the NMFS did not consider Entiat NFH stock to be a part of the Upper Columbia River spring chinook salmon ESU (NMFS 1999).

Category and rationale: Category 4, 3c or 2b. Both the broodstock history and the population genetic data indicate that the Entiat NFH stock was derived primarily from Carson NFH-origin stocks. Based on the location of broodstock collection, the Carson NFH stock was derived from a mixture of what are now considered to be several ESUs (see Carson NFH discussion below). Genetically, the Carson-derived stocks have allele frequencies intermediate between those typical of Snake and Upper Columbia River populations (Campton and Marshall 2000). The broodstock history therefore strongly suggests a category 4 designation (or possibly 3c, if one believes that Upper Columbia River fish made up a majority of the origin Carson collections). However, based on 2 years of data, the natural Entiat River population appears genetically similar to the Entiat NFH population (Ford et al. 2002). This similarity suggests the possibility of a 2b designation.

Stock name: *Winthrop NFH spring-run chinook salmon.*

Hatchery/collection site: Winthrop NFH is located in the town of Winthrop, Washington, on the Methow River at river kilometer 72. Broodstock are collected in various locations, including volunteers to the hatchery trap, Wells Dam, and at WDFW's Methow Fish Hatchery trap.

Broodstock origin and history

Year founded: First releases in 1941.

Source: From 1941 to 1962, broodstock consisted of fish captured at Rock Island Dam during the GCFMP and their descendents returning to the Methow River. Production of spring chinook ceased after 1962, and then resumed using primarily Carson-origin stocks in 1976. Broodstocks consisted of transfers from other hatcheries (primarily Carson NFH and Leavenworth NFH) and returns to Winthrop. No stock transfers have occurred into Winthrop since 1992 (USFWS Winthrop NFH HGMP 2002).

Broodstock size/natural population size: In the years 2000 and 2001, 1,058 and 330 adults were used for broodstock at Winthrop NFH (Cooper et al. 2002). The number of natural spawners in the Methow River system has varied from 0 to >4,000 spawners (Ford et al. 2001).

Recent events: Starting with the 2000 broodyear, the Winthrop stock is being discontinued in favor of the Methow Composite stock (see Methow Fish Hatchery below). The last substantial returns of the Winthrop stock are expected in 2003, only Methow Composite spring-run chinook salmon should return in 2004 (Cooper et al. 2002).

Relationship to current natural population: Spawning ground surveys have found large numbers of Winthrop NFH spring chinook salmon spawning naturally in the Methow River in close proximity to the hatchery facility Scribner et al. 1993.

Current program goals: The current program goal is to release 600,000 yearlings annually as part of a mitigation and supplementation program (NMFS et al. 1998, Cooper et al. 2002).

Population genetics: Genetically, samples of Winthrop NFH spring-run chinook are highly similar to samples from Carson, Leavenworth, and Entiat NFHs (Waknitz et al. 1995, Campton and Marshall 2000, Ford et al. 2002). Campton and Marshall (2000) and Narum et al. (2002) both conducted population genetic analyses designed to provide insight into the relationship between the Winthrop NFH stock and one or more stocks more recently derived from natural Methow River spawners. These studies are discussed in more detail in the descriptions of the Methow Hatchery stocks (see below).

Previous determinations: In previous comments, WDFW and USFWS did not consider this broodstock to be part of the ESU (Crawford 1998, Hillwig 1998). In the 1999 listing determination, the NMFS did not consider the Winthrop NFH stock to be a part of the Upper Columbia River spring chinook salmon ESU (NMFS 1999).

Category and rationale: Category 3c or 4. Both the broodstock history and the population genetic data indicate that the Winthrop NFH stock was derived primarily from Carson NFH-origin stocks. Based on the location of broodstock collection, the Carson NFH stock was derived from a mixture of what are now considered to be several ESUs (see Carson NFH discussion below). Genetically, the Carson-derived stocks have allele frequencies intermediate between those typical of Snake and Upper Columbia River populations and different from the native Methow River populations (Campton and Marshall 2000). The USFWS has been phasing out this stock in favor of the Methow Composite stock (see below), starting with the 2000 broodyear.

Stock name: *Chiwawa River spring-run chinook salmon.*

Hatchery/collection site: Broodstock are collected at a weir on Chiwawa River, a tributary of the Wenatchee River at river kilometer 78.2. Hatchery adults (identified by an adipose fin clip) are also collected at Tumwater Dam at river kilometer 53 on the Wenatchee River.

Broodstock origin and history

Year founded: 1989.

Source: Adult broodstock fish 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 been 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).

Broodstock size/natural population size:

Recent events: Chiwawa Hatchery fish have been found spawning in relatively high numbers in Nason Creek and other parts of the Upper Wenatchee watershed, possibly due to migration inhibition caused by the Chiwawa weir (Ford et al. 2001). The water source for winter rearing at the Chiwawa Ponds is from the Wenatchee River. The water intake is located below the confluence with Nason Creek, and rearing on this water source may also contribute to the high rates of Chiwawa program fish spawning in Nason Creek.

Relationship to current natural population: The program is designed to supplement the natural population.

Current program goals: The primary objective of the program is to rebuild the natural populations in the Wenatchee River. The secondary objective of the program is to release 672,000 yearlings annually as mitigation for mortality caused by Mid-Columbia hydropower projects (NMFS et al. 1998).

Population genetics: The Chiwawa River stock has allozyme frequencies typical of Upper Columbia River spring chinook samples (Waknitz et al. 1995, Utter and Marshall 1995, Myers et al. 1998, Campton and Marshall 2000). The Chiwawa River samples are significantly different from samples from Leavenworth NFH, which releases a Carson NFH-derived stock into the Icicle Creek (see Leavenworth NFH description above).

Previous determinations: WDFW and USFWS consider this stock to be in the ESU and essential for recovery (Crawford 1998, Hillwig 1998) and NMFS (1999) considered the stock to be in the ESU and essential for recovery.

Category and rationale: Category 1a. The stock was recently founded from a natural population that is considered part of the ESU. The hatchery began broodstock collections in 1989, and until 1995, used only natural-origin fish for broodstock.

Stock names: *Twisp, Chewuch, Methow, and Methow Composite spring-run chinook salmon.*

Hatchery/collection site: Collections have been made at traps in the Twisp and Chewuch Rivers, at Wells Dam, and from volunteers entering the Methow and Winthrop hatcheries (Bartlett and Bugert 1994, Bartlett 1996, 1997, 1998, 2001; Jateff 2001; Scribner et al. 1993).

Broodstock origin and history

Year founded: Broodstock collection began at the Twisp and Chewuch traps in 1992, and in the Methow Hatchery outfall in 1993.

Source: The Chewuch and Twisp stocks were founded in 1992-1994 from wild salmon trapped in the Chewuch and Twisp Rivers. The Methow stock was founded by collections at the Methow Hatchery outfall. Based on scale analyses, the Methow broodstock in 1993 and 1994 consisted of mostly or entirely hatchery-origin fish, presumably from Winthrop NFH. Methow Fish Hatchery records also indicate that 40,000 fingerlings (53/lb) were received on July 2, 1992 from Winthrop NFH for testing of the new Methow Hatchery. The transferred fish were reared to 9 fish/lb, and the surviving 22,559 were released at the hatchery site in April of 1993 (personal communication from Guy Weist, Methow Fish Hatchery manager to Kristine Peterson, NMFS, on March 13, 2002). In 1996, all spring chinook were captured at Wells Dam. Wild fish were assigned to broodstocks based on microelement analysis of scales while hatchery fish were assigned based on coded wire tags (Bartlett 1998).

Broodstock size/natural population size: Broodstock sizes from 1992 to 1995 were typically less than 100 for each stock. From 1987 to 1993, the number of natural spawners in the Methow River Basin ranged from ~700 to ~1,700 (Scribner et al. 1993). In 1995, only ~60 spring chinook returned to the Methow River Basin, and only 12 were collected for broodstock. In 1996 and 1998, all returning spring chinook were captured at Wells Dam and spawned in Methow and Winthrop hatcheries (Bartlett and Bugert 1994, Scribner et al. 1993, Bartlett 1996, 1997, 1998, 2000, 2001).

Recent events: Beginning in 1998, the Chewuch and Methow stocks were merged to form the Methow Composite stock (Bartlett 2001).

Relationship to current natural population: The Twisp and Chewuch stocks were founded in 1992–1994 and 1996 from natural population samples. The Methow stock, founded in 1993-1995, was based largely on hatchery–origin (presumably Winthrop NFH) fish, and in 1996, on wild fish captured at Wells Dam. All three stocks are intended as supplementation stocks to help rebuild the natural Methow River populations.

Population genetics: Campton and Marshall (2000) have provided the most complete analysis of the available allozyme data for Methow River samples. Narum et al. (2002) have recently reported on a study of microsatellite variation in several samples of the Methow Composite and Winthrop NFH stocks.

Campton and Marshall (2000) analyzed Twisp and Chewuch River samples from 1992, 1993, 1994, and 1996; Methow River samples from 1993, 1994, and 1996; Methow Composite stock samples from 1998; Winthrop NFH samples from 1992; Leavenworth NFH samples from 1991; and Carson NFH samples from 1989. Based on scale analyses, most of the 1993 and 1994 Methow River samples were hatchery-produced fish, presumably from Winthrop NFH. For context, they also included samples of natural spawners from the Wenatchee River and several samples from the Snake River. Like previous analysis (Waples and Mathews 1991, Waknitz et al. 1995, Utter and Marshall 1995, Myers et al. 1998), they found that overall levels of genetic differentiation among all of the stream-type samples to be low, although the Snake River samples were clearly differentiated from the Upper Columbia River samples. Within this context of low variation, they found small but consistent differences in allele frequencies between the Carson-origin samples (including the 1993 and 1994 Methow River samples) and the Twisp, Chewuch and natural-origin Methow River samples. The 1998 Methow Composite stock sample was more similar to the natural population samples than to the Carson stock samples. Campton and Marshall concluded that the Methow Rivers stocks were not homogenous and that the Winthrop NFH stock remained more similar to Carson NFH than to naturally produced Methow Basin salmon.

Narum et al. (2002) examined microsatellite DNA variation in samples from Methow Composite broodstock taken from adults in 1998 and 2000 at the Methow State Fish Hatchery; samples of Methow Composite juveniles in 2001 (progeny of year 2000 adults) at the Methow State Fish Hatchery; samples of Methow Composite juveniles sampled in 2001 (progeny of year 2000 adults) at the Winthrop NFH; and samples of Winthrop (Carson stock) juveniles from Winthrop NFH in 2001 (progeny of year 2000 adults). They found the level of differentiation between the Winthrop NFH (Carson-origin) sample and the Methow Composite stock samples to be less than the level of differentiation among the different Methow Composite stock samples, and concluded that there was no evidence that the stocks were reproductively isolated from each other.

Previous determinations: WDFW and USFWS considered these stocks to be in the ESU and essential for recovery (Crawford 1998, Hillwig 1998). The NFMS (1999) also considered these stocks to be part of the ESU.

Categories and Rationale: Twisp and Chewuch stocks: Category 1a. These stocks were recently founded from natural populations that are considered part of the ESU, and the available population genetic data suggest that they remain (at least as of 1996) genetically differentiated from the Winthrop NFH stock. Since 1998, the Chewuch stock has been combined with the Methow stock to create the Methow Composite stock, and the last Chewuch stock returns were 5 year olds in 2002. Methow stock: Category 3c or 4. The 1993 and 1994 broodcycles of this stock were mostly to entirely derived from the Winthrop NFH stock, as indicated by both the hatchery records and the genetic data of Campton and Marshall. The same data sources indicate that the 1996 broodcycle is more similar to the natural-origin Methow Basin samples (particularly the Chewuch River samples). The 1997 broodyear was composed primarily of broodyear 1993 returns, and hence, also likely to be predominantly of Winthrop NFH origin. Methow Composite stock: Category 2a/c. The Methow Composite stock was created by combining the Chewuch stock (Category 1a) and the Methow stock (Category 3/4). This stock is, therefore, partially derived from recently captured natural-origin salmon and partially from sources that were at least partially derived from populations that are not considered part of the ESU. The Methow Composite stock is in somewhat of a state of flux – as more natural origin fish are incorporated into this stock, it could be recategorized as 1a or possibly 1b, depending on what is believed about the current status of the natural populations.

Stock name: *White River (Wenatchee River Basin) spring-run chinook salmon captive broodstock.*

Hatchery/collection site: Native eggs/alevins are removed from redds in the White River by hydraulic pumping, transported to AquaSeed Inc., Rochester, Washington, and raised to maturity. Second generation eggs are collected from captive broodstock at the AquaSeed site.

Broodstock origin and history

Year founded: 1997.

Source: The brood source for the White River spring-run chinook salmon captive brood program is the population of spring-run chinook salmon spawning in the White River above its confluence with Lake Wenatchee (Utter et al. 1995). Eggs or fry are removed from spawning gravel by hydraulic sampling to provide the captive brood population.

Broodstock size/natural population size: Adult spawning populations of White River spring-run chinook salmon have ranged from two to 158 between 1990 and 2001 and averaged 48 spawners. The protocol for captive brood is to collect approximately 1,000 eyed eggs or pre-emergent fry each year based on a standard sample size of 40 fry from each of 25 redds.

Recent events: Rearing of White River captive brood continues (as is the case with Nason Creek and Twisp River captive brood as well). Mature adults have been spawned, with the largest egg production to date occurring in 2002. Progeny of 2002 brood are now being reared at AquaSeed Inc. and will be released in the White River in 2004 as yearling smolts at approximately 10 to 15 fish per pound. A historical database for the program is being developed but is not yet available.

Relationship to current natural population: The stock consists of fish that are the result of collections of naturally spawned eggs in the White River.

Current program goals: This is a conservation program designed to supplement the natural White River population.

Population genetics: Allozyme analysis indicates that the White River spawning populations is genetically the most differentiated population in the Upper Columbia River spring chinook salmon ESU (Anne Marshal, WDFW, unpublished data, WDF et al. 1993, Ford et al. 2001).

Morphology/behavior/fitness: Captive brood seem to display lower fecundity and younger average age-at-maturity compared to the populations from which they were drawn. Extensive monitoring and evaluation will determine the extent and implications of these and any additional differences (WDFW, unpublished data).

Previous determinations: NMFS (1999) considered this stock to be part of the ESU and essential for recovery.

Category and rationale: Category 1a. This stock was recently founded from a natural population that is part of the ESU.

Stock name: *Nason Creek (Wenatchee) spring-run chinook salmon captive broodstock.*

Hatchery/collection site: Native eggs/alevins are removed from redds in Nason Creek by hydraulic pumping, transported to AquaSeed Inc., Rochester, Washington, and raised to maturity. Second generation eggs are collected from captive broodstock at AquaSeed.

Broodstock origin and history

Year founded: 1998

Source: The brood source for the Nason Creek spring chinook rebuilding program is the population of spring chinook salmon spawning in Nason Creek above its confluence with the Wenatchee River at Rkm 86. Eggs or fry are removed from spawning gravel by hydraulic sampling to provide the captive brood population.

Broodstock size/natural population size: Adult spawning populations of Nason Creek spring chinook salmon have ranged from 15 to 598 between 1990 and 2001 and averaged 190 spawners. The protocol for captive brood is to collect approximately 1,000 eyed eggs or pre-emergent fry each year based on a standard sample size of 40 fry from each of 25 redds.

Subsequent events: The Nason Creek spring chinook program was initiated in a manner equivalent to that described for the White River spring chinook (see this section for White River). Average estimated run size between 1990 and 2001 has been 190 adults. Redd counts for the same period have averaged 92, but escapement has been inflated in recent years by adult chinook straying into Nason Creek from the Chiwawa River supplementation program. Stray rates have ranged from approximately 1% to slightly over 50% of the estimated run size into Nason Creek over the past 8 years. Subsequently, co-manager representatives concluded that the Nason Creek population had probably experienced introgression with Chiwawa River spring chinook resulting from straying of Chiwawa River adults into Nason Creek. As a result, the parties agreed to discontinue the Nason Creek captive brood program through attrition of the broodstock on hand.

Recent events: Progeny of 2002 brood are now being reared at AquaSeed Inc. and will be released in Nason Creek in 2004 as yearling smolts at approximately 10 to 15 fish per pound.

Relationship to current natural population: See above.

Current program goals: This is a conservation program designed to supplement the natural population.

Population genetics: Samples from Nason Creek appear genetically similar to other natural Upper Columbia spring chinook samples, especially the Chiwawa River (WDFW, unpublished data, Ford et al. 2001).

Morphology/behavior/fitness: According to WDFW, the captive brood seem to display lower fecundity and younger average age-at-maturity compared to the populations from which they were drawn.

Previous determinations: NMFS (1999) considered this stock to be part of the ESU and essential for recovery.

Category and rationale: Category 1a. This stock was recently founded from a natural population that is part of the ESU.

Stock name: *Twisp River (Methow) spring-run chinook salmon captive broodstock.*

Hatchery/collection site: Native eggs/alevins are removed from redds in the Twisp River by hydraulic pumping or from native (identified by unique CWTs) Twisp River adults spawned at Methow Hatchery. They are reared to maturity at AquaSeed Inc., Rochester, Washington. Second generation eggs are collected from captive broodstock at AquaSeed.

Broodstock origin and history

Year founded: 1996.
Source: The brood source for the Twisp River spring chinook rebuilding program is the native population of spring chinook salmon spawning in the Twisp River above its confluence with the Methow River.

Broodstock size/natural population size: Adult escapement in the Twisp River has ranged from zero to 204 during the years 1990 through 2001. At least two of the years in the range experienced zero escapement to the spawning grounds. This is due in part to the management decision to collect 100% of returning adults at Wells Dam during the most critical years of expected low escapement.

Recent events: According to WDFW, at this time the co-managers have determined that rebuilding of Twisp River spring chinook salmon will rely on adult-based supplementation programs already in place and captive brood propagation will be phased out. Captive brood adults currently on hand will be reared to maturity and spawned. The progeny will be incorporated into the existing adult-based supplementation program for release into the Twisp River.

Relationship to current natural population: The Twisp River natural population is supplemented by annual releases of spring chinook originating from the Twisp River under the auspices of Douglas Co. PUD mitigation agreements.

Current program goals: The intent of the supplementation program is to sustain and rebuild natural production of the Twisp River native population (NMFS et al. 1998).

Population genetics: After the White River, samples from the Twisp River are the genetically most distinctive spring chinook group within the Upper Columbia area (WDFW unpublished data, Ford et al. 2001).

Morphology/behavior/fitness: According to WDFW, the captive brood seem to display lower fecundity and younger average age-at-maturity compared to the populations from which they were drawn. Extensive monitoring and evaluation will determine the extent and implications of these and any additional differences.

Previous determinations: NMFS (1999) considered this stock to be in the ESU and essential for recovery.

Category and rationale: Category 1a. This stock was recently founded from a natural population that is part of the ESU.

Stock name: *Ringold spring-run chinook salmon (Carson Hatchery derivative).*

Hatchery/collection site: Ringold Hatchery is located on the Columbia River near Richland, Washington. Fish are collected at the Ringold Hatchery complex (on the Columbia River), but are transferred to Lyon's Ferry Hatchery for spawning, incubation, and early juvenile rearing.

Broodstock origin and history

Year founded: Ringold Hatchery began operating in 1963, primarily as a fall chinook salmon facility.

Source: 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.

Recent events: Program was terminated due to Mitchell Act funding shortage.

Previous determinations: WDFW and USFWS did not consider this broodstock to be part of the ESU, nor essential for recovery (Crawford 1998, Hillwig 1998) and the NMFS (1999) did not consider this stock to be part of the ESU.

Category and rationale: Category 3c or 4; see discussion of Carson, Leavenworth, Entiat, and Winthrop NFHs.

Stock name: *Carson NFH spring-run chinook salmon.*

Hatchery/collection site: Carson NFH, Wind River, Washington. The stock has been transferred to numerous other hatcheries.

Broodstock origin and history

Year founded: Historically, the Wind River did not have a run of spring chinook salmon. Shipperd Falls at RKm 4, blocked 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 the 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 presumably returning to spawning grounds in the Snake River Basin and other Columbia River tributaries above Bonneville Dam (Hymer et al. 1992).

Source: 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) and Umatilla River acclimation sites.

Population genetics: Genetically, Carson NFH spring chinook salmon most closely resemble fish from the Upper Columbia and Snake River Basins (Myers et al. 1998, Campton and Marshall 2000, Ford et al. 2002).

Morphology/behavior/fitness: No data.

Previous determinations: This broodstock was not considered part of the ESU by WDFW and USFWS, nor essential for recovery (Crawford 1998, Hillwig 1998). NMFS (1999) did not consider this population part of the Upper Columbia River spring-run chinook salmon ESU.

Category and rationale: Category 3c or 4. Based on the location of broodstock collection, the Carson NFH stock was derived from a mixture of what are now considered to be three ESUs: Upper Columbia River spring run, Snake River spring/summer run, and Mid-Columbia River spring run. Genetically, the Carson NFH stock has allele frequencies intermediate between those typical of Snake and Upper Columbia River populations (Campton and Marshall 2000).

Snake River Fall-Run Chinook Salmon ESU

Brief History of Artificial Propagation of Snake River Fall Chinook Salmon

In contrast to the Lower and Upper Columbia River, there was little effort directed toward the propagation of Snake River anadromous salmonids from the turn of the 20th century through the 1960s, although a facility in the Grande Ronde River released an unknown number of fall-run chinook salmon between 1903 and 1907 (Howell et al. 1985). Early artificial propagation programs for fall-run chinook salmon in the Snake River had little effect prior to 1976 (Howell et al. 1985, Waples et al. 1991b). Releases of marked fall-run chinook salmon (acquired from the Little White Salmon NFH) into the Salmon River in the 1920s did not result in any observed return of adults (Rich and Holmes 1928).

In 1964, the Idaho Power Company was required to construct the Oxbow Hatchery below Oxbow Dam to mitigate the effects of the dam on fish returning to that section of the Snake River (Wahle and Smith 1979). Several million juveniles were released in the Upper Snake River and in reservoirs above Oxbow Dam, but few returns were observed and the program was abandoned shortly thereafter. From 1955 to 1984, fall-run chinook salmon juveniles have been released in reservoirs, apparently to provide sport fishing opportunities.

In 1960 and 1970, attempts to introduce Spring Creek NFH fall-run chinook salmon into the Clearwater River Basin resulted in only limited numbers of returning adults (Howell et al. 1985, Waples et al. 1991b). From 1960 to 1967, between 0.4 million and 1.6 million eggs were collected annually at Oxbow Dam and transferred to the Clearwater River, but probably did not contribute many returning adults to the system (Waples et al. 1991b). Egg transfers to the Clearwater River were terminated in 1968.

There have not been any hatchery programs for fall-run chinook salmon on the Oregon side of the Lower Snake River, although strays of mixed ancestry from the reintroduction program on the Umatilla River (Columbia River tributary) have been observed in the Snake River since the late 1980s (Chapman et al. 1991, Mendel et al. 1996). All Umatilla River hatchery fall-run chinook salmon are now being marked so they can be intercepted at the Snake River dams (Kostow 1995). With a few minor exceptions, native stocks have generally been used in Snake River fall-run chinook salmon hatchery programs.

Stock name: *Lyon's Ferry Hatchery fall-run chinook salmon.*

Hatchery/collection site:

From the HGMP:
Incubation, rearing, and marking – Lyon's Ferry Hatchery, along the Snake River (Rkm 95), below the Palouse River, in Franklin County, Washington, and Oxbow Fish Hatchery , along the Snake River (Rkm 434) in Baker County, Oregon.

Juvenile Acclimation – Captain John Rapids Acclimation Facility. along the Snake River (Rkm 263), below the Grande Ronde River, in Asotin County, Washington; Pittsburg Landing Acclimation Facility, along the Snake River (Rkm 346), above the Salmon River, in Idaho County, Idaho; and Big Canyon Acclimation Facility, along the Clearwater River (Rkm 57) in Nez Perce County, Idaho.

Juvenile Release – Lyon's Ferry Hatchery, along the Snake River (Rkm 95), below the Palouse River, in Franklin County, Washington; Captain John Rapids Acclimation Facility, along the Snake River, below the Grande Ronde River, in Asotin County, Washington (Rkm 263); Pittsburg Landing Acclimation Facility, along the Snake River (Rkm 346), above the Salmon River, in Idaho County, Idaho; Below Hell's Canyon Dam, along the Snake River (Rkm 395) in Wallowa County, Oregon; and Big Canyon.

Acclimation Facility – along the Clearwater River (Rkm 57) in Nez Perce County, Idaho.

Adult Collection – Lyon's Ferry Hatchery, along the Snake River (Rkm 95), below the Palouse River, in Franklin County, Washington, and Lower Granite Dam Adult Trap, Snake River (Rkm 173) in Garfield County, Washington.

Adult Holding and Spawning – Lyon's Ferry Hatchery, along the Snake River (Rkm 95), below the Palouse River, in Franklin County, Washington.

Broodstock origin and history

Year founded: 1985.

Source: After creation of the LSRCP program in 1976, WDFW initiated a fall chinook egg bank development program for the Snake River. WDFW initiated adult trapping at IHR Dam between 1977 and 1993. In addition, fish have been trapped on-site at Lyon's Ferry Hatchery since 1984. Over time, the program has changed to a supplementation program to enhance fall chinook production in the Snake River using Snake River stock. The incidence of stray fish in the broodstock at Lyon's Ferry increased until 1989, when it was determined after spawning that 41% of fish used for broodstock were strays. It was decided that maintaining the genetic integrity of Snake River fall chinook was paramount. Moreover, the management agencies were concerned that strays were spawning in the wild with natural Snake River stock and the integrity of the natural population was being compromised. Fish from the 1989 broodyear were not used as broodstock. In 1990, trapping also began at Lower Granite River Dam to monitor and remove strays from the Snake River, and to supplement broodstock for Lyon's Ferry Hatchery. As of 1990, WDFW began reading CWTs to determine origin of fish prior to spawning. To benefit the integrity of natural populations, any fish of unknown origin were to be removed at Lower Granite River Dam and excluded from the broodstock used for supplementation. In an effort to benefit the integrity of fall chinook in the Snake River, WDFW continues to mate only known Snake River-origin fish reared at the hatchery. In 1993, trapping ceased at Ice Harbor dam because of the high number of strays from the Columbia River that were detected during a 3-year radio telemetry project. WDFW plans to continue trapping at Lyon's Ferry Hatchery and supplementing the broodstock with fish trapped at Lower Granite River Dam. Once stray rates have decreased to below 5% in the Snake River, managers desire to include up to 10% naturally produced Snake River stock fall chinook in Lyon's Ferry Hatchery broodstock annually (Source: Draft Lyons Ferry HGMP (Section 6.2.1).

Broodstock size/natural population size: The Snake River Stock was likely derived from a genetically distinct population of fall chinook in the Snake River Basin. Collection of fish from the Lower Granite River adult trap has consisted entirely of hatchery-origin spawners (adipose-clipped fish). Unmarked fish (i.e. presumably natural origin) are not targeted at the Lower Granite River adult trap. The only unmarked/untagged fall chinook encountered at spawning are incidentally trapped at Lyon's Ferry Hatchery. WDFW suspects these fish to be primarily Snake River-origin hatchery-reared fish that were released unmarked from the NPT at upriver acclimation sites. Unfortunately, data are not available at this time to determine if they are, in fact, natural fish or unmarked hatchery fish. Since 1990, unmarked/untagged fish have not been included in broodstock because of the possibility of encountering unmarked strays. As stated above, managers have identified the goal of having up to 10% of the Lyon's Ferry Hatchery broodstock consist of naturally produced salmon (Source: Section 6.2.3 of the draft HGMP).

Subsequent events: Broodstock operations were transferred to the WDFW Lyon's Ferry Hatchery when it began operations in 1984 (Delarm and Smith 1990d, Waples et al. 1991b). The Lyon's Ferry Hatchery broodstock of Snake River fall chinook salmon was derived from the Kalama Falls egg bank program and fish collected at Ice Harbor and Lower Granite Dams (Chapman et al. 1991).

Recent events: A portion of the Lyon's Ferry production transferred to acclimation facilities operated by the Nez Perce Tribe for release in the Mainstem Snake River and Clearwater Basin. Fall-run chinook salmon broodstock for Nez Perce Tribal Hatchery derived from adult returns of Lyon's Ferry stock fall-run chinook salmon. In 1994, an agreement was made by state and federal agencies and several Indian tribes to release about half of the yearling production (~ 450,000 smolts) and all of the sub-yearling fall chinook salmon production (in excess of 200,000 juveniles) upstream of Lower Granite Dam in 1996 and to provide the potential for additional natural spawning adults above Lower Granite Dam in future years. Some funding was provided in 1995 by the U.S. Army Corps of Engineers for design and construction of acclimation facilities in the Snake River Basin upstream of Lower Granite Dam.

Relationship to current natural population: As a result of low numbers of naturally produced fall-run chinook salmon and an increasing number of hatchery-produced fish, the Snake River fall chinook salmon run was thought to be a composite of hatchery and naturally produced fish by the mid-1980s (Howell et al. 1985). Tagged fish from the Lyon's Ferry Hatchery have been recovered from the mainstem Snake River and the Tucannon River (Nelson and Bodle 1990, Marshall et al. 1995). Between 7% and 67% (mean 38%) of fall-run chinook salmon passing over Lower Granite Dam have been hatchery produced fish (ODFW 1991). In addition, strays from the Upper Columbia River Basin have recently been observed in substantial numbers (4% to 39%) at Lyon's Ferry Hatchery, Lower Granite Dam, and on the spawning grounds (Waples et al. 1991b, Garcia et al. 1996, Mendel et al. 1996).

Current program goals: According to the draft HGMP (Section 1.7), the program goals are integrated recovery/mitigation. The program will continue to provide mitigation as specified under the LSRCP program (USACE 1975) while meeting conservation and recovery criteria established for the Snake River fall chinook ESU. In addition, it will provide harvest opportunities established under *US v Oregon* for tribal and recreational fisheries.

Population genetics: Similar to most Mid- and Upper Columbia River summer and fall-run chinook salmon and Snake River fall-runs (Myers et al. 1998).

Morphology/behavior/fitness: Data not available.

Category and rationale: Category 2a. The broodstock originated as a collection from a native natural population, and it is currently released into its native watershed. The hatchery uses only hatchery-origin fish in the broodstock. There is little evidence for divergence between the hatchery and naturally spawning populations.

Snake River Spring- and Summer-Run Chinook Salmon ESU

Artificial propagation efforts did not occur in this ESU as early as in other regions, and the level of production has been lower than in many other areas. From 1921 to 1934, the U.S. Fish and Fisheries Commission operated a hatchery at Salmon, Idaho. Eggs were collected from chinook salmon adults returning to the Lemhi and Pahsimeroi Rivers and the Yankee Fork of the Salmon River (Bowles and Leitzinger 1991). In all, 26.5 million eggs were collected from local sources, incubated, and the progeny released into local waters. An additional 9.7 million eggs were transferred to the Salmon River Hatchery (Idaho) substation from outside sources, 7.7 million from the McKenzie River, and 2 million eggs from the Little White Salmon NFH. The majority of juvenile fish were released as fingerlings. Overall, stock transfers into the Snake River Basin were minimal prior to the mid-1900s (Matthews and Waples 1991).

Currently, the major spring and summer-run chinook salmon propagation facilities (satellite facilities or adult collection weirs) operating in the Snake River Basin area are: WDFW's Tucannon and Lyon's Ferry hatcheries; ODFW's Lookingglass and Wallowa (Big Canyon) hatcheries; IDF&G's Sawtooth (East Fork Salmon River), McCall, and Clearwater (Powell, Red River) hatcheries; IPC's Rapid River and Pahsimeroi hatcheries; and USFWS's Dworshak and Kooskia hatcheries (Delarm and Smith 1990b). Stocks used in the ESU's 15 hatcheries are either locally derived (Imnaha stock, Tucannon stock, Grande Ronde stocks), mostly locally derived with some influence from other Snake River stocks (e.g., Sawtooth, Pahsimeroi, South Fork Salmon), derived from mixtures of Snake River Basin stocks (Rapid River), or derived from mixtures of Snake River and non-Snake River stocks (Selway, Kooskia).

Spring and summer-run stocks in the Clearwater River Basin are not included within the Snake River spring/summer chinook salmon ESU, but artificial propagation activities for the basin are covered here because of their potential impact on the ESU. Native runs of spring and summer-run chinook salmon on the Clearwater River were probably eliminated following the construction of the Lewiston Dam (1927) on the Lower Clearwater River (Kiefer et al. 1992). Modifications in the fish migration facilities at the dam were made in 1940, and from 1947 to 1953 approximately 100,000 spring-run chinook salmon eggs from the Middle Fork Salmon River were introduced annually into the Little North Fork of the Clearwater River (Fulton 1968, Kiefer et al. 1992). Spawning channels on the Selway River were used in restoration efforts in the Clearwater River Basin. From 1961 to 1985, nearly 50 million eggs from the Rapid River Hatchery, Carson NFH, Spring Creek NFH, and the Salmon River were placed into various rearing/spawning channels (Kiefer et al. 1992).

Stock name: *McCall Hatchery summer chinook salmon IDF&G.*

Hatchery/collection site: The McCall Fish Hatchery is located approximately 2.25 km south of state highway 55 at 300 Mather Road in the city limits of McCall, Idaho. The facility includes an adult weir and trap located on the South Fork Salmon River approximately 42 km east of Cascade, Idaho.

Broodstock origin and history

Year founded: Constructed in 1979, it is the first LSRCP hatchery built in Idaho, part of a federal mitigation program created to compensate for fish loss due to the construction of the four Lower Snake River dams.

Source: The draft HGMP (Section 6.1) states that the program was founded with adult summer chinook salmon collected between 1974 and 1979 at Ice Harbor, Little Goose, and Lower Granite dams. Adults were collected from the summer-run period at the dams that were locally adapted to the South Fork Salmon River. Early collections established an egg bank program prior to the completion of the hatchery. Between 1976 and 1980, smolts produced from these early collections were planted in the South Fork Salmon River upstream of the present location of the weir. Since 1981, all adults used for broodstock purposes have been collected at the South Fork Salmon River weir. Since 1981, no out-of-basin stocks have been used at McCall Hatchery. USFWS (1998) states that all adults for broodstock are collected at the trapping facility on the South Fork Salmon River

Broodstock size/natural population size: Approximately 380 female and 760 male chinook salmon are needed annually to meet state and federal production objectives for the McCall Fish Hatchery (Draft HGMP, Section 7.4.1). Past broodstock numbers are listed below, under "Relationship to current natural population,"

The draft HGMP (Section 2.2.2) provides the 1995-2002 estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, and provides the annual spawning abundance estimates.

Return Year	McCall Fish Hatchery Total Returns (Hatchery-Produced/Natural)	Total Number of Natural Adults Released Upstream of Weir
1995	307 (269/38)	23
1996	1,199 (1,042/157)	124
1997	3,659 (3,371/288)	186
1998	974 (822/152)	62
1999	1,961 (1,670/291)	216
2000	6,812 (6,093/719)	660
2001	10,922 (9,144/1,778)	1,740
2002	8,603 (7,322/1,281)	1,160

Subsequent events: N/A.

Recent events: The McCall Hatchery has been responsible for the majority of the 11 million juvenile summer-run chinook salmon released into the South Fork Salmon River.

Relationship to current natural population: The South Fork Salmon River summer-run chinook salmon stock reared at the McCall Hatchery has probably had minimal influence from outside sources (Matthews and Waples 1991, Kiefer et al. 1992). In the past, spawning protocols have tended to mix natural and hatchery spawners. A major portion of the Stolle Meadows population was probably integrated into the hatchery broodstock (Schiewe 1992). Recently, there has been an attempt to keep natural and hatchery stocks separate and to maintain separate supplementation and production stocks.

The draft HGMP (Section 2.2.2) provides the number of natural-origin adult spring chinook salmon retained ("ponded") in the hatchery and incorporated in annual spawning designs for supplementation research.

Return Year	McCall Fish Hatchery Trapping History (Hatchery-Produced/Natural)	Total Spawned (H/N)	Total Males Spawned (H/N)	Total Females Spawned (H/N)
1995	307 (269/38)	171 (159/12)	114 (106/8)	57 (53/4)
1996	1,199 (1,042/157)	333 (303/30)	222 (202/20)	111 (101/10)
1997	3,659 (3,371/288)	1,689 (1,587/102)	1,126 (1,058/68)	563 (529/34)
1998	974 (822/152)	897 (807/90)	598 (538/60)	299 (269/30)
1999	1,961 (1,670/291)	1,281 (1,212/69)	854 (808/46)	427 (404/23)
2000	6,812 (6,093/719)	1,083 (1,032/51)	722 (688/34)	361 (344/17)
2001	10,922 (9,144/1,778)	1,251 (1,221/30)	834 (814/20)	417 (407/10)
2002	8,603 (7,322/1,281)	1,143 (1,029/114)	762 (686/76)	381 (343/38)

Current program goals: According to the draft HGMP (Section 1.7), the goal of this program is to return 8,000 summer chinook salmon above Lower Granite Dam to mitigate for survival reductions resulting from construction and operation of the four Lower Snake River dams.

Population genetics: Samples of the production stock (before segregation of marked and unmarked adults) appeared distinct from other South Fork Salmon River samples (Waples et al. 1993, Robin Waples, NMFS, unpubl. data).

Morphology/behavior/fitness: No data.

Previous Determination: NMFS (1992), in its final listing determination, did not include any hatchery-origin fish in the ESU.

Category and rationale: Category 1a and 2a. The "supplementation stock" has recently included a substantial number of natural origin fish in the broodstock and there is no reason to believe that it is more than minimally diverged from the natural population. The "reserve stock" has been propagated from only hatchery origin fish since 1992, and population genetic data indicate that there is some divergence between this stock and the natural population in the South Fork Salmon River. We therefore consider the reserve stock to be Category 2a. Uncertainty about the origin of the fish trapped at the Snake River dams used to initiate this program, some of which were probably destined for other Snake River areas (besides the South Fork Salmon River), creates some uncertainly about the status of this stock.

Stock name: *Rapid River Hatchery spring chinook salmon, IDF&G.*

Hatchery/collection site: Rapid River Hatchery, Little Salmon River. Broodstock are collected at the hatchery weir.

Broodstock origin and history

Year founded: The Rapid River facility was constructed in 1964 to mitigate the loss of spring-run chinook salmon spawning habitats resulting from the construction of the Hell's Canyon Dam complex (Howell et al. 1985). Adults were collected from a trap at the Hell's Canyon Dam on the Snake River from 1964 to 1969, and thereafter from fish returning to the hatchery weir on the Rapid River (Kiefer et al. 1992). Fish from the Rapid River Hatchery and satellite facilities have been released in considerable numbers in the Rapid, Salmon, Snake, Clearwater, and Grande Ronde Rivers (Howell et al. 1985, Kiefer et al. 1992).

Source: Since 1970, the broodstock has been drawn from adults returning to Rapid River, supplemented by fish trapped below Hell's Canyon Dam in the area where juvenile releases occur. At the time the Hell's Canyon Dam was completed, the largest chinook salmon population returning to that area spawned in Pine Creek, and this population was probably the most important natural population source for the Rapid River stock.

Broodstock size/natural population size: The hatchery is physically and geographically isolated from the natural habitat for the naturally spawning population. Broodstocks sizes have been fairly large (>1000 fish -- Herb Pollard, NMFS, pers. commun. March 27, 2003).

Subsequent events: Rapid River stock has been spread widely throughout the Snake River Basin.

Recent events:

Relationship to current natural population: The hatchery stock is considered a spring run but the hatchery is on a stream where the native stock is considered to be summer run. Unmarked fish are released above a velocity barrier on Rapid River to spawn naturally. The Rapid River Hatchery is geographically isolated from the native habitat for this population, and at present, there are no realistic prospects of restoring the Rapid River stock to its home streams in the Upper Snake River. Over time, the Rapid River Hatchery chinook salmon population has probably substantially interbred with the native Rapid River population.

Current program goals: Primarily fishery augmentation. The program provides surplus eggs to other hatchery programs in the basin.

Population genetics: Moran (1998) found that that Rapid River marked and unmarked adults differed, but did not differ significantly in allele frequencies for molecular markers. There are some genetic similarities between Rapid River wild fish and some Northeast Oregon populations. These similarities are likely due to hatchery strays and plants, or possibly due to historical similarities between the founded populations and populations from Northeast Oregon.

Morphology/behavior/fitness: No data available.

Category and rationale: Category 3c. There is considerably uncertainty regarding which natural population were the founders of this stock. The stock was founded by collections at Hells Canyon Dam, and therefore may consist of a mixture several populations that historically spawned in Snake River tributaries above that point. However, by the time the stock was founded, most of those populations were probably substantially depressed (or eliminated) by the completion of Brownlee Dam in 1958. Pine Creek, as the last major tributary to be blocked, may therefore have been the predominate source for the Rapid River stock (Herb Pollard, NMFS, pers. commun. March 27, 2003). The stock has probably also included a small number of the native Little Salmon River chinook into the broodstock over the years. Regardless of its founding population(s), the stock has received few natural-origin fish into the broodstock since it was founded 35 years ago, and it is not released within the watershed of its founding population.

Stock name: *Sawtooth Hatchery spring-run chinook salmon IDF&G.*

Hatchery/collection site:

> *Sawtooth Fish Hatchery* – The Sawtooth Fish Hatchery is located on the Upper Salmon River approximately 8.0 km south of Stanley, Idaho. The river kilometer code for the facility is 503.303.617.
>
> *East Fork Salmon River Satellite* – The East Fork Salmon River Satellite is located on the East Fork Salmon River approximately 29 km upstream of the confluence of the East Fork with the main stem Salmon River. The river kilometer code for the facility is 522.303.552.029.

Broodstock origin and history

Year founded: 1984.

Source: The Sawtooth Hatchery and satellite facilities on the Upper Salmon River have collected native returning spring chinook salmon for broodstock purposes since 1984 (Howell et al. 1985, Delarm and Smith 1990b, Kiefer et al. 1992). Rapid River fish were introduced into nearby watersheds through the 1980s (Kiefer et al. 1992) and were used initially at the Sawtooth Hatchery. In 1978, IDF&G initially used a temporary weir to trap native broodstock at the Sawtooth site with the goal of increasing returns for the new hatchery program.

Broodstock size/natural population size: Approximately 450 spring chinook females are needed to meet current program management objectives for the Upper Salmon River. The ratio of males to females needed is approximately 50:50, necessitating the need to trap and pond approximately 450 males (Draft HGMP Section 1.11.1).

The draft HGMP (Section 2.2.2) provides the 1995-2002 annual spawning abundance estimates, and hatchery origin/natural origin numbers.

Return Year	Sawtooth Fish Hatchery Total Returns (Hatchery-Produced/ Natural)	Total Ponded (H/N)	Total Released (H/N)	Total Male Returns (H/N)	Total Female Returns (H/N)
1995	37 (19/18)	17 (17/0)	20 (2/18)	33 (17/16)	4 (2/2)
1996	156 (51/105)	62 (32/30)	94 (19/75)	118 (34/84)	38 (17/21)
1997	254 (99/155)	142 (92/50)	112 (7/105)	153 (49/104)	101 (50/51)
1998	153 (26/127)	61 (17/44)	92 (9/83)	76 (11/65)	77 (15/62)
1999	196 (75/121)	67 (26/41)	129 (49/80)	161 (66/95)	35 (9/26)
2000	986 (451/535)	461 (408/53)	525 (43/482)	734 (329/405)	252 (122/130)
2001	2,103 (1,427/676)	872 (815/57)	1,231 (612/619)	1,227 (833/394)	876 (594/282)
2002	1,786 (923/863)	446 (377/69)	1,340 (546/794)	884 (368/516)	902 (555/347)

Return Year	East Fork Salmon River Total Returns (Hatchery-Produced/ Natural)	Total Ponded (H/N)	Total Released (H/N)	Total Male Returns (H/N)	Total Female Returns (H/N)
1995	0 (0/0)	0	0	0	0
1996	10 (1/9)	0	10 (1/9)	8 (1/7)	2 (0/2)
1997	7 (1/6)	0	7 (1/6)	5 (0/5)	2 (1/1)
1998	Trap Not Operated				
1999	Trap Not Operated				
2000	Trap Not Operated				
2001	Trap Not Operated				
2002	Trap Not Operated				

The draft HGMP (Section 2.2.3) states that all adult spring chinook salmon (hatchery- and natural-origin) are trapped and handled at the Sawtooth Fish Hatchery weir. The numbers of natural-origin adults varies annually (see final tables from Section 2.2.2 above). Beginning in 2003, the IDF&G anticipates that all natural-origin adults will be passed upstream for spawning as the development of supplementation broodstocks is expected to conclude. Following capture, natural-origin fish may be marked and tissue sampled before release.

Subsequent events:

Recent events:

Relationship to current natural population: There appears to be little reason to believe that the fish currently held at Sawtooth are substantially different genetically from their natural counterparts. Currently 35% of the hatchery broodstock are natural-origin fish, and no more than 50% hatchery-origin fish are allowed on the spawning grounds. Prior to adult return year 2003, a portion of natural adults were retained for broodstock purposes (see above). About 66% of the adults reaching the weir (including marked and unmarked fish) have been taken for broodstock.

Current program goals: According to the draft HGMP (Section 1.7), the program goal is mitigation. The goal of the Lower Snake River Compensation Plan is to return approximately 19,445 adult spring chinook salmon to the project area above Lower Granite Dam to mitigate for survival reductions resulting from the construction and operation of the four Lower Snake River dams. Initial facility plans identified production targets of 1.3 million smolts released in the Salmon River at the Sawtooth Fish Hatchery, 700,000 smolts released in the East Fork Salmon River, and 300,000 smolts released in Valley Creek, a tributary to the Salmon River. Adult return targets were 11,310 adults back to the Sawtooth Fish Hatchery, 6,090 adults back to the East Fork Salmon River, and 2,045 adults back to Valley Creek (all based on a smolt-to-adult return rate of 0.87%).

The Valley Creek component of the program has never been implemented. The East Fork Salmon River component was terminated in 1998.

Population genetics: Similar to Valley Creek natural-origin chinook salmon. Estimated effective number of breeders was approximately 92 fish, one-fourth of the number of spawners (adjusted for sex ratios) in 1988 and 1989 (Waples et al. 1993).

Morphology/behavior/fitness: No data available.

Previous determination: NMFS originally concluded that the Sawtooth hatchery stock was part of the ESU, but was concerned that the hatchery program had adversely affected the natural population by taking broodstock to support an unsuccessful hatchery operation (Schiewe 1992).

Category and rationale: Category 1a. Despite an initial influence of out-of-basin fish, natural-origin fish have been included in the broodstock annually, and there are apparently few, if any, differences between natural and hatchery-origin fish.

Stock name: *Pahsimeroi Hatchery summer-run chinook salmon, (IPC, IDF&G).*

Hatchery/collection site: Pahsimeroi Hatchery, Salmon River, located near the town of Ellis, Idaho, is 2 Km upstream of the confluence of the Pahsimeroi and Salmon Rivers. Two rearing ponds are located at a separate location 11.2 Km further upstream on the Pahsimeroi River.

Broodstock origin and history

Year founded: From 1967-1986, native Pahsimeroi River fish were used.

Source: The Pahsimeroi Hatchery broodstock was founded with native summer-run fish returning to the Pahsimeroi River (Kiefer et al. 1992). However, summer-run chinook salmon from the South Fork Salmon River (McCall Hatchery) were introduced into the Pahsimeroi River during 1985-90 and may have been integrated into the Pahsimeroi Hatchery broodstock (Kiefer et al. 1992). Spring-run chinook salmon (Rapid River Hatchery stock) were also reared and released at the Pahsimeroi Hatchery for a limited time during the 1980s. Over the last 10 years, the program has ceased using non-native stocks and has focused on collecting natural Pahsimeroi summer chinook (Herb Pollard, pers. commun.).

Broodstock size/natural population size: Up to 300 females are used for broodstock, and the combined natural and hatchery escapement has ranged from ~100 to over 1,000 fish (Herb Pollard, NMFS, pers. commun.).

Subsequent events: Some Rapid River stock have been released from the hatchery. Rapid River fish, which were marked and separated, were only included into the broodstock for a few years.

Recent events: Currently, the program releases both a "supplementation stock" and a "reserve stock." The latter has been based solely on hatchery X hatchery crosses since the early 1990s (Herb Pollard, NMFS, pers. commun.).

Relationship to current natural population: According the broodstock guidelines, no more than 30% of the natural run can be used for broodstock, and no more than 50% of the spawning on the spawning grounds should be hatchery-origin fish (Herb Pollard, NMFS, pers. commun.).

Current program goals: Due to the 1992 listing of Snake River summer chinook salmon (Oncorhynchus tshawytscha) as threatened under the Federal Endangered Species Act of 1973 (ESA), the Pahsimeroi Fish Hatchery has shifted from a fishery mitigation program to a supplementation/conservation program (IHOT 1997). Production goals are to rear 1.0 million summer chinook smolts for release into the Pahsimeroi River. This hatchery is currently operated as an integrated recovery program.

Population genetics: Data not available.

Morphology/behavior/fitness: Data not available.

Previous determinations: Due to input of Rapid River and South Fork Salmon River stocks, NMFS did not consider this stock to be part of the original biological ESU (Schiewe 1992).

Category and rationale: Category 1a for the supplementation stock; Category 1a or 2a for the "reserve" stock. The supplementation stock has incorporated a sizeable fraction of natural-origin fish annually since it was founded ~10 years ago. There is little reason to believe the stock has diverged substantially from the natural population. The "reserve" stock has been propagated from hatchery returns alone for two to three generations.

Stock name: *Catherine Creek summer-run chinook salmon, Lookingglass Creek Hatchery; Upper Grande Ronde summer-run chinook salmon; Lostine River summer-run chinook salmon.*

Hatchery/collection site:

- Lookingglass hatchery (LGFH) is located 18 miles north of the town of Elgin, adjacent to Lookingglass Creek 2.2 miles above its confluence with the Grande Ronde River at about river mile 86 (ODFW watershed code 080440000). Elevation at the hatchery is 2,550 feet above sea level. Adult facilities consist of two traps and two concrete raceways (4,560 ft^3). Incubation is in 288 vertical incubator trays with a capacity of 2.3 million eggs to hatching. There are 32 Canadian troughs for starting fish, each with a capacity of 100 to 125 pounds of fish. Rearing is in 18 concrete raceways (3,500 ft^3), each with a capacity of 4,000 lb (Lewis 1996).
- Oxbow Hatchery is located 2 miles east of the town Cascade Locks, Oregon, adjacent to the Columbia River (ODFW watershed Herman Creek-code 0400200000). Elevation at the hatchery is 100 feet above sea level. Incubation facilities consist of 240 trays, 10 deep and 11 shallow troughs. Eleven Canadian troughs are used for inside rearing. One outside raceway (3,500 ft^3) is available.

- Irrigon Hatchery is located along the south bank of the Columbia River, above John Day Dam, near Irrigon, Oregon. Captive brood eyed eggs are shipped to Irrigon for final incubation, hatching, and early rearing. Inside rearing containers include 68 circular tanks each with a rearing volume of 70 $ft.^3$ (6 feet x 3 feet), and 288 incubation trays in 36 stacks.

Broodstock origin and history

Year founded: Late 1990s. A number of chinook salmon stocks (both native and non-native) have been reared at the Lookingglass Hatchery. Harvest directed programs have been replaced by three captive broodstock/supplementation programs directed at local populations.

Source: The draft HGMP (Section 6.2.1) provides the following broodstock history:

> During the construction phases of LGFH in the late 1970s, it was thought there were too few natural fish returning to Lookingglass Creek to develop adequate broodstock in a short timeframe. ODFW decided that broodstock development and smolt production goals could be promptly achieved by importing hatchery stock from outside the basin. In 1978, the first eggs were taken from Rapid River stock (Idaho) and smolts were released in Lookingglass Creek in 1980. Due to egg availability and disease concerns, Carson stock replaced the Rapid River in the mid 1980s. Rapid River stock was imported through out the late 1980s and early 1990s (LSRCP Status Review Symposium 1998).
>
> In the early 1990s, two major policy rulings influenced the Grande Ronde spring chinook salmon hatchery program. In 1990, ODFW adopted the Wild Fish Management Policy, which established guidelines for the maximum acceptable level of non-local-origin

hatchery fish that would spawn in nature with local populations. In 1992, naturally produced Grande Ronde Basin spring chinook were listed as endangered by the NMFS under the ESA. The hatchery operations were inconsistent with conservation and recovery opinions.

A genetic assessment by an independent scientific panel in the *US v Oregon* dispute resolution indicated that there remained significant genetic differentiation between natural populations and between hatchery populations and the natural populations, even though significant out planting and straying of non-local hatchery fish had occurred. There was still significant genetic differentiation between hatchery and natural populations and between the Minam, Wenaha, Grande Ronde, and Lostine Rivers and Catherine Creek natural spawners (Currens et al. 1996, Waples et al 1993).

Given the uncertainties of using artificial production to increase natural production, two approaches to hatchery supplementation were implemented using endemic stocks.

- Captive Brood
- Conventional Brood

The intent of the captive brood program is to maintain natural escapement above a minimum threshold to prevent extinction. As natural production and escapement increases, a more traditional or conventional approach to supplementation can be implemented to achieve LSRCP objectives.

Captive Brood—The program was initiated because Catherine Creek, Lostine River, and Upper Grande Ronde populations were below viable population thresholds with spawning escapement below 50 fish during the mid-1990s (LSRCP Symposium 1998). Captive broodstock for this program is based on collecting naturally produced spring chinook salmon parr from each of three populations. We plan to collect naturally produced parr for a minimum of 10 years to evaluate the efficacy of the program, rear the juveniles to near smolt stage at LGFH, transport two-thirds as smolts to Bonneville Fish Hatchery (BOH), and one-third as smolts to NMFS Manchester Marine Lab (MML), respectively, and rear fish at those facilities to maturity. Maturing adults will be transported from MML to BOH and all fish spawned at BOH. Captive broodstock progeny will be incubated to eyed stage at BOH then transported to LGFH for final incubation and rearing to the smolt stage. Resulting smolts will be released into the river of parent origin and/or other chinook producing streams within that drainage.

The draft HGMP (Section 6.1) provides the following *current* broodstock source information:

Lookingglass Creek—Releases to date have been from Rapid River/Carson out-of-basin stocks. The last marked adults returned in 2002. Unmarked adults, considered naturalized from Rapid River/Carson stocks, continue to return. The intent is to phase out this composite stock (remove unmarked component through 2008) and replace with Catherine Creek stock using surplus production from captive brood. Future broodstock for Lookingglass Creek will be collected from Catherine Creek adults that return from captive brood-produced smolts. The first return (jack) could occur in 2003 from parr released in 2001. Adults will be trapped in the upper Lookingglass Hatchery trap.

Lostine—Conventional broodstock for the Lostine spring/summer chinook salmon program is collected from adult returns trapped at Lostine weir and then transferred to Lookingglass hatchery for spawning. This includes primarily naturally and few conventionally produced hatchery fish. The ratio of hatchery-to-wild fish collected for broodstock is based on adult escapement sliding scale (Table 5.1.A.). Captive broodstock for the Lostine is derived from chinook parr collected in stratified random manner along natural production areas in the Lostine River. Collection is based on a proportion of total redds within each section. The goal is to provide a good probability of representing all families and to provide as much genetic variability in the collection as possible. Parr are collected during August and September, approximately 12 months after eggs were fertilized. Parr surviving to adults are spawned for smolt production. Adults returning from captive brood production are released to spawn naturally.

Catherine Creek—Conventional broodstock for Catherine Creek spring/summer chinook salmon program is collected from adult returns trapped at the Catherine Creek weir and then transferred to Lookingglass Hatchery for spawning. This includes naturally produced hatchery fish. Future broods will include conventional hatchery-produced adults. The ratio of hatchery-to-wild fish collected for broodstock is based on an adult escapement sliding scale (Table 5.1.A). Captive broodstock for Catherine Creek is derived from chinook parr randomly collected in a stratified manner along natural production areas in Catherine Creek. Collection is based on the proportion of total redds within each section. The goal is to provide a good probability of representing all families and to provide as much genetic variability in the collection as possible. Parr are collected during August and September, approximately 12 months after eggs were fertilized. Parr surviving to adults are spawned for smolt production. Adults returning from captive brood production are released to spawn naturally.

Upper Grande Ronde—Conventional broodstock for the Upper Grande Ronde spring/summer chinook salmon program is collected from adult returns trapped at the Upper Grande Ronde weir and then transferred to Lookingglass Hatchery for spawning. This includes naturally produced hatchery fish. Future broods will include conventional hatchery-produced adults. The ratio of hatchery-to-wild fish collected for broodstock is based on Grande Ronde Basin Hatchery Management Plan (Zimmerman et al. 2002). Captive broodstock for the Upper Grande Ronde is derived from chinook parr randomly collected in stratified natural production areas in the Grande Ronde. Collection is based on the proportion of total redds within each section. The goal is to provide a good probability of representing all families and to provide as much genetic variability in the collection as possible. Parr are collected during August and September, approximately 12 months after eggs were fertilized. Parr surviving to adults are spawned for smolt production. Adults returning from captive brood production are released to spawn naturally.

Broodstock size/natural population size:

According to the draft HGMP (Section 1.11.1), the proposed annual broodstock collection level (maximum number of adult fish) are as follows:

> *Captive Brood*—Juvenile collection is not expected to exceed 1,500 parr (i.e., 500 fish from each of the three target tributaries: Catherine Creek [CC], Lostine River [LR], and Upper Grande Ronde [UGR]). Fish are reared to maturity and used for broodstock (DeHart and Carmichael 1996).
>
> *Conventional Brood*—Adult (ages 4 and 5) collection is not expected to exceed 360 males and 360 females. Age composition and fecundity of adults varies from year to year. However, given expected program adult prespawning survival, female fecundity, and egg-to-smolt survival, 720 adults (1:1 sex ratio) will produce approximately 900,000 smolts. For the year 2002, co-managers targeted a collection of 50 males and 50 females per tributary to produced 360,000 smolts (AOP 2002, LSRCP). In 2003, co-managers will target a collection of 60 males and 60 females per tributary (Catherine Creek, Lostine River, and Upper Grande Ronde) to produced 390,000 smolts.

Maximum by stock
Catherine Creek—200 adults decreasing to 120 adults
Lookingglass Creek—120 adults increasing to 200 adults
Lostine River—200 adults
Upper Grande Ronde—200 adults

The draft HGMP (Section 2.2.2), provides the most recent 12-year (e.g. 1986-2001) annual spawning abundance estimates as follows:

> ODFW has been monitoring spawning spring/summer chinook since the late 1940s and early 1950s. Since 1986, ODFW has conducted spawning ground surveys on the majority of the available spawning habitat including the five core populations in the Grande Ronde subbasin (Table 2.2.2A).

Table Redd counts observed in selected tributaries in the Grande Ronde sub-basin, 1986-2002 (Walters, pers. commun.,).

Year	Catherine Creek	Lostine River	Upper Grande Ronde	Minam	Wenaha
1986	94	90	48	63	68
1987	234	94	207	103	152
1988	212	182	115	96	170
1989	46	52	N/A	38	18
1990	39	27	31	67	83
1991	20	28	10	50	58
1992	49	36	116	95	183
1993	84	102	103	88	100
1994	11	16	3	29	42
1995	14	11	6	15	21
1996	15	27	22	84	102
1997	46	49	19	48	72
1998	34	35	25	57	65
1999	40	57	0	40	22
2000	34	64	20	128	119
2001	133	118	15	179	262

Subsequent events:

Recent events:

Relationship to current natural population:

The HGMP (Section 6.2.1) provides the following information regarding the past levels of hatchery-origin and natural-origin fish in the broodstock:

6.2.1.A. Catherine Creek captive broodstock spawning data for the 1998 through 2002 broodyears.

Brood Year	Males Spawned	Females Spawned	Spawning Ratio F/M	Average Fecundity	Egg Take (1,000s)	Fry Ponded (1,000s)	Smolt releases (1,000s)
1998	93	69	0.75	1,380	95.25	42.7	38.0
1999	164	162	0.98	1,619	262.35	153.5	136.8
2000	176	177	1.00	1,894	335.17	199.8	180.0
2001	218	124	0.57	1,966	243.77	140.0	N/A
2002	138	128	0.93	1,600	204.85	N/A	N/A

6.2.1.B. Lostine River captive broodstock spawning data for the 1998-2002 broodyears.

Brood Year	Males Spawned	Females Spawned	Spawning Ratio F/M	Average Fecundity	Egg Take (1,000s)	Fry Ponded (1,000s)	Smolt releases (1,000s)
1998	98	47	0.48	1,455	68.37	39.9	35.0
1999	174	140	0.80	1,739	243.47	150.2	133.9
2000	215	92	0.43	1,851	170.27	67.8	77.6
2001	197	131	0.67	2,125	278.34	177.5	N/A
2002	174	144	0.83	1,589	228.79	N/A	N/A

6.2.1.C. Upper Grande Ronde captive broodstock spawning data for the 1998-2002 broodyears.

Brood Year	Males Spawned	Females Spawned	Spawning Ratio F/M	Average Fecundity	Egg Take (1,000s)	Fry Ponded (1,000s)	Smolt releases (1,000s)
1998	5	4	0.80	1,050	4.20	1.7	1.5
1999	16	5	0.31	1,209	6.04	2.8	2.6
2000	186	188	1.01	1,664	312.82	227.7	151.4
2001	179	199	1.11	2,031	404.18	284.0	N/A
2002	39	56	1.44	1,750	97.98	N/A	N/A

The Conventional Brood program was initiated in 1997 to supplement natural populations in Catherine Creek, Lostine River, and Upper Grande Ronde River. However, the populations were below critical escapement, preventing the collection of adults in Catherine Creek and Upper Grande Ronde from 1997 through 2000. Escapement was higher, but still below critical threshold in Lostine, which allowed collections in 1997, 2000, 2001, and 2002. Spawning data is summarized in Tables 6.2.1 A-C.

6.2.1.D. Lostine River spring/summer chinook salmon spawning data for the 1997 through 2002 broodyears.

Brood Year	Marked Males Spawned	Marked Females Spawned	Unmarked Males Spawned	Unmarked Females Spawned	% Un-marked	Spawning Ratio F/M	Average Fecundity	Egg Take (1,000s)	Fry Ponded (1,000s)	Smolt releases (1,000s)
1997	0	0	4	4	100%	0.92	4,496	17	12	11.8
1998	0	0	0	0	N/A	N/A	-	-	-	-
1999	0	0	0	0	N/A	N/A	-	-	-	-
2000	0	0	*24	8	100%	0.33	4,329	35	32	31
2001	5	11	29	25	76%	1.06	4,463	161	103	Est. 101

*Twelve 3-year olds males (jacks) are included in the unmarked males spawned. Milt was pooled and used to fertilize a maximum of 10% of the available eggs; therefore, the % marked fish and spawning ratio (F/M) are skewed.

6.2.1.E. Catherine Creek spring/summer chinook salmon spawning data for the 2001 and 2002 broodyears.

Brood Year	Marked Males Spawned	Marked Females Spawned	Unmarked Males Spawned	Unmarked Females Spawned	% Un-marked	Spawning Ratio F/M	Average Fecundity	Egg Take (1,000s)	Fry Ponded (1,000s)	Smolt releases (1,000s)
2001	0	0	7	12	100%	1.71	3,651	43.8	25	N/A
2002	0	0	17	20	100%	1.18	4,096	81.9	70	

6.2.1.F. Upper Grande Ronde River spring/summer chinook salmon spawning data for the 2001 and 2002 broodyears.

Brood Year	Marked Males Spawned	Marked Females Spawned	Unmarked Males Spawned	Unmarked Females Spawned	% Un-marked	Spawning Ratio F/M	Average Fecundity	Egg Take (1,000s)	Fry Ponded (1,000s)	Smolt releases (1,000s)
2001	0	0	8	8	100%	1.00	4,420	35.4	27.5	N/A
2002	0	0	23	25	100%	1.09	3,454	86.3	70.0	N/A

Current program goals: According to Section 1.7 of the draft HGMP, the short-term goal is to use captive broodstock technology and conventional supplementation to prevent the extinction (preservation/conservation) of three wild chinook populations in the Grande Ronde Basin, provide a future basis to reverse the decline in stock abundance of Grande Ronde River chinook salmon, and ensure a high probability of population persistence well into the future, once the causes of basinwide population declines have been addressed. Associated objectives include:

1) To prevent the extinction of native wild chinook populations in the Lostine, Upper Grande Ronde River, and Catherine Creek;
2) Maintain genetic diversity of indigenous artificially propagated chinook populations;
3) Maintain genetic diversity in wild chinook populations specifically the Minan and Wenaha Rivers;
4) Reintroduce spring/summer chinook into Lookingglass Creek with Catherine Creek stock, which is indigenous to the Grande Ronde subbasin.

An intermediate goal of this program is the restoration of spring chinook salmon in the Grande Ronde subbasin using three indigenous stocks.

The long-term goal of this program is the recovery, de-listing, and mitigation of fish losses occurring as a result of the construction and operation of the four Lower Snake River Dams.

Population genetics: According to the draft HGMP (Section 6.2.1), a genetic assessment by an independent scientific panel in the *US v Oregon* dispute resolution indicated that there remained significant genetic differentiation between natural populations, and between hatchery populations and the natural populations, even though significant out planting and straying of non-local hatchery fish had occurred. There was still significant genetic differentiation between hatchery and natural populations, and between the Minam, Wenaha, Grande Ronde, and Lostine Rivers, and Catherine Creek natural spawners (Currens et al. 1996, Waples et al. 1993).

Morphology/behavior/fitness: No data available.

Previous determinations: None.

Category and rationale: Lookingglass stock: Category 3c or 4. This stock was derived from a mixture of populations from the Snake River and Upper Columbia River ESUs. This stock is being phased out in favor of a newer "Lookingglass" stock to be based on the Catherine Creek captive broodstock.

Lostine, Catherine Creek, Grande Ronde stocks: Category 1a. These stocks were all recently derived from natural population in the watersheds in which they are released.

Stock name: *Clearwater Hatchery spring-run chinook salmon IDF&G.*

Hatchery/collection site:

Clearwater Fish Hatchery—The program consists of the main hatchery and three satellite facilities. The Clearwater Fish Hatchery is located at confluence of the North Fork and main Clearwater Rivers, RKm 65 on the Clearwater River; 121 km upstream from Lower Granite Dam, and 842 km upstream from the mouth of the Columbia River. The Hydrologic Unit Code is 17060300800100.00.

Red River—The Red River satellite facility is located at RKm 27 of Red River, a tributary to the South Fork of the Clearwater River at RKm 101. The facility is 310 km upstream from Lower Granite Dam and 1,030 km from the mouth of the Columbia River. The Red River pond was built in 1977 under the Columbia River Fisheries Development Project and was administered by NMFS, IDF&G, USFS, and the Pacific Northwest Regional Commission until 1986. In 1986, a permanent adult trapping facility and holding complex was constructed by the U.S. Corps of Engineers as part of the LSRCP.

Crooked River—The Crooked River satellite facility is located at RKm 1 of Crooked River, also a tributary to the South Fork Clearwater River at RKm 94. The facility is located 287 km upstream from Lower Granite Dam and 1,007 km upstream from the mouth of the Columbia River. The Crooked River satellite has been in operation since 1990.

Powell—The Powell satellite facility is located at the headwaters of the Lochsa River (RKm 0), at the confluence of Brushy Fork Creek and Colt Killed Creek (previously White Sand Creek). The Lochsa River is a tributary to the Middle Fork Clearwater. The satellite facility is 320 km upstream from Lower Granite Dam and 1,040 km upstream from the mouth of the Columbia River.

Broodstock origin and history

Indigenous spring chinook salmon populations in the Clearwater Basin are generally thought to have been virtually eliminated by the construction and operation of Lewiston Dam from 1927 to 1972. However, the dam was modified in the 1960s to facilitate passage of chinook salmon. Other efforts to restore spring chinook salmon runs in the basin consisted of outplants of juveniles from several hatcheries in the Columbia River Basin, and the present naturally producing populations, which are likely influenced by fish of non-native origin. The primary stock used for Clearwater River introductions has been from the Rapid River Fish Hatchery, and this stock has been released in the basin in recent years. Current preferred broodstocks are adult returns to weirs at the satellite facilities. Returns to the Red River and Crooked River weirs are now managed as an aggregate South Fork Clearwater River stock. Powell and South Fork Clearwater River stocks may be used at either facility, depending upon broodstock availability. Dworshak NFH stock has also been used in the Clearwater River Program. The original broodstock for the Powell facility was trapped using the floating Mitsubishi weir at the confluence of Colt Killed Creek and Crooked Fork Creek.

Year founded: The Clearwater Hatchery was constructed in 1992 as part of the LSRCP to compensate for anadromous fishery losses caused by the four federal dams constructed on the Lower Snake River. The LSRCP mitigation goals are to return 11,915 adult spring chinook salmon.

Source: According to the draft HGMP (Section 6.1), founding hatchery stocks used for spring chinook salmon re-introductions were primarily obtained from the Rapid River Hatchery (Kiefer et al. 1992, Nez Perce Tribe and IDF&G 1990). Initially however, spring chinook stocks imported for restoration came from Carson, Big White, Little White, or those captured at Bonneville Dam (Nez Perce Tribe and IDF&G 1990). Genetic analyses confirm that existing natural spring chinook salmon in the Clearwater River subbasin are derived from reintroduced Snake River stocks (Matthews and Waples 1991).

Broodstock size/natural population size: The proportion of hatchery-origin and natural-origin fish on the spawning grounds is unknown (HGMP Section 2.2.2). The Dworshak spring chinook salmon program usually observes a 1:1 sex ratio in adult returns. The program requires about 600 females in order to get all the eggs needed for a full program. Therefore, in order to fulfill the requirement, the program needs to collect about 1,200 adults total (HGMP Section 7.4.1).

The draft HGMP (Section 7.4.2) provides the broodstock collection levels for 1990-2001. This represents the total number of spring chinook salmon returning to the hatchery. Because spring chinook salmon are immature at the time of initial inventory, it is almost impossible to distinguish males from females. Therefore, this reports the total number of II- and III-ocean adults and the number of jacks (I-ocean adults).

Total number of spring chinook salmon returning to the hatchery between 1990 and 2001.

Year	Adults	Jacks
1990	2,027	7
1991	149	16
1992	347	22
1993	814	9
1994	71	3
1995	42	83
1996	688	275
1997	3,138	12
1998	904	11
1999	130	670
2000	2,931	221
2001	3,982	36

Subsequent events:

Recent events:

Relationship to current natural population: Natural-origin fish are not currently incorporated into the harvest mitigation broodstock or Crooked River supplementation broodstock. Natural-origin fish are not incorporated into Red River supplementation broodstocks, and are released upstream of the weir (HGMP).

Current program goals: According to the draft HGMP (Section 1.7), the program goal is mitigation. The goal of this program is to return 12,000 spring chinook salmon above Lower Granite Dam to mitigate for survival reductions resulting from construction and operation of the four Lower Snake River dams.

Population genetics: Relevant data is not available.

Morphology/behavior/fitness: No data available.

Category and rationale: Category 2b. These stocks were founded from a mixture of populations that were part of the Snake River spring/summer chinook ESU. Few natural origin fish have been incorporated into the broodstock in recent years.

Stock name: *Imnaha River spring/summer chinook salmon (ODFW stock # 29).*

Hatchery/collection site: Fish are collected at a weir on the Imnaha River and spawned at the Imnaha Facility, normally transferred to the Lookingglass Hatchery for rearing, and then returned to Imnaha and acclimated prior to release.

Broodstock origin and history

Year founded: 1982.

Source: Since the beginning of this program in 1982, only natural or hatchery-produced Imnaha River spring/summer chinook salmon have been used for broodstock (Chapman et al. 1991, Olsen et al. 1992, HGMP).

Broodstock size/natural population size: Broodstock collections are not expected to exceed 332 fish (HGMP). Combined natural and hatchery escapements have ranged from the several hundred to several thousand over the last 20 years (HGMP).

Subsequent events:

Recent events: Returns during 2001 and 2002 numbered several thousand hatchery and natural adults.

Relationship to current natural population: Based on carcass recoveries from 1994 to 1997, the proportion of marked hatchery fish on the natural spawning grounds ranged from 11.8% to 64.9% (HGMP). The proportion of natural fish used for broodstock has varied, but from 1990-2001 was generally 50% or less.

Current program goals: According the Imnaha Hatchery HGMP, the goal of the program is "the restoration of spring/summer chinook salmon in the Imnaha River using the indigenous stock and to mitigate for fish losses occurring as a result of the construction and operation of the four Lower Snake River Dams. The program mitigation goal is to return 3,210 hatchery adults to the area above Ice Harbor Dam. Based upon this adult goal and an estimated 0.65% smolt-to-adult survival rate, the target for smolt production was set at 490,000 fish."

Population genetics: In most years, Imnaha Hatchery and wild samples were more similar to one another than to other populations in Northeast Oregon (Waples et al. 1993, Waples et al. unpubl., Moran et al. unpubl.). The effective number of breeders in 1988 and 1989 was estimated to be 64, which was about half the adjusted number of spawners.

Morphology/behavior/fitness: No data available.

Category and rationale: Category 1a. This stock was derived from the local natural population, and has continued to incorporate an average of ~40% natural-origin fish into the broodstock since the time of founding. Genetic analysis indicates that the stock has not diverged much, if at all, from the natural population.

Stock name: *Dworshak Hatchery spring-run chinook salmon stock (USFWS).*

Hatchery/collection site: Dworshak NFH.

Broodstock origin and history

Year founded: The Kooskia and Dworshak NFH spring-run chinook salmon programs were establish in 1981 as part of the Lower Snake River Compensation Plan. The first releases occurred in 1983.

Source: From 1983 to 1986, broodstock for these hatcheries came primarily from the Rapid River Hatchery, with significant contributions from Carson-stock hatcheries (Leavenworth, Little White Salmon, and Carson NFHs) and Willamette River hatcheries. The 1987 and 1988 releases were entirely of Rapid River origin. The Dworshak Hatchery has been largely self-sufficient in its eggs needs since 1988.

Broodstock size/natural population size:

Subsequent events:

Recent events:

Relationship to current natural population: Dworshak Dam prevents anadromous access to the North Fork Clearwater River. The natural population below the dam is thought to be heavily influenced by releases from the hatchery.

Current program goals: The mitigation goal is to produce 1.1 million Dworshak Hatchery-stock smolts for on-station release.

Population genetics: Data not available.

Morphology/behavior/fitness: Data not available.

Category and rationale: Category 3b or 4. The stock was derived from a mixture of sources, some of which are not considered part of the Snake River spring/summer chinook ESU (e.g., Carson Hatchery stocks). According to hatchery records, however, there was an attempt in the late 1980's to consolidate the Rapid River derived stocks to Dworshak Hatchery and the Carson derived stocks to Kooskia Hatchery (Herb Pollard, NMFS, pers. commun., March 27, 2003). The Dworshak stock may therefore be predominately of Rapid River origin, and perhaps more likely a Category 3b than Category 4. In any case, the stock has received little or no introduction of natural-origin fish since the time of its founding.

Stock name: *Kooskia Hatchery spring-run chinook salmon (USFWS).*

Hatchery/collection site: Kooskia NFH is located on Clear Creek, a tributary to the Middle Fork of the Clearwater River at RKm 124 in the Snake River Basin, Idaho.

Broodstock origin and history

Year founded: 1969.

Source: From the HGMP: "The Kooskia NFH spring Chinook salmon program was started using a wide variety of stocks from the Lower Columbia River and Rapid River SFH. However, from 1973 through 1980, smolt releases had a very strong Carson stock influence. Egg transfers of Carson type stock from Dworshak NFH in 1985 and 1986 resulted in smolt releases in 1987 and 1988 that were a mixed stock, referred to as Clearwater stock. Since the Kooskia NFH program already had stock made up primarily of Carson derivatives, the resultant program (1989 and later) is still considered a Carson type stock, but is referred to as Kooskia stock. Length frequency data, ocean age class at return time information, and allele frequencies (Elliot and Pascho 1994) all support a distinction between Dworshak and Kooskia stocks."

Broodstock size/natural population size:

Subsequent events:

Recent events:

Relationship to current natural population: The Kooskia stock is not associated with any particular natural population. Natural fish are not used for broodstock, and the there is no intent to have Kooskia stock chinook spawning in the wild (HGMP).

Current program goals: According to the HGMP, the purpose of this program is to mitigate for Clearwater River tribal and sport fishing opportunities that were lost because of the construction of water development projects in the Columbia River Basin.

Population genetics: Data not available.

Morphology/behavior/fitness: Data not available.

Category and rationale: Category 3b or 4. The stock was derived from a mixture of sources, some of which are not considered part of the Snake River spring/summer chinook ESU (e.g., Carson Hatchery stocks). According to hatchery records, however, there was an attempt in the late 1980's to consolidate the Rapid River derived stocks to Dworshak Hatchery and the Carson derived stocks to Kooskia Hatchery (Herb Pollard, NMFS, pers. commun., March 27, 2003). The Kooskia stock may therefore be predominately of Carson origin, and perhaps more likely a Category 4 than Category 3. In any case, the stock has received little or no introduction of natural-origin fish since the time of its founding.

Stock name: *Tucannon Hatchery spring-run chinook salmon (WDFW).*

Hatchery/collection site: Adults are collected at a floating weir and fish trap on the Tucannon River.

Adult Collection—Tucannon Hatchery Adult Trap, RKm 59 on the Tucannon River, Columbia County, Washington.

Holding, spawning, incubation, rearing, and marking—Lyon's Ferry Hatchery, along Snake River in Franklin County, Washington (RKm 90).

Final rearing—Tucannon Hatchery, RKm 58 on the Tucannon River, Columbia County, Washington.

Smolt acclimation and release—Curl Lake Acclimation Pond, RKm 66 on the Tucannon River, Columbia County, Washington.

Broodstock origin and history

Year founded: 1985.

Source: From the HGMP: "The Tucannon River has native runs of both spring and fall chinook salmon. The runs are well separated both spatially and temporally. Prior to 1985, the Tucannon River spring-run chinook salmon population was maintained entirely by natural production (Howell et al. 1985). Before the establishment of the hatchery population, a limited number of non-native fish were introduced in the Tucannon River--16,000 Klickitat River and 10,500 Willamette River spring-run chinook salmon in 1962 and 1964, respectively. Native broodstock were used to establish the Tucannon Hatchery spring-run chinook salmon population, although the number of fish available was limited (the total adult run size was approximately 200 fish during the early 1980s) (Howell et al. 1985). Under the current program, adults were first collected from the Tucannon River in 1985, and first smolt releases occurred in 1987. The absence of other spring-run chinook salmon propagation facilities nearby has probably limited introgression by non-native stocks, although a limited number of CWT-tagged hatchery-derived fish from the Umatilla River and Grande Ronde River (Rapid River stock) have been recovered (Marshall et al. 1995)."

According to the draft HGMP (Section 6.1), ESA-listed natural and hatchery-origin adults and jacks captured at the Tucannon River adult trap will be used for the supplementation broodstock on an annual basis. No adults will be collected for the captive broodstock program. The captive broodstock program will be started from emergent fry from the supplementation program. No adults that return from the captive broodstock program will be used in the supplementation program unless future run sizes get critically low.

Broodstock size/natural population size: The draft HGMP (Section 1.11.1), lists the proposed annual broodstock collection level (maximum number of adult fish) as follows:

Supplementation Program: The current supplementation program level is to collect 100 adult fish annually (proposed 50 natural and 50 hatchery origin) of either hatchery or natural-origin. Additional jacks (above the 100 adult fish collected) may also be collected for broodstock purposes, but will not exceed the proportion of jacks captured at the Tucannon Adult Trap.

Captive Broodstock Program: For the captive broodstock program, no adults are collected. Instead, the program has been built by collecting eggs/fry from the hatchery supplementation program. This was done to lessen the effects of the program on the natural population. The number of spawned fish will vary based on the maturity by age of the captive broodstock.

The draft HGMP provides the broodstock collection levels from 1986-2001, and lists natural-origin and hatchery-origin broodstock.

Number of natural and hatchery-origin spring chinook collected from the Tucannon River for the supplementation program, 1986-2001.

Year	Natural Origin	Hatchery Origin
1986	116	0
1987	101	0
1988	116	9
1989	67	102
1990	60	75
1991	41	89
1992	47	50
1993	50	47
1994	36	34
1995	10	33
1996	35	45
1997	43	54
1998	48	41
1999	4	132
2000	12	69
2001	52	54

The draft HGMP provides the most recent 12-year (e.g. 1988-2000) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds. It also provides the estimated natural and hatchery-origin spawning spring chinook salmon based on weekly spawning ground surveys, carcass collection, and adult trap information in the Tucannon River from 1985-2001. The data are compiled from the LSRCP annual report for Tucannon River Spring Chinook Hatchery Evaluations (1986-2001).

Estimates of natural and hatchery reared Tucannon River spring chinook salmon on the spawning grounds from the Tucannon River, 1985-2001.				
Run Year	**Natural Origin**	**Hatchery Origin**	**Percent Natural**	**Percent Hatchery**
1985	539	0	100	0
1986	570	0	100	0
1987	527	0	100	0
1988	322	11	96.7	3.3
1989	294	8	97.4	2.6
1990	433	178	70.9	29.1
1991	219	171	56.2	43.8
1992	336	228	59.6	40.4
1993	254	182	58.3	41.7
1994	62	8	88.6	11.4
1995	11	0	100	0
1996	106	32	76.8	23.2
1997	78	68	53.4	46.6
1998	37	14	72.5	27.5
1999	2	105	1.9	98.1
2000	70	169	29.3	70.7
2001	658	236	73.6	26.4

In general, half or less of the adults reaching the weir have been taken for broodstock, and all progeny from the program have been marked since its inception.

Subsequent events: In the 1990s, adult returns to the Tucannon, as was the case throughout the Snake River Basin, declined sharply. Starting with broodyear 1997, some of the supplementation progeny were captively reared to adults to produce additional eggs. Broodyear 2001 is the last class that will be captive reared.

Recent events:

Relationship to current natural population: See above.

Current program goals: According to the draft HGMP (Section 1.7), the purpose (goal) of program (based on priority) is to provide mitigation as specified under the LSRCP program (USACE 1975) while meeting conservation and recovery criteria established for the Tucannon River population and Snake River spring/summer chinook ESU. The goal of this program is the restoration and enhancement of spring chinook salmon in the Tucannon River using supplementation with the indigenous stock. A second goal is to conserve genetic resources of naturally reproducing Tucannon River spring chinook due to low population abundance using captive broodstock propagation methods.

Population genetics: The stock is relatively distinct from other Snake River spring and summer-run chinook salmon and very different from Snake River fall-run populations. It may be intermediate between Mid-Columbia River and Upper Columbia River spring-run populations, which would correspond well with its geographic location (Myers et al. 1998).

Morphology/behavior/fitness: According to the draft HGMP (Section 6.2.4), to date WDFW has no evidence that the hatchery supplementation fish, natural-origin fish, or captive broodstock fish are genetically or ecologically different from one another. The spring chinook program in the Tucannon River has been in operation for only 3.5 generations, and it is unlikely that much genetic change has occurred. Further, the captive broodstock program has just begun, and given the short-term nature (one generation, 5 broodyears) of the program, will not likely cause any genetic or ecological changes in the natural population.

Previous determinations:

Category and rationale: Category 1a. The hatchery population was founded relatively recently as a 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.

OREGON COAST RECOVERY DOMAIN

Oregon Coastal Coho ESU[4]

A note on Oregon coastal coho phenotypic data (information from Kathryn Kostow, ODFW): There are no morphological or life-history data for coho salmon compiled for this area, but information is available from adult and juvenile traps, weirs, and several fish ladders. These data could be substantial. The data would be of highest quality for the last 5 or so years because during that time, all hatchery coho have been marked and the coastwide juvenile and adult monitoring increased under the Oregon Plan. These data would take months to locate, compile and analyze and we were, therefore, unable to include such analyses in the current report due to time constraints.

Stock name(s): *North Fork Nehalem coho salmon (32); Fishhawk Lake coho salmon (99).*

Unless otherwise noted, all information on these stocks was obtained from Kostow et al. (2000a).

Hatchery/collection site: Two hatchery stocks are used together in a single hatchery program on the Nehalem River, Oregon. The North Fork Nehalem stock (32) is used in 2 years of the coho generation cycle and the Fishhawk Lake stock (99) is used in the third year. These two stocks have different origins and have been under cultivation for different periods. All current broodstock collection and hatchery fish releases for both stocks occur at Nehalem Hatchery, North Fork Nehalem River, Oregon.

Broodstock origin and history

North Fork Nehalem stock (32)

Year founded: The current stock was started in 1966 at the North Fork Nehalem site. The Foley Creek stock was apparently started in 1926.

Source: The current stock was founded by moving the older Foley Creek stock from Foley Creek, a tributary of the Lower Nehalem River where the original Nehalem River hatchery operated from 1926 to 1965. The stock was started with returning hatchery adults from smolts produced from the 1964 and 1965 broodyears at the Foley Creek site and then released at the new hatchery site and from wild fish collected from the North Fork Nehalem.

During the transfer period, the third broodyear of the older Foley Creek stock was lost. In an initial effort to make up the third year, Trask stock coho (34) were released at this site in 1966-67, and for release years 1969 through 1977 the coho stock released was not documented.

[4] The data and stock histories in this section were obtained and summarized by Kathryn Kostow, ODFW.

Some sources suggest that a mix of Alsea and Trask stock was used for the third brood cycles during that time period. Poor survival resulted in the establishment of the Fishhawk Lake wild coho (stock 99) for the third year.

While in operation, the Foley Creek hatchery collected coho eggs from Foley Creek. It also received eggs from other areas between 1928 through 1952. These areas include Klaskanine, Necanicum, Trask, Nestucca, Siletz and Coos Rivers, and Tenmile Creek.

Broodstock size/natural population size: The target broodstock size in the Nehalem is about 300 fish. The average wild population size for the Nehalem/Necanicum population group for 1990-2000 was about 3,600 wild coho. Most of the wild coho are in the upper Nehalem.

Subsequent events: Since 1996, this broodstock has been collected at the hatchery on the North Fork Nehalem. There was an initial effort to use an electric weir at this site to capture fish that were migrating up the North Fork, but the weir was ineffective and its use was eventually discontinued. Instead, the broodstock collection relied on fish that voluntarily entered the hatchery trap, located in a side channel off of the North Fork. Hatchery coho were not marked in this basin until the late 1990s. Now that the hatchery fish are marked, it is evident that few wild coho ever enter the hatchery trap. This was probably the case for most years of this program.

Recent events: There have been no recent changes in this program, except that all the hatchery fish are now marked. There is no effort to include wild fish in the broodstock.

Relationship to current natural population: There is no effort to include wild fish in this broodstock. The recent returns of mass marked coho salmon indicate that few, if any, unmarked fish are incorporated into the broodstock.

It is ODFW's intention to keep this broodstock isolated from wild fish in the Nehalem Basin. Stray rates into all areas of the Nehalem, outside of the North Fork, are very low, between 0% and 5%. Hatchery straying into the streams of the North Fork near the hatchery remains high. There is an effort to restrict the number of strays that pass Nehalem Falls, which is located upstream of the hatchery. However, not all coho use the Nehalem Falls ladder and monitoring indicates that some hatchery straying continues to occur.

Program goal: This hatchery stock is used primarily to provide fish for fisheries.

Genetics data: This broodstock clustered other Oregon Coast coho salmon populations (Weitkamp et al. 1995).

Phenotypic data: Recent information is available but has not been compiled.

Previous determination: NMFS (1998) concluded that this hatchery stock was of uncertain relationship to the ESU.

Category and rationale: Category 2c, based on the following characteristics: it was largely founded from within the ESU, although the older Foley Creek stock had a mixed origin. Has not received substantial non-ESU fish since 1950. Previously, some fish were transferred here from Klaskanine Hatchery in the Lower Columbia River ESU, however the Klaskanine stock at the time of the transfer had been including many Oregon Coastal fish. Genetics data indicate that the broodstock clusters with the Oregon Coast ESU. The broodstock was founded nearly 30 coho salmon generations ago, dating back into the 1920s. Few or no wild fish have been included in the broodstock for many years.

Broodstock origin and history: *Fishhawk Lake stock (99)*

Year founded: 1978.

Source: Wild coho salmon collected from Fishhawk Creek, within the distribution of the Upper Nehalem sub-population.

Broodstock size/natural population size: The target broodstock size in the Nehalem is about 300 fish. The average naturally spawning population size for the Nehalem/Necanicum population group for 1990-2000 was about 3,600 wild coho. Most of the naturally spawning coho are in the Upper Nehalem.

Subsequent events: Naturally-produced coho salmon collected from Fishhawk Creek, within the distribution of the Upper Nehalem population, were used for the 1978 to 1980 broodyears. Returning hatchery adults collected at the hatchery on the North Fork Nelahem have been used since 1981. However, for broodyears 1978 through 1986, both a wild fish-origin stock and a returning hatchery fish-origin stock were raised each year. The two stocks were kept separate by differential marking. Since the 1987 broodyear, the broodstock has been made up only of hatchery fish returning to the hatchery on the North Fork Nehalem. Only one stock has been raised each year.

Recent events: No new developments since 1990.

Relationship to current natural population: No wild fish from Fishhawk Creek have been used in this broodstock since 1987. The broodstock has been collected in the North Fork Nehalem. As stated for the North Fork Nehalem stock 32 above, now that all the hatchery fish are marked, it is evident that no wild fish from the North Fork Nehalem are being incorporated into the stock accidentally.

Program goal: This hatchery stock is used primarily to provide fish for fisheries. The stock could be considered for use in a reintroduction into Neahkanie Creek, a Lower Nehalem Basin tributary that has been blocked until recently, but only if wild fish are not available or are unsuccessful.

Genetics data: This broodstock clustered other Oregon coast coho salmon populations (Weitkamp et al. 1995).

Phenotypic data: Recent information is available but has not been compiled.

Previous determination: NMFS (1998) determined that this stock was part of the ESU, but not essential for recovery.

Category and rationale: Category 2a or 3a, based on the following characteristics: this broodstock was founded from a population within the same basin, but has not included any wild fish since the late 1980s. The level of divergence between the hatchery stock and the local natural population is unknown, but could be substantial.

Stock name: *Trask coho salmon (34).*

Hatchery/collection site: Broodstock collection and hatchery fish release occur at Trask Hatchery and its satellite pond on the Trask River in the Tillamook Bay watershed, Oregon.

Broodstock origin and history

Year founded: Likely dates to the 1920s.

Source: The source of this stock included coho from the Nestucca River, Trask River, and several transfers from other unknown coastal stocks in 1928-1933 and in 1950.

Broodstock size/natural population size: The average naturally spawning population size for the Tillamook Bay coho salmon has been 1,800 fish between 1990 and 2000. It dropped to a low of 400 fish in the late 1990s. These naturally spawning coho are distributed across multiple tributaries of Tillamook Bay, including Trask River.

Subsequent events: Since 1961, the broodstock has been made up exclusively of fish collected at either of the hatchery's two traps. One of these traps is located on Gold Creek, a tributary of the Trask River adjacent to the upper hatchery ponds, while the other is a pond and fishway located near the lower hatchery ponds, adjacent to Trask River. Neither trap blocks upstream passage to the Trask River. Hatchery coho have been 100% marked only since the late 1990s. Since that time, it has been evident that there are no to few wild fish being captured in the hatchery trap, so it is likely that few, if any, wild fish have been incorporated into the broodstock in the last several decades.

Recent events: All of the hatchery fish are now marked. There are no efforts to incorporate wild fish into this broodstock.

Relationship to current natural population: It is unlikely that any wild fish have been incorporated into this broodstock for many years. Now that the hatchery fish are 100% marked, it is clear that no wild fish are being added to the broodstock accidentally.

Program goal or use of broodstock: This broodstock is used to provide fish for fisheries.

Genetics data: This broodstock clustered other Oregon coast coho salmon populations (Weitkamp et al. 1995).

Phenotypic data: No data have been compiled, although it is likely that some is available.

Previous determinations: NMFS (1998) did not consider this stock to part of the ESU.

Category and rationale: Category 2c or 3c, based on the following criteria: this broodstock was founded from a mix of populations from within the ESU, including the fish from the basin in which it is released. There is some uncertainty in how far much this stock has diverged from the natural coho population(s) in the basin. The broodstock was founded many salmon generations ago, and has probably not included any substantial numbers of wild fish for several decades.

Stock name: *Siletz coho salmon (ODFW #33).*

Hatchery/collection site: Broodstock are collected at Salmon River Hatchery, and occasionally at the old Siletz Hatchery site on Rock Creek on the Siletz. Hatchery fish are released into the Salmon River and Siletz River, Oregon.

Broodstock origin and history

Year founded: 1937.

Source: About one third of the fish for the initial broodstock were from Rock Creek, a tributary of the Siletz, and about two thirds of the fish were from Tenmile Lake, further south on the Oregon Coast. The Siletz stock was moved to the Salmon River Hatchery on the Salmon River with the 1986 broodyear because of the closure of the Siletz Hatchery.

Broodstock size/natural population size: Wild population size data is not available for the Salmon River, however the number of unmarked coho in the river is extremely low.

Subsequent events: During the Siletz Hatchery's operations, other coho stocks that were also released into the Siletz included Klaskanine stock (in the 1949 broodyear, less than 200,000 fish released), Trask stock (733,000 smolts total over 2 years, 1976, 1978), Fall Creek stock (101,000 smolts in 1980), and a Nehalem-Siletz mixture (379,000 smolts total over 2 years, 1955, 1960). Since the broodstock was moved to the Salmon River, the broodstock has included fish collected from the Siletz and Salmon Rivers. Between 1983 and 1986, some Alsea River fish (Fall Creek stock) were also included. Hatchery fish were not 100% marked until the late 1990s, when it became evident that the wild population in the Salmon River was very small. It is unlikely that wild fish were being incorporated into the brood since the stock was moved to the Salmon River.

Recent events: The hatchery fish are now 100% marked. Wild broodstock have not deliberately been incorporated into this stock. Based on the lack of unmarked fish observed in the system, it is now clear that the wild Salmon River coho population is very small and few, if any, wild fish enter the hatchery trap.

Relationship to current natural population: Straying into the Salmon River by this hatchery stock is high. Few unmarked (wild) fish are seen in the Salmon River, indicating that natural production by the hatchery fish is poor, and also that the wild population is small, if present. No wild fish are being included into the broodstock.

Program goal or use of broodstock: This broodstock is used to provide fish for harvest.

Genetics data: This broodstock clustered other Oregon coast coho salmon populations (Weitkamp et al. 1995, NMFS 1997).

Phenotypic data: No data has been compiled, although it is likely that some is available.

Previous determinations: NMFS (1998) did not consider this stock to be part of the ESU.

Category and rationale: Category 2a or 3a, based on the following criteria: the broodstock was founded from a mix of populations in the ESU, including fish from the basins into which this stock is released. It has not received substantial non-ESU fish since 1950. A 1949 transfer from Klaskanine Hatchery in the Lower Columbia River ESU was likely made up of Oregon coast coho. Broodstock was founded many coho salmon generation ago. It has not included any wild fish for a long time. The relationship with local natural population is uncertain, but the stock seems likely to be moderately to substantially diverged from any native local stocks.

Stock name: *Umpqua River coho salmon (ODFW #55); Cow Creek coho salmon (ODFW #18).*

Hatchery/collection site: The Umpqua stock 55 and the Cow Creek stock 18 are collected and used in the Umpqua River, Oregon. Broodstock for Umpqua stock 55 are currently collected at either Rock Creek Hatchery on Rock Creek, tributary of the North Umpqua, or at Winchester Dam near the mouth of the North Umpqua. Releases include smolts into the North Umpqua, occasionally into the South Umpqua, and unfed fry into the same basins and other Lower Umpqua tributaries. Broodstock for Cow Creek stock 18 are collected just below a dam on Cow Creek, a tributary of the South Umpqua. Hatchery fish are released into Cow Creek.

Broodstock origin and history

Year founded: In the 1970s.

Source: Umpqua stock 55 was originally stock 151 and was founded on the Smith River, a major tributary of the Lower Umpqua near the estuary. It was transferred to the North Umpqua in the 1980s and renamed Umpqua stock 55. It was then transferred again to the South Umpqua in 1986 and renamed Cow Creek stock 18. The North Umpqua, South Umpqua, and Smith River are different sub-populations in the Umpqua River Basin.

Broodstock size/natural population size: The Umpqua 55 broodstock includes several hundred fish annually. The wild coho salmon population in the Umpqua averaged over 6,000 fish between 1990 and 2000. The count at Winchester Dam is a small portion of the total wild fish count. There are also some wild coho salmon in Cow Creek.

Subsequent events: In the 1980s, stock 151 was transferred to Rock Creek Hatchery, on Rock Creek, a tributary of the North Umpqua, and renamed Umpqua stock 55. At the time of the transfer, the wild North Umpqua population was considered to be too small to be used as a source for a new broodstock. Hatchery fish were not 100% marked until the late 1990s, so it is not clear whether any North Umpqua wild fish were being incorporated into the broodstock until the late 1990s. It is likely few were after 100% marking began. It was then determined that few wild fish were being caught at the Rock Creek Hatchery trap. ODFW also takes natural-origin broodstock from Winchester Dam, some 32 km downstream of the hatchery. The stock was further transferred to the South Umpqua in 1986 and renamed Cow Creek Stock 18. Cow Creek maintains a fairly good run of natural-origin fish. It is likely that broodstock collected from the system are representative of the natural population.

Recent events: The hatchery fish are now 100% marked. Since that started, wild fish captured from Winchester Dam have been intentionally incorporated into the Umpqua stock 55 broodstock, although returning hatchery fish still dominate the brood. Currently, the goal is to include about 30% wild fish in the brood. Wild fish from Cow Creek are also included in stock 18 when possible, but this rarely occurs. Periodic releases of Umpqua stock 55 into Cow Creek continue to occur when stock 18 does not meet production goals. Also, the returning hatchery adults from these releases continue to provide most of the broodstock for stock 18.

Relationship to current natural population: Umpqua stock 55 has been widely outplanted as unfed fry. Studies of otolith-marked unfed fry indicate that some adult coho have returned from these releases. Adults from smolt releases stray primarily into the reaches of the lower mainstem North Umpqua between Winchester Dam and Rock Creek, and into Rock Creek. Some North Umpqua wild fish have been added to the broodstock in the last few years, but not enough to consider the stock completely re-established. Few wild fish have been caught at the trapping site on Cow Creek. Therefore, Cow Creek stock 18 is essentially made up of returning hatchery adults from releases of Umpqua stock 55. Stock 18 dominate the natural spawning areas in Upper Cow Creek below the dam.

Program goal: These hatchery stocks are used to provide fish for harvest. They also have been widely outplanted to supplement wild populations in the Umpqua. Umpqua stock 55 was used in 2001 for an experimental supplementation/pedigree project in the Calapooia subbasin in the Umpqua.

Genetics data: These broodstocks clustered with other Oregon Coast coho salmon populations (Weitkamp et al. 1995). Recent microsatellite data indicate that there may be some differentiation between natural spawning groups within the Umpqua River Basin (Ford, unpublished data).

Phenotypic data: No data has been compiled.

Previous determinations: NMFS (1998) considered these stocks to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2a, based on the following characteristics: the broodstocks are from the Umpqua, although from another stream than where they are currently released. There may be some genetic differences between the original Smith River stock and the North Umpqua and South Umpqua wild populations. The broodstocks were founded many salmon generations ago. In the last few years, small numbers of wild fish have been included in the broodstocks. If more local, natural origin fish are incorporated into these stocks, their categorization should be reevaluated.

Stock name: *Woahink Lake coho salmon.*

Hatchery/collection site: Wild fish from Woahink Lake (an offshoot of Stilcoos Lake) are spawned by Oregon STEP volunteers. The two areas that may receive this stock are Little Woahink Lake, which was artificially formed off of Woahink Lake and is separated from it by an artificial berm, and Munsel Lake which is a "sterile" lake near Florence.

Broodstock origin and history

Year founded: Unsure.

Source: Woahink Lake, Stilcoos Lake Basin, Oregon. Wild fish are used as broodstock. This program does not take broodstock every year.

Broodstock size/natural population size: Just a small number of wild fish are used. The wild population size in the combined Oregon Lakes population has averaged over 7,000 fish between 1990-2000. Stilcoos Lake is one of the largest lakes in this system.

Subsequent events: Unfed or fed fry are released into two sterile lake systems that do not naturally have wild coho salmon. Munsel Lake cannot support coho salmon because there is no spawning habitat, although the lake provides rearing habitat. Little Woahink Lake is an artificial embayment of Woahink Lake that was formed from the natural lake by a berm. It provides no natural access for coho. This program only occurs periodically. In some years, rather than spawning adults, the volunteers just catch returning adults and release them into the lakes. In other years, no activity occurs.

Recent events:

Program goal: This is a public education project.

Genetics data: N/A.

Phenotypic data: N/A.

Previous determinations: Not previously evaluated.

Category and rationale: Category 1a. This broodstock meets the following criteria: it is from a native local population, although it is released into areas that do not have wild coho. The release areas are near the broodstock source. It uses 100% wild coho each time. The wild population source is considered to be part of the ESU.

Stock name: *Coos coho salmon (ODFW #37).*

Hatchery/collection site: Fish are collected on Priorly Creek and are currently released into South Slough and Noble Creek. All sites are in the Coos Basin, Oregon. This is an Oregon STEP program.

Broodstock origin and history

Year founded: 1983.

Source: This broodstock was established by collecting wild Coos Basin coho salmon at several traps in the Coos Basin.

Broodstock size/natural population size: The combined wild population size for the Coos and Coquille has averaged over 13,000 fish between 1990 and 2000. The broodstock goal is 168 fish (84 pairs), of which, 30% are natural-origin recruits.

Subsequent events: Broodstock continue to be collected at several locations in the Coos system, specifically targeting wild fish. However, returning hatchery fish are also used.

Recent events: All of the hatchery coho are now marked. The broodstock is now primarily taken at Priorly Creek trap on the South Fork Coos. The goal is to include at least 30% wild fish in the broodstock each year. This goal is met in most years.

Relationship to current natural population: This program includes about 30% wild fish each year. The current goal is to keep the hatchery fish from interbreeding with the wild naturally spawning Coos Basin populations. The hatchery fish are released into areas that do not have many or any wild coho. Straying is well monitored at weirs and traps throughout the Coos system. Stray rates into the major wild populations on the South Fork Coos and Millicoma are low, less than 5%.

Program goal: This broodstock is used to provide terminal fisheries in blind sloughs in Coos Bay.

Genetics data: Wild and hatchery samples from the Coos formed their own cluster within the larger cluster of Oregon Coast coho populations (Weitkamp et al. 1995).

Phenotypic data: No data has been compiled, although it is likely that some is available.

Previous determinations: NMFS (1998) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2a, based on the following criteria: the stock is from the native local Coos Bay coho, although it is currently released into areas in Coos Basin that have few or no wild coho. No genetic changes are evident. It was founded in the 1980s, but has received moderate proportions of wild fish into the broodstock since then. The wild population source is considered to be part of the ESU.

Stock name: *Coquille River coho salmon (ODFW #44).*

Hatchery/collection site: This stock is currently collected at Bandon Hatchery on Ferry Creek in the Lower Coquille Basin. Hatchery fish are released into either Ferry Creek or Sevenmile Creek, which is also located in the Lower Coquille River.

Broodstock origin and history

Year founded: 1980.

Source: Wild Coquille River coho, captured in traps or by netting.

Broodstock size/natural population size: The combined wild population size for the Coos and Coquille has averaged over 13,000 fish between 1990 and 2000. The broodstock consists of a few hundred fish.

Subsequent events: Broodstock fish were collected on Ferry Creek, including returning hatchery fish. For many years after founding, wild fish were targeted as broodstock fish were also collected at traps or by netting elsewhere in the Coquille.

Recent events: Since 1990, the broodstock have been collected on Ferry Creek. The hatchery fish are 100% marked. There is a goal to use at least 30% wild fish in the broodstock, but in more recent years, the proportion used has been about 25%.

Relationship to current natural population: This broodstock continues to include about 25% to 30% wild fish each year. It is released only into the Lower Coquille Basin in an effort to keep it isolated from wild Coquille River fish in the upper forks of the Coquille. Hatchery fish dominate in Ferry Creek.

Program goal: This broodstock is used to provide fish for fisheries. It is considered to be a useful source of fish for reintroduction into the Coquille, if any are needed. Currently, no reintroductions are planned.

Genetics data: This broodstock clustered with other Oregon Coast coho salmon populations (Weitkamp et al. 1995).

Phenotypic data: No data has been compiled, although it is likely that some is available.

Previous determinations: NMFS (1998) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2a, based on the following criteria: the stock is from the native local Coquille Basin coho, although it is currently kept out of the major Coquille wild populations. There are no genetic changes evident. It was founded in 1980, but has received regular moderate infusions of wild fish. The wild population source is considered to be part of the ESU.

SOUTHERN OREGON/NORTHERN CALIFORNIA COAST RECOVERY DOMAIN

Southern Oregon/Northern California Coho Salmon ESU

Stock name: *Rogue River coho salmon (ODFW #52).*

Hatchery/collection site: Throughout the history of the program, both the broodstock collection location and the smolt release location have been at Cole M. Rivers Hatchery, located on the Upper Rogue River, Oregon.

Broodstock origin and history

Year founded: This broodstock was founded in the 1974-75 broodyear.

Source: Wild Rogue River coho salmon from the Upper Rogue River sub-population that swam voluntarily into the hatchery trap following closure of Lost Creek Dam. The hatchery is at the base of the dam, which currently blocks fish access above the hatchery site.

Broodstock size/natural population size: The Rogue River stock 52 broodstock consists of approximately 300 fish taken annually. It is drawn randomly from thousands of hatchery adults that return to the hatchery trap. It includes about 100 wild fish, which, in some years, may be all the wild fish that enter the hatchery trap. The wild fish in the hatchery trap constitute less than 5% of the wild fish counted at Gold Ray Dam (2,000 to 3,000 wild fish in the late 1990s).

Subsequent events: Returning hatchery fish apparently were incorporated into the brood starting in 1977-78. Not all hatchery fish were marked, so definitive information on the numbers of hatchery and wild fish in the broodstock is not available until 1994-95. Starting in that year, and in subsequent years, the hatchery fish have been 100% marked. It is evident that only about 2% to 5% of the fish entering the trap are unmarked (wild) coho. Therefore, it is reasonable to assume that no more than 5% of the broodstock was wild coho in most years up to 1994-95. In the late 1970s, a broodstock from the Umpqua River was accidentally mixed with the Rogue broodstock. A considerable effort was made to remove the Umpqua River coho salmon, but it is possible that a few may have been mixed into the Rogue broodstock.

Recent events: Starting in 1994-95, an effort was made to incorporate wild fish to make up at least 30% of the broodstock. In recent years, the broodstock has been 100% wild coho salmon.

Relationship to current natural population: The program goal is that at least 30% of the broodstock are wild fish. More wild fish may be used if the plan is consistent with protecting wild fish. The program goal has been met or exceeded since 1994-95. The program goal is to keep straying from this hatchery stock into all Rogue River wild populations to 10% or less. Recent estimates of stray rates into wild populations below Gold Ray Dam are less than 5%. The area above Gold Ray Dam receives more hatchery strays, especially in the mainstem immediately below the hatchery.

Program goal: This hatchery program was developed to mitigate for the loss of coho to fisheries caused by three U.S. Army Corps of Engineers dams in the Upper Rogue River Basin. Returning hatchery adults were used for some outplanting into natural streams in the early 1980s. The stock is currently used to provide fish for fisheries. The stock has been identified as potentially useful for reintroductions in the Rogue River Basin, although no reintroductions are currently planned.

Genetics data: This broodstock, along with wild Rogue River coho samples, was included in several genetics analyses conducted in the 1990s as part of the NMFS coho salmon status review (Weitkamp et al. 1995). The Rogue River samples generally clustered with other Oregon or California coastal samples.

Phenotypic data: Adult phenotypic data was analyzed as part of the Hatchery Genetics Management Plan in 1998. The hatchery and wild fish have similar run times at Gold Ray Dam, adult age distribution, and adult size. Some juvenile phenotypic data has been more recently analyzed. The hatchery juveniles are significantly larger than wild juveniles. Out-migration timing is more narrow, but within the wild out-migration window. Wild and hatchery juveniles both smolt as yearlings.

Previous determinations: NMFS (1998) considered this stock to be part of the ESU, but not essential for recovery.

Category and rationale: Category 2a, based on the following characteristics: The stock is founded from the native local population into which it is released. It was founded in the 1970s, but has low to moderate regular infusions of wild fish since the mid-1990s. The wild population source is considered to be part of the ESU. There is no reason to believe the stock has diverged substantially from the natural population.

Stock Name: *Iron Gate Hatchery coho salmon (Klamath coho salmon [CDFG]).*

Hatchery/collection site: Iron Gate Hatchery is on the Klamath River 306 km upriver near Hornbrook (CDFG/NMFS 2001). This hatchery was built by Pacific Power and Light Company to mitigate the Iron Gate Project and is operated by CDFG. Fish are collected at an auxiliary ladder at the hatchery outlet and at the main ladder at the base of Iron Gate Dam.

Broodstock origin and history

Year founded: The hatchery was founded in 1965, with the first releases occurring in 1966.

Source: The Iron Gate Hatchery coho stock was founded with Trinity River fish released in 1966 and Cascade (Columbia River) fish released in 1966, 1968, 1969, and 1970. Other stocks released from Iron Gate include Trinity (1969 and 1977) and unknown (1970). Only Klamath stocks have been released at the hatchery since 1977. The Klamath Basin has also been planted with other hatchery stocks including Darrah Springs and Mad River hatcheries (NMFS 1997).

Broodstock size/natural population size: An average of 1,120 adult coho were trapped and 161 females were spawned during the broodyears 1991 to 2000 (Hiser 1993-95, Rushton 1996-2002a). Coho runs in the Klamath River Basin have been greatly diminished and are now largely composed of hatchery fish (CDFG 1994).

Subsequent events:

Recent events: All coho have been marked with a left maxillary clip since 1995. Hatchery and naturally spawned fish are used in the broodstock in proportion to that which return to the hatchery (CDFG/NMFS 2001).

Relationship to current natural population: Data not available.

Current program goals: The hatchery coho production goals are 75,000 yearlings raised to 10-20/lb and released from March 15 to May 1 (CDFG/NMFS 2001).

Population genetics: Allozyme data indicate that there is little genetic structure in California and Oregon coho, but a Northern and a Southern group are apparent (Weitkamp et al. 1995). Iron Gate Hatchery samples fall within the Northern group, but are not uniquely grouped. New microsatellite DNA data for California coho show Iron Gate and Trinity hatcheries grouped closely together as the only Northern samples and distant from other more Southern coho samples (D. Hedgecock, pers. commun.).

Morphology/behavior/fitness: No data available.

Previous determination: NMFS (1997) was uncertain about the Iron Gate stock ESU status.
Category and rationale: Category 2c. Since the late 1970s, the entire broodstock has originated from the Klamath River Basin, and has included some natural origin fish. The current

relationship between the hatchery and natural populations in the basin is uncertain, however. The hatchery population may be somewhat diverged from the local natural populations. The pre-1977 introductions of non-local stocks may have also influenced the hatchery stock.

Stock name: *Trinity River Hatchery coho salmon (Trinity River coho [CDFG]).*

Hatchery/collection site: Trinity River Hatchery is located below Lewiston Dam 248 km upriver (CDFG/NMFS 2001). The trap is located at the hatchery.

Broodstock origin and history

Year founded: The hatchery was completed in 1963 and the first release of coho was in 1966. Trapping began in 1958.

Source: The Trinity River Hatchery coho broodstock was started using progeny of fish collected at the weir, but Eel River (1965), Cascade (1966-1967, 1969), Alsea (1970), and Noyo (1970) stocks were released as well. Trinity River fish were also released in those years. Only Trinity River stocks have been released from the hatchery since 1970. Trinity River coho has been a very productive program and is often used as a source of coho in other hatcheries throughout California. The same non-local stocks used at the hatchery were also released elsewhere in the Trinity Basin.

Broodstock size/natural population size: About 3,814 adult coho were trapped during 1991 to 2001, and about 562 females were spawned during broodyears 1991 to 2001 (Ramsden 1993-2002). It is commonly assumed that there is little to no natural coho production in the Trinity Basin except for Trinity River Hatchery strays (CDFG/NMFS 2001).

Subsequent events:

Recent events: All coho are marked starting with the 1995 broodyear with a right maxillary clip. Hatchery and naturally spawned fish are used in the broodstock in proportion to that which return to the hatchery (CDFG/NMFS 2001).

Relationship to current natural population: It is commonly assumed that there is little to no natural coho production in the Trinity Basin except for Trinity River Hatchery strays (CDFG/NMFS 2001).

Current program goals: The hatchery coho production goals are 500,000 yearlings raised to 10-20/lb and released from March 15 to May 1 (CDFG/NMFS 2001).

Population genetics: Allozyme data, as mention above, indicate little genetic structure for coho in California (Weitkamp et al. 1995). All the Trinity samples are in the Northern group with the two Trinity River Hatchery samples grouped together within the Northern group. However, Trinity samples are separate from Deadwood Creek, Trinity River, and Iron Gate Hatchery. The microsatellite data show Iron Gate and Trinity Hatcheries grouped closely together and away from more Southern coho (D. Hedgecock pers. commun.).

Morphology/behavior/fitness: No data available.

Previous determination: NMFS (1997) determined that the Trinity River Hatchery stock was in the ESU, but not essential for recovery. However, it was determined that this hatchery may play an important role in recovery efforts because there appears to be no natural production in the basin.

Category and rationale: Category 2b. Although this stock has had introductions from non-local sources, since 1970, all of the broodstock has come from the hatchery weir. Genetic evidence does not group Trinity fish with the recorded source populations, suggesting that these introductions may have had little influence on the current stock. The relationship between the hatchery stock and any remaining natural populations in the basin is uncertain, but because of extensive hatchery straying, there is little reason to believe that there is substantial divergence between the natural and hatchery populations.

Stock name: *Mad River Hatchery coho salmon (Mad River Coho [CDFG]).*

Hatchery/collection site: Mad River Hatchery is located 20 km upriver near the town of Blue Lake, California (CDFG/NMFS 2001). The trap is located at the hatchery. Since 1995, the trap has been inoperable and all fish entering the hatchery through the ladder have been volunteers.

Broodstock origin and history

Year founded: The hatchery opened in 1970 and the first coho were released in 1971.

Source: Mad River Hatchery has used the greatest number of coho broodstocks, both out-of-basin and out-of-ESU, of any CDFG hatchery. The stock was begun with Noyo broodstock, released in 1970. Fish from the Noyo stock were released from the hatchery for an additional 12 years (1971, 1972, 1975, 1976, 1981, 1985, 1988, 1991, 1993-1994, and 1996). Other stocks released from the hatchery include Alsea (1973), Klamath (1981, 1983, 1986-1989), Klaskanine (1973), Prairie Creek (1988, 1990), Sandy (1980), Green River (1979), Trask (1972), Trinity (1971), and unknown (1977). Darrah Springs used exotic stocks to also release numerous coho salmon into the Mad River during 1960s and 1970s (NMFS 1997).

Broodstock size/natural population size: About 38 adult coho were trapped from 1991 to 2000, with 16 females spawned during the broodyears 1991 to 1999 (Gallagher 1994 a, b, c, 1995, Cartwright 1996-2001).

Subsequent events:

Recent events: Since the 1998 broodyear, trapping operations have averaged 23 fish. The program is undergoing re-evaluation. The 1999 coho broodyear was the last raised and was released in March of 2001. CDFG is currently beginning plans to use Mad River Hatchery as a coho recovery hatchery (CDFG/NMFS 2001).

Relationship to current natural population: There are no coho abundance estimates for the Mad River, but juveniles are widely distributed throughout the basin (NMFS 2001).

Current program goals: The hatchery is California's only supplementation hatchery. Its coho production goal before ending the program was 250,000 yearlings raised to 8-10/lb and released from March to May (CDFG/NMFS 2001).

Population genetics: Hjort and Schreck (1982) evaluated a number of coho hatchery stocks based on one locus. The Mad River Hatchery clusters separately from Iron Gate and Trinity hatcheries.

Morphology/behavior/fitness: No data available.

Previous determination: NMFS (1997) determined that the Mad River Hatchery stock was not in the ESU.

Category and rationale: Category 4. The program has a large, and recent, use of out-of-basin and out-of-ESU broodstock. The program has been ended and this decision only considers coho that returned during the 2002.

CALIFORNIA COASTAL RECOVERY DOMAINS

CALIFORNIA COASTAL RECOVERY DOMAINS-COHO SALMON

Central California Coast Coho ESU

Current California hatchery coho stocks being considered in this ESU include:

- Noyo River Fish Station.
- Don Clausen Fish Hatchery.
- Monterey Bay Salmon & Trout Project.

Stock name: *Noyo River Fish Station coho salmon (Noyo Coho [CDFG]).*

Hatchery/collection site: The Noyo River Egg Station is located on the South Fork Noyo River within the Jackson State Demonstration Forest 17 km inland of Fort Bragg (Jones 1998). Fish are spawned at the station, but incubated and raised at a number of CDFG facilities, most commonly Mad River Hatchery, Don Clausen Fish Hatchery, and Silverado Fish Transfer Station. Coho are imprinted at the Noyo Station for a minimum of two weeks before release.

Broodstock origin and history

Year founded: The site was originally constructed as a research facility in 1961, but egg-taking activities were initiated immediately.

Source: There are no records of broodstock from other locations being used at Noyo. The Noyo program has been very successful. Introductions into other watersheds using Noyo fish have been extensive. Marking has been sporadic, but when available, hatchery fish are excluded from the broodstock. Out-of-ESU coho have been planted in the Noyo River, including Alsea (Oregon Coast ESU) and Klaskanine (Lower Columbia River ESU) fish.

Broodstock size/natural population size: There was an average of 524 fish trapped from 1991 to 2001 and 100 females spawned in broodyears 1991 to 2001 (Grasse 1992-2002). However, in 1998 and 1999, only 16 and 85 fish were trapped. There are no coho salmon abundance estimates for the Noyo River, but juveniles are widely distributed and abundant throughout the basin (NMFS 2001).

Subsequent events:

Recent events:

Relationship to current natural population:

Current program goals: The program's goal is to develop a minimum sustained escapement to the South Fork Noyo River of 1,500 adult coho salmon annually. To reach this goal, the program target is 75,000 smolts released from March to April each year (Hunter 1987).

Population genetics: Microsatellite data show Noyo samples clustering tightly with other coho stocks south of the Eel River (D. Hedgecock, pers. commun.).

Morphology/behavior/fitness:

Previous determination: NMFS (1996) determined that the Noyo River Hatchery stock was in the ESU, but a final decision was deferred.

Category and rationale: Category 2a. The stock founded several decades ago from local collections, and there have been no out-of-basin stocks introduced into the broodstock over its history. An unknown but probably no more than moderate proportion of naturally spawned fish have been included into broodstock ever year.

Stock name: *Don Clausen Hatchery coho salmon (Warm Springs Coho [CDFG]).*

Hatchery/collection site: The Don Clausen Fish Hatchery is located on Dry Creek at the base of Warm Springs Dam, 71 km upstream from the mouth of the Russian River. The trap is at the hatchery.

Broodstock origin and history

Year founded: The hatchery went into service in 1980. The first releases were in 1981.

Source: Noyo River coho were heavily planted into the Russian River. The program was considered unsuccessful and ended in 1996. Starting in 2001, a captive broodstock program was initiated. Fish for the captive broodstock program are obtained by electrofishing 300 to 600 juveniles from the Green Valley and Mark West Springs Creeks (Russian River Basin), or the Olema and Redwood Creeks (Marin County) if necessary (NMFS 2002a).

Broodstock size/natural population size: From 300 to 600 juveniles will be taken from the Russian River, or failing that, the Lagunitas-Olema system. No population estimates are available for the Russian River Basin, but fish are rare and only occur consistently in Green Valley Creek (NMFS, draft HGMP).

Subsequent events:

Recent events: In 2001, 337 juvenile coho were taken from Green Valley and Mark West Springs Creeks (Russian River Basin), and Olema Creek to initiate the captive broodstock program (NMFS 2002a).

Relationship to current natural population:

Current program goals: The captive broodstock program proposes to release 50,000 fingerlings and 50,000 yearlings into five Russian River streams.

Population genetics: Allozyme data show Willow Creek, Russian River, grouping with the Southern cluster, closest to the South Fork of the Eel River (Weitkamp et al. 1995). Newer microsatellite data show the previous hatchery closely related to the Noyo River and Lagunitas Creek samples (D. Hedgecock, pers. commun)

Morphology/behavior/fitness:

Previous determination: There has been no previous NMFS consideration of the new Don Clausen captive broodstock hatchery program.

Category and rationale: Category 1a. This stock is recently founded from a native natural population.

Stock name: *Kingfisher Flat (Big Creek) Hatchery coho salmon (Scott Creek Coho [MBSTP]).*

Hatchery/collection site: Kingfisher Flat Hatchery is located on Big Creek, a tributary of Scott Creek, 6 RM from the mouth. This hatchery takes on increased importance because it is the Southern extent of coho salmon's range. Broodstock are taken by divers netting adults usually in Big Creek below the hatchery. However, this can also occur throughout the Scott Creek system (NMFS, Draft Biological Opinion).

Broodstock origin and history

Year founded: The Monterey Bay Salmon & Trout Program (MBSTP) started the Kingfisher Flat hatchery in 1975, but it was not in operation until 1982. California state hatchery activity near this site has a long history back to 1904 (Strieg 1991). Due to flood damage, the state hatchery program ended in 1942. There was also a nearby ocean-ranching operation, Silver-King Oceanic Farms, at Waddell Creek and the San Lorenzo River from the 1960s until the early 1980s.

Source: Since 1976, when the MBSTP took over operations, there have been no out-of-basin fish introduced into Scott Creek. Since then, broodstock have been taken by nets in Scott Creek. All coho are marked. No hatchery fish are used in spawning unless minimum goals are not met. Mating occurs in a factorial protocol. Prior to 1942, when there was a state hatchery, there were widespread introductions of broodstock from within California, including Mt. Shasta (1913, 1915, 1917, 1928, and 1937), Ft. Seward (1930, and 1932), and Prairie Creek (1933, 1934, 1936, 1938, and 1941) hatcheries. This stock was considered an extremely healthy one and was widely planted throughout the state's coastal streams. During the Silver-King operation, broodstock was obtained from Oregon, Washington, British Columbia, and Alaska.

Broodstock size/natural population size: Up to 30 females and 45 males can be taken with the restriction that the first 10 spawning pairs to be observed must be undisturbed. Then, only one out of four females may be taken to insure natural spawning. However, in recent years, few to no fish have been taken for spawning due to low abundance. However, in 2001, 123 coho were observed and 26 wild females were taken for spawning. Of the remaining 97 coho, 43 were marked. There are no abundance surveys, but coho are well distributed within the Scott Creek basin (NMFS, Draft BO).

Subsequent events:

Recent events: Starting in 2002, a captive broodstock program for Scott Creek was initiated at the NMFS Santa Cruz Laboratory. The 2001 returning coho numbers to Scott Creek were estimated to be well over 300. The hatchery staff handled 109 females (26 wild) and 123 males (36 wild).

Relationship to current natural population:

Current program goals: The goal is to spawn 30 unmarked females and 45 unmarked males to obtain approximately 60,000 eggs (NMFS 2002b).

Population genetics: Microsatellite data show Scott Creek samples, including Big Creek Hatchery samples, clustering tightly together as a branch of the Central California group (D. Hedgecock, per. commun.).

Morphology/behavior/fitness:

Previous determination: NMFS (1996) determined that the Kingfisher Flat Hatchery stock was in the ESU, but a final decision was deferred.

Category and rationale: Category 1a. There have been no introductions into the watershed in the last 30 years and, in most years, the broodstock has consisted substantially or entirely of wild fish.

CALIFORNIA COASTAL RECOVERY DOMAINS-STEELHEAD

Northern California Steelhead ESU

Current California hatchery steelhead stocks being considered in this ESU include:

- Mad River Hatchery.
- Yager Creek Hatchery.
- North Fork Gualala River Steelhead Project.

Stock name: *Mad River Hatchery steelhead (Mad River Steelhead [CDFG]).*

Hatchery/collection site: Mad River Hatchery is located 20 km upriver near the town of Blue Lake, California (CDFG/NMFS 2001). The trap is located at the hatchery. Since 1995, the trap has been inoperable and all fish entering the hatchery through the ladder have been volunteers.

Broodstock origin and history

Year founded: The hatchery was opened in 1970, and steelhead were first released in 1971.

Source: The original steelhead releases were from adults taken at Benbow Dam on the South Fork of the Eel River. Between 1972 and 1974, broodstock at Mad River Hatchery were composed almost exclusively of South Fork Eel River steelhead. After 1974, returns to the hatchery supplied about 90% of the egg take; others eggs originated from Eel River steelhead. In addition, over 500 adult San Lorenzo River steelhead were spawned at Mad River Hatchery in 1972. Progeny of these fish may have been planted in the basin. All subsequent broodyears have come from trapping at the hatchery.

Broodstock size/natural population size: About 5,536 adults were trapped from 1991 to 2002 with an average of 178 females spawned during the broodyears 1991-2002 (Gallagher 1994 a, b, c, 1995, Cartwright 1996-2001). There are no abundance estimates for the Mad River, but steelhead are widespread and abundant throughout the basin.

Subsequent events:

Recent events: Starting in 1998, steelhead have been 100% marked. Fish are included in the broodstock in proportion to the numbers returned.

Relationship to current natural population:

Current program goals: The current production goals are 250,000 yearlings raised to 4-8/lb for release in March to May.

Population genetics: Allozyme data group Mad River samples in with the Mad River Hatchery and then with the Eel River (Busby et al. 1996).

Morphology/behavior/fitness:

Previous determination: NMFS (1998b) determined that the Mad River Hatchery stock was not in the ESU.

Category and rationale: Category 3c. This stock was primarily founded from fish that are not local to the basin. There have been no introductions since 1974, and some naturally spawned fish are included in the broodstock. However, it remains likely that the stock is substantially diverged from most native, natural populations in the watershed.

Stock name: *Yager Creek Hatchery (Yager Creek Steelhead [PalCo]).*

Hatchery/collection site: The Yager Creek trapping and rearing facility is located at the confluence of Yager and Cooper Mill Creeks (tributaries of the Van Duzen River, 7 km from its mouth, and 72 km from the mouth of the Eel River).

Broodstock origin and history

Year founded: The project was initiated in 1976.

Source: Adult broodstock are taken from Yeager Creek and juveniles are released in the Van Duzen River Basin. As with all cooperative hatcheries, the fish are all marked and hatchery fish are excluded from broodstock. There are no records of introductions to the broodstock.

Broodstock size/natural population size: In broodyear 1989, 20,040 excess Mad River steelhead were reared and released in Yager Creek (Yarbrough 1994, Radford 1996-1998a, b, Ayers, pers. commun.). Trapped adult steelhead averaged 21, and spawned females averaged five in the years 1993 to 1995. There was an average of 8,273 fingerlings release from 1991-1999. There is no estimate of population size in Yager Creek.

Subsequent events:

Recent events: About 4,600 Freshwater Creek (a tributary of Humboldt Bay) juvenile steelhead were released in the Yager Creek Basin in 1993 (Busby et al 1996).

Relationship to current natural population:

Current program goals: The goal is the restoration of Van Duzen River steelhead.

Population genetics: There are no genetic data for this hatchery.

Morphology/behavior/fitness:

Previous determination: NMFS (1998b) determined that the Yaeger Creek Hatchery stock was in the ESU, but was not essential for recovery.

Category and rationale: Category 1a. The broodstock consists primarily of locally collected, naturally produced fish.

Stock name: *North Fork Gualala River Hatchery chinook salmon (Gualala River Steelhead Project [CDFG/Gualala River Steelhead Project]).*

Hatchery/collection site: This project rears juvenile steelhead rescued from tributaries of the North Fork Gualala River. Rearing facilities are located on Doty Creek, a tributary of the Gualala River 12 km from the mouth. Steelhead smolts resulting from this program are released in Doty Creek.

Broodstock origin and history

Year founded: The project was started in 1981 and has operated sporadically since.

Source: Juvenile steelhead are rescued from the North Fork of the Gualala River and reared at Doty Creek.

Broodstock size/natural population size: An average of 3,740 fingerlings have been released in the years 1989-95, 1998, and 2000 (Yarbrough 1994, Radford 1996-1998a, b, Ayers, pers. commun.). There is no abundance estimates for the Gualala River.

Subsequent events:

Recent events:

Relationship to current natural population: Only naturally spawned juveniles are reared at this facility.

Current program goals: The goal is restoration of Gualala River steelhead.

Population genetics: There are no genetic data for this hatchery.

Morphology/behavior/fitness:

Previous determination: NMFS (1998b) determined that the North Fork Gualala program was in the ESU, but not essential for recovery.

Category and rationale: Category 1a. Only local, naturally produced fish are used in the broodstock.

Central California Steelhead ESU

Current California hatchery steelhead stocks being considered in this ESU include:

- Don Clausen Fish Hatchery.
- Monterey Bay Salmon & Trout Project.

Stock name: *Don Clausen Fish Hatchery Steelhead [CDFG].*

Hatchery/collection site: The Don Clausen Fish Hatchery is located on Dry Creek, 9 km from the confluence of Dry Creek and 71 km from the mouth of the Russian River. In 1992, the Coyote Valley Fish Facility was opened at the base of Coyote Valley Dam on the East Fork of the Russian River, 98 miles from the mouth. Both facilities trap fish on site. Coyote Valley fish are trapped and spawned there, but raised at Don Clausen Hatchery. The Coyote Valley steelhead are imprinted for 30 days at the facility before release.

Broodstock origin and history

Year founded: The hatchery was founded in 1981, and the first steelhead releases were in 1982. The Coyote Valley Fish facility was opened in 1992.

Source: The Don Clausen Hatchery has had few out-of-basin transfers into its broodstock. However, significant numbers of Mad River Hatchery steelhead have been released into the basin prior to the construction of the hatchery. In the earlier part of the century, steelhead from Scott Creek were released throughout the basin. Since the Coyote Valley Fish Facility has been constructed, the broodstock has been taken from trapping at the facility.

Broodstock size/natural population size: At Don Clausen Hatchery, fish trapped from 1992-2002 averaged 3,301, with 244 females spawned during the broodyears 1992-2002 (Williams 1993, Quinones 1994, CDFG 2000). At the Coyote Valley Fish Facility, there have been an average of 1,947 steelhead trapped from 1993-2002, and an average of 124 females spawned (Cartwright 1993, 1994, Fortier 1994, Duran 1995, 1996, Wilson 1997-2002, Garcia 2002). There are no steelhead abundance estimates for the Russian River, but fish are widely distributed and plentiful (NMFS 2002a).

Subsequent events:

Recent events: Since 1998, steelhead have been 100% ad-clipped. Until broodyear 2000, both hatchery and naturally spawned fish were included in the broodstock in the proportion in which they returned to the hatchery. Since then, only adipose-marked fish are spawned. All unmarked steelhead are relocated into tributaries of Dry Creek.

Relationship to current natural population:

Current program goals: The production goal for Don Clausen Hatchery is 300,000 yearlings released by size beginning in December, and all fish by April. The Coyote Valley facility's goal is 200,000 yearlings that volitionally release between January and March.

Population genetics: There are no genetic data for this stock.

Morphology/behavior/fitness:

Previous determination: NMFS (1997a) determined that the Don Clausen Fish Hatchery stock was of uncertain ESU status.

Category and rationale: Category 2a. The stock was primarily founded from local collections and has been cultured for four to five generations with moderate levels of natural fish used in the broodstock. Since 2000, no natural fish have been included in the broodstock.

Stock name: *Kingfisher Flat (Big Creek) Hatchery steelhead (Scott Creek Steelhead [MBSTP]).*

Hatchery/collection site: Kingfisher Flat Hatchery is located on Big Creek, a tributary of Scott Creek, 6.4 RKm from the mouth of Scott Creek. Broodstock fish are taken by divers netting adults usually in Big Creek below the hatchery. However, take can also occur throughout the Scott Creek system (NMFS, Draft Biological Opinion). Steelhead are also taken at a trap on the San Lorenzo River in Felton. San Lorenzo River steelhead are kept separate and released back into the San Lorenzo Basin.

Broodstock origin and history

Year founded: The Kingfisher Flat Hatchery began in 1975, but it was not in operation until 1982. However, California state hatchery activity near this site has a long history back to 1904 (Strieg 1991). Due to flood damage, the state hatchery program ended in 1942.

Source: Under the California state hatchery program, Scott Creek steelhead were widely planted throughout Coastal California because they were thought to be an exceptionally healthy stock. The hatchery was damaged by floods in 1941-42 and closed. There are limited records of introductions from Mt. Shasta and Prairie Creek hatcheries into this broodstock. In 1976, the MBSTP began operations at the Big Creek location. Since then, broodstock have been taken either by divers in Scott Creek, or at a trap in the San Lorenzo River near Felton. Broodstock taken in the San Lorenzo River are kept separate. Since 1976, there have been no introductions into the broodstock. As with all cooperative hatcheries, the fish are all marked. Hatchery fish are excluded from the broodstock. Fish are released in either Scott Creek or the San Lorenzo River, depending on the source of the broodstock.

Broodstock size/natural population size: Trapped fish averaged 98, with 25 females spawned during the 1990-1996 broodyears (Yarbrough 1994, Radford 1996-1998a, b, Ayers, pers. commun.). For the broodyears 1989-1990, there was an average of 25,208 yearlings released. There are no abundance estimates for Scott Creek and the San Lorenzo River, but juveniles are widespread and abundant (NMFS 2002b).

Subsequent events:

Recent events: Starting in 2000, the practice of planting San Lorenzo fish into the North Fork of the Pajaro River Basin was discontinued. Although the distance is only a matter of kilometers, it transverses ESU boundaries.

Relationship to current natural population:

Current program goals: The goal is the restoration of local steelhead stocks.

Population genetics: Allozyme data groups Scott Creek, San Lorenzo and Carmel Rivers together (Busby et al. 1996). These three streams fall into the south of the Russian River grouping.

Morphology/behavior/fitness:

Previous determination: NMFS (1997a) determined that the Kingfisher Flat Hatchery stock was in the ESU, but that the stock probably was not essential for recovery.

Category and rationale: Category 1a. This stock consists primarily of collections of natural-origin fish from the local watershed.

South Central California Steelhead ESU

Current California hatchery steelhead stocks being considered in this ESU include:

- Whale Rock Hatchery

Stock name: *Whale Rock Hatchery steelhead (Whale Rock Steelhead [CDFG]).*

Hatchery/collection site: Whale Rock Reservoir was created in 1961 by placing a dam on Old Creek (and Cottontail Creek), 1 mile northwest of Cayucos, California. Old Creek had supported a large steelhead run prior to construction of the dam. These fish were presumably trapped behind the dam. Whale Rock Hatchery was established in 1992 in an effort to improve the sport fishery in the reservoir. The original Whale Rock broodstock (40 fish) was collected at a temporary weir placed in the reservoir at the mouth of Old Creek Cove (Nielsen et al. 1997). Adult fish are trapped in the shallows of the reservoir using nets that are set during late winter and spring, as the fish begin their migration upstream from the reservoir into Old Creek. The fish are held in an enclosure while they are monitored for ripeness. Eggs and sperm are collected from fish using non-lethal techniques, and then the adult fish are returned to the reservoir. Fish were originally hatched and raised at the Whale Rock Hatchery located below the dam at the maintenance facility, but are now raised at the Fillmore Hatchery in Ventura County. The fry are cared for until September or November, at which time they are released back into the reservoir as 7.5-12.5 cm fingerling trout.

Broodstock origin and history

Year founded: Hatchery operations began in 1992 and have been sporadic since. The project began as a cooperative venture, but has been taken over by CDFG. Fish were raised in 1992, 1994, 2000, and 2002 (John Bell, pers. commun.).

Source: All broodstock are taken from the reservoir.

Broodstock size/natural population size: During the program’s first 5 years, spawned females averaged 47. However, in 2002, a total of 129 females spawned (J. Bell, pers. commun.). Spawning success was poor. There are no population estimates for the reservoir and the hatchery fish are not marked.

Subsequent events:

Recent events:

Relationship to current natural population:

Current program goals: The goal is to increase angling success in Whale Rock Reservoir.

Population genetics: Despite a loss of an overall genetic diversity within the hatchery stock, Nielsen et al. (1997) found significant genetic identity remains between the Whale Rock Hatchery stock and wild steelhead in the Santa Ynez River and Malibu Creek.

Morphology/behavior/fitness:

Previous determination: NMFS (1997a) determined that the Whale Rock stock was in the ESU and that the stock was possibly essential for recovery.

Category and rationale: Category 3b. Broodstock were taken from the local population, but the small broodstock sizes may have led to substantial genetic divergence from the source stock. There is little information about the relationship between the hatchery and natural population.

CALIFORNIA COASTAL RECOVERY DOMAINS- CHINOOK SALMON

California Coast Chinook ESU

Current California hatchery chinook stocks being considered in this ESU include:

- Mad River Hatchery.
- Humboldt Fish Action Council, Freshwater Creek.
- Yager Creek Hatchery.
- Redwood Creek Hatchery.
- Hollow Tree Hatchery.
- Van Arsdale Fish Station.
- Mattole Salmon Group.

Stock name: *Mad River Hatchery chinook salmon (Mad River chinook salmon[CDFG]).*

Hatchery/collection site: Mad River Hatchery is located 20 km upriver near the town of Blue Lake, California (CDFG/NMFS 2001). The trap is located at the hatchery. Since 1995, the trap has been inoperable and all fish entering the hatchery through the ladder have been volunteers.

Broodstock origin and history

Year founded: The hatchery was opened in 1970, with the first chinook released in 1970.

Source: During the first year, no adult chinook salmon broodstock were trapped locally, but 650,000 juvenile fall chinook salmon from the Minter Creek Hatchery (Puget Sound ESU) were released. The next year, 323 adult fall-run chinook salmon were trapped from the Mad River. In 1973, 45 female chinook salmon from Freshwater Creek were brought to the Mad River Hatchery; their offspring accounted for about half of the juveniles released in the Mad River that year. In 1975-1978 and 1983, a total of 6.4 million Klamath-Trinity chinook were released. In subsequent years, returning adults have provided the eggs for the hatchery production.

Broodstock size/natural population size: The Mad River chinook program was ended in broodyear 2000. Average number of chinook adults trapped was only 23 fish from 1991 to 2000, with an average of nine females spawned (Gallagher 1994 a, b, c, 1995, Cartwright 1996-2001). There are no abundance estimates for the Mad River.

Subsequent events:

Recent events:

Relationship to current natural population:

Current program goals: Prior to ending the chinook program in 2000, the Mad River Hatchery chinook goals were to release 4 million smolts at 60/lb in May-June and 1 million yearlings at 8-10/lb in October. The hatchery averaged 20,000 to 50,000 smolts for its last several broodyears.

Population genetics: Allozyme data group the entire California Coastal ESU together including a Mad River Hatchery sample (Myers et al. 1998). However, there is not much of an apparent structure within the ESU.

Morphology/behavior/fitness:

Previous determination: NMFS (1999a) determined that the Mad River Hatchery stock was not in the ESU.

Category and rationale: Category 2a , 2b or 2c. This determination only affects returns for the next several years because the program was ended in 2000. Broodstock came from within the basin after early use of Minter Creek and Klamath fish. However, numbers of spawned fish were extremely small and therefore vulnerable to genetic bottlenecks. The relationship to natural populations appears extremely uncertain.

Stock name: *Freshwater Creek chinook salmon (Humboldt Fish Action Council chinook salmon (HFAC).*

Hatchery/collection site: Fish are trapped on Freshwater Creek approximately 7 km from the mouth. The hatchery is located 2 km upriver from the trap site on McCready Gulch (Radford 1998a).

Broodstock origin and history

Year founded: The project has been in operation since 1969, but has not raised fish every year.

Source: Adult spawners are taken from a nearby tributary of Freshwater Creek. As with all California cooperative hatchery programs, all juveniles are marked and not used as returning spawners unless egg goals are not met. Juveniles have been released in Freshwater Creek and Cloney Gulch (a Freshwater Creek tributary near the hatchery site). Stocking records do not document large releases of non-native fish into this basin, although during 1970-72, there were some 584,000 fish of unknown origin planted (NMFS 1999).

Broodstock size/natural population size: An average of five females spawned between years 1990 and 1995 (Yarbrough 1994, Radford 1996-1998a, b, Ayers, pers. commun.). For broodyears 1993-2001, there was an average of 20,342 chinook fingerlings released. There are no estimates of abundance for Freshwater Creek.

Subsequent events:

Recent events:

Relationship to current natural population:

Current program goals: The program's goals are restoration of chinook runs in Freshwater Creek.

Population genetics: There are no genetic data for these fish.

Morphology/behavior/fitness:

Previous determination: There was no previous determination for the Freshwater Creek stock.

Category and rationale: Category 1a. All broodstock have come from Freshwater Creek and usually consist entirely of natural origin fish.

Stock name: *Yager Creek Hatchery chinook salmon (Yager Creek Chinook [PalCo]).*

Hatchery/collection site: The Pacific Lumber Company (PalCo) has operated a trapping and rearing complex at Cooper Mill Creek, a tributary to Yager Creek, 7 km upriver from the mouth of the Van Duzen River and 72 km upriver from the mouth of the Eel River.

Broodstock origin and history

Year founded: The program was begun in 1976, but in the early years, fish were not always raised.

Source: Adult broodstock are taken from Yager Creek and juveniles are released into the Van Duzen River Basin. As with all co-op hatcheries, the fish are all marked and hatchery fish are excluded from broodstock.

Broodstock size/natural population size: An average of 12 females spawned during the broodyears 1990-1996 (Yarbrough 1994, Radford 1996-1998a, b, Ayers, pers. commun.). In the broodyears 1994-2001, there was an average of 27,819 fingerlings and 2,388 yearlings released. There are no estimates of abundance for the Van Duzen Basin.

Subsequent events:

Recent events: The hatchery was not operated for chinook in 2002 and the program is being re-evaluated.

Relationship to current natural population:

Current program goals: The program's goals are restoration of salmon and steelhead in the Yager Creek system.

Population genetics: The Van Duzen allozyme sample clusters in the center of the Coastal California samples (Myers et al. 1998).

Morphology/behavior/fitness:

Previous determination: NMFS (1999a) determined that the Yager Creek Hatchery stock was in the ESU, but not essential for recovery.

Category and rationale: Category 1a. All fish are taken from and returned to the basin and the broodstocks generally consist only of natural origin fish.

Stock name: *Redwood Creek Hatchery chinook salmon (Redwood Creek Chinook [PCFFA]).*

Hatchery/collection site: The rearing facility and trapping facility are on Marshal Creek, a tributary to Redwood Creek, 113 km from the mouth of the South Fork Eel River (CDFG/NMFS 2001).

Broodstock origin and history

Year founded: The program was initiated in 1983.

Source: All adult broodstock are taken from Redwood Creek. As with all cooperative hatcheries, the fish are all marked and hatchery fish are excluded from broodstock.

Broodstock size/natural population size: An average of 42 adults were trapped and 12 females were spawned during the broodyears 1990-1996 (Yarbrough 1994, Radford 1996-1998a, b, Ayers, pers. commun.). In the broodyears 1994-2001, there was an average of 24,437 fingerlings released. There are no abundance estimates for Redwood Creek.

Subsequent events:

Recent events:

Relationship to current natural population:

Current program goals: The program's goals are restoration of chinook and coho stocks in the Redwood Creek Basin. The program's permit allows the take of 20 female and 40 male chinook to obtain approximately 100,00 eggs.

Population genetics: There are no genetic data for these fish.

Morphology/behavior/fitness:

Previous determination: There was no previous determination for the Redwood Creek stock.

Category and rationale: Category 1a. All fish are taken from and returned to the basin. Hatchery fish are excluded from the broodstock.

Stock name: *Hollow Tree Creek Hatchery chinook salmon (Hollow Tree Chinook [PCFFA]).*

Hatchery/collection site: The Hollow Tree Creek Hatchery is located on Hollow Tree Creek, a tributary to the South Fork Eel River, 195 km from its mouth. The trap is located at the hatchery.

Broodstock origin and history

Year founded: The Hollow Tree program started in 1979, and has been in production since then.

Source: Broodstock are taken from the trap at the hatchery and released within Hollow Tree Creek. As with all cooperative hatcheries, all releases are marked and returning hatchery fish are excluded from the broodstock.

Broodstock size/natural population size: Trapped adult chinook averaged 114 and 12 females spawned during the broodyears from 1990-1996 (Yarbrough 1994, Radford 1996-1998a, b, Ayers, pers. commun.). In the broodyears 1994-2001, there was an average of 75,381 fingerlings released. There are no abundance estimates for Hollow Tree Creek.

Subsequent events:

Recent events:

Relationship to current natural population:

Current program goals: The hatchery has a target of 80,000 fingerlings each year. The program's permit allows the take of 100 female and 100 male chinook to obtain approximately 200,000 eggs.

Population genetics: Allozyme data show that fish from Hollow Tree Creek group with Redwood Creek and then with the Eel River as part of the California Coast chinook ESU (Myers et al. 1998).

Morphology/behavior/fitness:

Previous determination: NMFS (1999a) determined that the Hollowtree Creek Hatchery stock was in the ESU, but not essential for recovery.

Category and rationale: Category 1a. All fish are taken from and returned to the basin. Hatchery fish are excluded from the broodstock.

Stock name: *Van Arsdale Fish Station chinook salmon (Eel River Chinook [CDFG]).*

Hatchery/collection site: Van Arsdale Fish Station is located 250 km up the Eel River at Cape Horn Dam, northeast of Ukiah, California. This is the terminus of the Eel River. Fish are spawned at the station and then raised at other CDFG facilities. Fish are imprinted at the station for 30 days before release.

Broodstock origin and history

Year founded: The station was first established in 1930 and has been operated sporadically as an egg-take facility. Starting in 1994, an "emergency stock rescue" program was initiated.

Source: All broodstock are taken from the Eel River at the station or a nearby tributary Outlet Creek. In the mid-1970s, a program was begun to spawn chinook. In some years, eggs from Iron Gate Hatchery were imported and released into the Eel River (1972-1977, 625,000 eggs) (NMFS 1999). Both hatchery and naturally spawned fish are used as broodstock.

Broodstock size/natural population size: Adult returns averaged 211 fish trapped from 1994 to 2001 and 22 fish spawned during the broodyears 1994 to 2001 (Grasse 1995-2002). Since 1998, all fish are marked with CWT. This is a terminal fish station.

Subsequent events:

Recent events: Starting in 1998, all chinook released at Van Arsdale have been marked with CWT.

Relationship to current natural population:

Current program goals: The program goals are to produce 50,000 pre-smolts to 60-90/lb for release in May and to produce 50,000 yearlings to 10-15/lb for release in October or November (CDFG/NMFS 2001). These fish are now 100% tagged with CWT.

Population genetics: There are no genetic data for these fish.

Morphology/behavior/fitness:

Previous determination: NMFS (1999a) determined that the Van Arsdale Fish Station stock was in the ESU, but not essential for recovery.

Category and rationale: Category 2a. The lack of introduced broodstock and the inclusion of moderate proportions of naturally spawned fish into the broodstock suggest the stock is not substantially diverged from the natural population.

Stock name: *Mattole Watershed Salmon Support Group chinook salmon (Mattole River Chinook [MWSSG]).*

Hatchery/collection site: The Mattole Watershed Salmon Support Group traps adults returning to the mainstem Mattole River at Ettersberg and in the headwaters at Whitehorn and rears them along with rescued juveniles at facilities throughout the Mattole River Basin.

Broodstock origin and history

Year founded: The project was initiated in 1980.

Source: Broodstock are taken from the traps or from rescue situations and released within the Mattole River Basin. As with all cooperative hatcheries, all releases are marked. Returning hatchery fish are excluded from the broodstock. There have no introductions of fish from outside of the basin into the Mattole River (NMFS 1999).

Broodstock size/natural population size: Trapped adults averaged eight and spawned females averaged two for the broodstock years 1990-1996 (Yarbrough 1994, Radford 1996-1998a, b, Ayers, pers. commun.). In the broodyears 1995-1999, there was an average of 10,596 fingerlings released. Fish are not raised every year. There are no abundance estimates for the Mattole River Basin.

Subsequent events:

Recent events:

Relationship to current natural population:

Current program goals: The goal is to restore Mattole River salmon populations.

Population genetics: The Mattole River allozyme data groups within the California Coastal ESU but as an outer member in the cluster (Myers et al. 1998).

Morphology/behavior/fitness:

Previous determination: NMFS (1999a) determined that the Mattole Salmon Group stock was in the ESU, but not essential for recovery.

Category and rationale: Category 1a. All fish are taken from and returned to the basin. Hatchery fish are excluded from the broodstock.

CENTRAL VALLEY RECOVERY DOMAIN

Central Valley Steelhead ESU

Current California hatchery steelhead stocks being considered in this ESU include:

- Coleman NFH stock
- Feather River Hatchery stock
- Nimbus Hatchery stock
- Mokelumne Hatchery stock

Stock name: *Coleman NFH steelhead (Coleman steelhead [USFWS]).*

Hatchery/collection site: The U.S. Fish and Wildlife Service's Coleman NFH is located on Battle Creek, a tributary to the Sacramento River. There is a trap at the hatchery and broodstock is also taken at Keswick Dam, 432 km from the San Francisco Bay.

Broodstock origin and history

Year founded: Although operations at the hatchery began in 1942, steelhead were first released from here in 1948.

Source: The steelhead broodstock used at this hatchery are derived from Sacramento River stock(s) captured at the Keswick Dam trap on the Upper Sacramento River (USFWS 2001). Historically, most steelhead adults collected for Coleman NFH broodstock have come from Battle Creek or the Upper Sacramento River. Propagation of steelhead at the Coleman NFH was initiated in 1947, with the collection of natural-origin steelhead adults at the Keswick Dam fish trap. In 1953, hatchery-origin adults began to return to Battle Creek and steelhead broodstock were collected from Battle Creek for the first time. From 1954 through 1977, steelhead broodstock were collected at both Battle Creek and the fish trap at Keswick Dam. In 1978, steelhead broodstock were collected at the Red Bluff Diversion Dam. From 1979 through 1983, all steelhead broodstock fish were collected from Battle Creek. Steelhead broodstock was collected from the Keswick Dam fish trap most recently in 1984. Since then, all steelhead broodstock have been collected from Battle Creek. Throughout the history of the steelhead program at the Coleman NFH, both natural and hatchery adults have been used as broodstock. Steelhead collected at the Keswick Dam fish trap are considered to be natural origin, whereas steelhead collected from Battle Creek are considered to be a mix of natural- and hatchery-origin adults.

As noted above, steelhead broodstock fish at Coleman NFH have been collected primarily from Battle Creek or the Upper Sacramento River. However, transfers of steelhead broodstock and eggs from other locations occurred approximately eight times throughout the 55-year propagation program history. These transfers included; Feather River Hatchery (1983 and 1989), Nimbus Hatchery (1972, 1975, 1976, 1977, and 1984), and Mad River Hatchery (1978). With the exception of 1979, the majority of fish released from the Coleman NFH were the progeny of fish returning to the Upper Sacramento River. During 1979, 72% of the juveniles released were of Mad River Hatchery origin. Juvenile releases of Nimbus Hatchery origin (1973, 1975, 1976, 1977, 1978, and 1985), and Feather River Hatchery origin (1984) constituted 17% (on average) of the total number of fish released in those years. In all other years, broodstock were derived wholly from Upper Sacramento River collections. Kamloops trout (*O. m. gairdneri*) were reared at Coleman NFH in the past and released primarily in reservoirs. The exception were in 1958, 1962, 1963, and 1964, when small numbers (approximately 2,000 to 90,000) were released directly into the Sacramento River.

Broodstock size/natural population size: Trapped steelhead averaged 1,836, and 400 females spawned during the 1990s broodyears There are no population estimates for Battle Creek or the Upper Sacramento River naturally spawning populations, but steelhead are widespread and abundant (USFWS 2000).

Subsequent events: Although undocumented, it is believed that a selection of larger-sized steelhead for broodstock may have occurred during some years. This practice, which may have been common in California hatcheries, is believed to have occurred until the mid-1980s. Beginning in 1986, exclusive selection for larger than 544 mm steelhead broodstock was instituted to “breed out” characteristics believed to exist due to non-anadromy. This selective breeding for size was based on scale analysis (USFWS 1979). In the mid-1990s, research was conducted that showed that 1) growth rates of steelhead shorts were greater than those typical of resident rainbow trout in the Upper Sacramento River; 2) Coleman Hatchery-origin steelhead were not smaller than steelhead populations prior to the hatchery; and 3) steelhead shorts were identified as anadromous through otolith micro-chemistry (USFWS 2001). Based on this information, steelhead shorts have been reincorporated into Coleman broodstock since 1999.

Recent events: A 100% marking program for steelhead was instituted for broodyear 1998. All fish returning in 2002 will be identifiable. Beginning with spawning-season 2002-2003, Coleman NFH will follow a strategy of incorporating 10% natural spawners (40 out of 400) into the broodstock each year.

Relationship to current natural population:

Current program goals: The current goals are to produce 600,000 smolts to 4/lb. for release in January.

Population genetics: Genetic evidence indicates that Coleman NFH samples, along with Feather River Hatchery samples, cluster with wild Sacramento River steelhead in Deer and Mill Creeks (NMFS. 1998).

Morphology/behavior/fitness:

Previous determination: NMFS (1998b) determined that the Coleman NFH stock was in the ESU and that the stock may be essential for recovery.

Category and rationale: Category 2a. Coleman NFH steelhead stock was founded from Upper Sacramento River indigenous stock. Additionally, throughout the history of the steelhead program at the Coleman NFH, both natural and hatchery adults have been used as broodstock. Steelhead collected at the Keswick Dam trap are considered to be natural origin, whereas steelhead collected from Battle Creek are considered to be a mixture of natural- and hatchery-origin adults.

Stock name: *Feather River Hatchery steelhead (Feather River Steelhead [CDFG]).*

Hatchery/collection site: The Feather River Hatchery is located on the Feather River in the town of Oroville, California, 247 km from the mouth of San Francisco Bay. There have been a number of earlier steelhead hatcheries in the Feather River Basin. They are higher in the watershed now, behind Oroville Dam. These hatcheries used a mixture of natural-origin and out-of-ESU stocks. The present Feather River Hatchery production mitigates the loss of naturally spawning steelhead resulting from the construction of Oroville Dam.

Broodstock origin and history

Year founded: The hatchery was first operational in 1967. The first releases were in 1968.

Source: Beginning in 1967, steelhead adults were trapped in the Feather River to establish the hatchery broodstock. In addition to the use of returning adults, a domesticated broodstock (founded from adults collected from the Feather River) was reared at the hatchery to provide additional fish for release. The Nimbus Hatchery winter-run steelhead stock was incubated and released from the Feather River Hatchery in considerable numbers during the late 1970s and early 1980s. According to Reynolds et al. (1993), Nimbus Hatchery steelhead (founded from Eel River fish) may have introgressed into the Feather River Hatchery broodstock.

Broodstock size/natural population size: Adult returns averaged 1,613 fish during the 1990 broodyears. This is a terminal hatchery; however, there does appear to be some natural spawning in the Lower Feather and Yuba Rivers (McEwan and Jackson 1996).

Subsequent events: During the late 1970s and early 1980s, summer-run steelhead eggs from Nimbus Hatchery (Skamania stock) were reared and released from the Feather River Hatchery. This program was discontinued due to low return rates (NMFS 1998). It is unknown how much introgression occurred between summer and winter (fall) runs.

Recent events: Starting in 1998, releases are 100% marked with an adipose clip. Fish are included into the broodstock in proportion to their returns to the hatchery.

Relationship to current natural population:

Current program goals: The hatchery goal is 450,000 yearlings raised to 4/lb. and released in January and February.

Population genetics: Allozyme genetic evidence indicates that Feather River Hatchery samples along with Coleman NFH samples, cluster with wild Sacramento River steelhead in Deer and Mill Creeks, (NMFS 1998).

Morphology/behavior/fitness:

Previous determination: NMFS (1998b) determined that the Feather River Hatchery stock was in the ESU and that the stock may be essential for recovery.

Category and rationale: Category 2a. Although introduced broodstock was used during the initial stages, and molecular genetic data indicate a similarity to other Upper Sacramento stocks, the stock has probably incorporated few natural fish over many years.

Stock name: *Nimbus Hatchery steelhead (Eel River Steelhead [CDFG]).*

Hatchery/collection site: The Nimbus Salmon and Steelhead Hatchery is located on the American River in Rancho Cordova, California, 129 km from the mouth of San Francisco Bay. The trap is located at the hatchery.

Broodstock origin and history

Year founded: The hatchery began operation in 1955 as mitigation for the construction of Nimbus and Folsom dams. The first releases were not until 1960.

Source: From 1956-1962, an average of 230 winter-run fish entered the hatchery (January-April) each year. Due to the low return, additional eggs were acquired from the Van Arsdale Station (Eel River). During the first 7 years of operation, approximately 168,700 yearling smolts were released annually. Changes in rearing protocol resulted in higher returns to the hatchery and higher production. In 1978, 1988, and 1989, eggs from the Mad River Hatchery (Eel River stock) were transferred to the Nimbus Hatchery. During the 1980s, eggs from Coleman NFH were also transferred to the Nimbus Hatchery (Cramer et al. 1995). Fish from the Warm Springs Hatchery have also been utilized. In 1983 and 1990, 100,000 and 235,000 eggs (respectively) from the Warm Springs Hatchery were incorporated into the Nimbus Hatchery release in the American River. Run timing would indicate that the current Nimbus stock is Eel River derived (Cramer et al. 1995)—although a later arriving (and physically smaller) portion of the steelhead run may represent native fish (McEwan and Nelson 1991).

Broodstock size/natural population size: Adult returns averaged 1,421 in the 1990s broodyears. This is a terminal hatchery and there is very little spawning area between the hatchery and the confluence of the American and Sacramento rivers.

Subsequent events:

Recent events: Starting in 1998, releases were 100% marked with an adipose clip. Fish are included in the broodstock in proportion to their returns (CDFG/NMFS 2001).

Relationship to current natural population:

Current program goals: The hatchery goal is 430,000 yearlings raised to 4/lb. to be released in January and February.

Population genetics: Recent genetic evidence shows that Nimbus Hatchery steelhead cluster with Eel River samples from which the stock originated (NMFS 1998).

Morphology/behavior/fitness:

Previous determination: NMFS (1998b) determined that the Nimbus Hatchery stock was not in the ESU.

Category and rationale: Category 4. This stock was founded primarily from fish that are not part of the ESU.

Stock name: *Mokelumne River Hatchery steelhead (Eel River Steelhead [CDFG]).*

Hatchery/collection site: The Mokelumne River Hatchery is located on the Mokelumne River near Lodi, California. The trap is located at the hatchery.

Broodstock origin and history

Year founded: The hatchery began operation in 1964 as mitigation for Comanche Dam.

Source: Prior to the establishment of the Mokelumne Hatchery, there were numerous releases of steelhead from the Mt. Shasta, Mt. Whitney, Basin Creek, Fern Creek, Kaweah, and Mormon Creek hatcheries into the San Joaquin River Basin. Since there is no documentation of egg collections from local (San Joaquin River Basin) sources, it is presumed that these fish came from sources in the Eel River and Scott Creek/San Lorenzo River Basins. However, the exact origin of these released steelhead is unknown. Due to the very poor adult return rate, the hatchery has had to rely on external sources of eggs, primarily from Nimbus Hatchery, virtually every year. Because of the out-of-basin origin of the Nimbus steelhead stock, the 2000-2001 broodyear brought a policy change that allowed only Feather River steelhead eggs to supplement Mokelumne Hatchery steelhead. Considerable debate has arisen as to whether there were indigenous steelhead in the Mokelumne River prior to releases of out-of-basin hatchery stocks (Cramer et al. 1995, McEwan and Jackson 1996). Therefore, the origin of the few locally returning fish used to establish the Mokelumne River Hatchery broodstock is in question.

Broodstock size/natural population size: Adult returns averaged 48 during the 1990 broodyears. This is a terminal hatchery with little natural spawning in the Mokelumne River.

Subsequent events:

Recent events: Starting in 1998, releases were 100% marked with an adipose clip. Due to low numbers of returns, all returning fish are used as broodstock.

Relationship to current natural population:

Current program goals: The hatchery goal is 100,000 yearlings to 4/lb. to be released in January and February.

Population genetics: Although there are no genetic data, the Nimbus Hatchery operational plan states that if by late January, the Mokelumne River Hatchery has not been able to met its steelhead egg goal, up to 250,000 steelhead eggs will be taken at Nimbus for transfer to Mokelumne. This has occurred in most years. Due to a new policy that started with the 2000-2001 broodyear, only Feather River Hatchery eggs are used to supply the Mokelumne Hatchery steelhead stock.

Morphology/behavior/fitness:

Previous determination: NMFS (1998b) determined that the Mokelumne Hatchery stock was not in the ESU.

Category and rationale: Category 4. This stock was founded primarily from fish that are not considered part of the ESU.

Sacramento River Winter-Run Chinook ESU

Current California hatchery chinook stocks being considered in this ESU include:

- Livingston Stone NFH.

Stock name: *Livingston Stone NFH winter-run chinook salmon (NFH) (Sacramento winter-run chinook [USFWS]).*

Hatchery/collection site: Livingston Stone NFH is a conservation hatchery for winter-run chinook, located at the base of Shasta Dam. Fish are trapped at Keswick Dam, downstream from Shasta Dam.

Broodstock origin and history

Year founded: Livingston Stone NFH began operations in 1997, but the winter-run chinook conservation program began earlier at Coleman NFH.

Source: Between 1962 and 1990, Sacramento winter-run chinook were occasionally reared at Coleman NFH (USFWS 2001). Adults were taken at Red Bluff Diversion and Keswick Dams. Attempts to raise winter-run chinook in the early 1990s were unsatisfactory because the fish were imprinting on and returning to the Battle Creek or Coleman NFH, whereas the goal of the program was to supplement the natural population in the mainstem of the Upper Sacramento River. To assure proper imprinting of the juveniles and subsequent return of the adults to the Upper Sacramento River, Livingston Stone NFH was constructed in 1997 and the winter-run program was moved to that location. At Livingston Stone NFH, no more than 10% of the broodstock is composed of hatchery origin and no more that 15% of the run is taken for broodstock, up to a maximum of 120 fish. Previous DNA evidence suggested that spring-run chinook may have incorporated into winter-run stock (Hedgecock et al. 1995). Therefore, genetic analysis is conducted on all potential broodstock. Only those with significant genotypic odds of being winter-run are used in the broodstock.

Broodstock size/natural population size:

Subsequent events:

Recent events:

Relationship to current natural population:

Current program goals: The goal is to produce 250,000 pre-smolts at 60/lb. for release in January (USFWS 2001).

Population genetics: Winter-run genetic samples were the most distinct of any of the Central Valley chinook runs (Banks et al. 2000), and remain separate from other populations even after displacement from their natural spawning areas.

Morphology/behavior/fitness:

Previous determination: There was no previous determination for the Livingston Stone winter-run chinook stock.

Category and rationale: Category 1a. This stock was recently founded from the local natural population and uses a high fraction of natural-origin fish for broodstock.

Sacramento River Spring-Run ESU

Current California hatchery chinook stocks being considered in this ESU include:

- Feather River Hatchery.

Stock name: *Feather River Hatchery spring-run chinook salmon (Feather River Spring-Run[CDFG]).*

Hatchery/collection site: The Feather River Hatchery was built in Oroville to mitigate for the loss of habitat upstream of Oroville Dam. The hatchery is 247 km from the mouth of San Francisco Bay. The trap is located at the hatchery.

Broodstock origin and history

Year founded: The hatchery began operations in 1964.

Source: During 1968 and 1969, spring-run chinook were allowed to enter the hatchery as early as they arrived, which usually started in April and May (CDFG 1998). Because of water temperature issues, this early entry resulted in significant mortality until the fish were ready for spawning. Starting in 1970, spring-run fish were excluded from the hatchery until September 1. Spring-run broodstock fish were taken during the first 5 days in September and were selected by the hatchery manager as spring runs. The policy has been changed in recent years to allow fish from the first 15 days of September to be selected as spring-run broodstock.

Broodstock size/natural population size: Adult returns averaged 4,114 in the 1990 broodyears. This is a terminal hatchery. Releases averaged 3.3 million smolts during the 1990 broodyears. There is considerable debate concerning the status of naturally spawning spring-run chinook salmon in the Feather River.

Subsequent events: Based on returns of tagged fall progeny during the spring-run spawning season and vice versa, spring-run and fall-run chinook are thought to have been hybridization in the Feather River Hatchery (CDFG 1998).

Recent events:

Relationship to current natural population: Uncertain.

Current program goals: The goal is 5 million smolts raised to 40-60/lb. for release from April 1 to August 15. Releases averaged 3.3 million smolts during the 1990 broodyears.

Population genetics: Allozyme analysis of Feather River spring-run hatchery samples cluster with fall-run chinook (David Teel pers. commun.). Recent microsatellite evidence shows that Feather River Hatchery spring-runs cluster more closely with fall-run chinook than they do with naturally spawning spring-run chinook from Deer, Mill, and Butte Creek (D. Hedgecock, pers. commun.). However, there still is some small degree of separation between Feather River Hatchery spring-run and Feather River Hatchery fall-run chinook.

Morphology/behavior/fitness:

Previous determination: NMFS (1998b) determined that the Feather River spring-run chinook hatchery stock was in the ESU, but was not essential for recovery. USFWS (2003) suggests that this is a Category 2 stock.

Category and rationale: Category 4. There is considerable uncertainty about the origin and current status of this stock. Based on molecular genetic characters, these fish are more closely related to the California Central Valley fall run than spring run. If the naturally spawning population is in the ESU, and the hatchery stock is essentially the same as the natural population, then a case could be made that the stock should be a category 2b.

REFERENCES

Banks, M., V. Rashbrook, M. Calavetta, C. Dean, and D. Hedgecock. 2000. Analysis of microsatellite DNA resolves genetic structure and diversity of chinook salmon (*Oncorhynchus tshawytscha*). Can. J. Fish. Aquat. Sci. 57:915-927.

Bartlett, H. R., and B. Bugert. 1994. Methow River Basin spring chinook salmon hatchery program evaluation. 1992 Annual Report. Washington Department of Fish and Wildlife.

Bartlett, H. R. 1996. Summary report for Methow Basin spring chinook salmon hatchery program. 1994 Annual Report. Washington Department of Fish and Wildlife. Report # H97-01.

Bartlett, H. R. 1997. 1995 Summary report for Methow Basin spring chinook salmon hatchery program. Washington Department of Fish and Wildlife. Report #97-11.

Bartlett, H. R. 1998. 1996 Methow spring chinook summary report. Washington Department of Fish and Wildlife. Report # H98-11.

Bartlett, H.R. 2001. Summary report for the 1997 brood year Methow Basin spring chinook salmon hatchery program. Washington Department of Fish and Wildlife. Annual report #: FPA01-03.

Bentzen, P., J. Olsen, and J. Britt. 1998. Microsatellite DNA polymorphism in spring chinook salmon (*Oncorhynchus tshawytscha*) from Clackamas hatchery, the upper Sandy river, and the Bull run river and its implications for population structure. Final report to City of Portland, Bureau of Water Works. 14 p.

Bowles, E. 1997. Letter to NMFS. Comments on NMFS' draft "Review of Steelhead Stocks Used in Snake River Basin Artificial Propagation Facilities." 6 p.

Bryant, F. G. 1949. A survey of the Columbia River and its tributaries with special references to management of its fishery resources. 2. Washington streams from the mouth of the Columbia River to and including the Klickitat River (Area I). Special Scientific Rep. 62. 110 p.

Bryant, G. 1994. Status review of coho salmon populations in Scott Creek and Waddell Creeks, Santa Cruz County, California. NMFS, unpubl. rep., dated April 1994, 102 p.

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, F. W. Waknitz, and I. V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-27, 261 p.

CDFG (California Department of Fish and Game). 1994. Petition to the Board of Forestry to list coho salmon (*Oncorhynchus kisutch*) as a sensitive species. CDFG, Sacramento, CA. 110 p.

______. 1998. A status review of the spring-run chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento River Drainage. California Department of Fish and Game, Candidate Species Status Report 98-01, Sacramento CA. XIV Sections.

_______. 2000. Annual report Warm Springs salmon and steelhead hatchery, 1999-2000. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

California Department of Fish and Game, National Marine Fisheries Service Joint Hatchery Review Committee. 2001. Final Report on Anadromous Salmonid Fish Hatcheries in California. Available from Southwest Region, NMFS, Long Beach, CA. 87 pp.

Campton, D. E. and A. M. Marshal 2000. Genetic comparisons among hatchery and wild populations of spring chinook salmon in the Methow River Basin: ESA controversies in the Columbia River Basin. Unpubl. manuscr.

Cartwright, W. F. 1993. Annual report Coyote Valley fish facility, 1992-1993. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Cartwright, W. F. 1994. Annual report Warm Springs salmon and steelhead hatchery, 1991-1992. California Department of Fish and Game, Inland Fisheries Administrative Report No. 94-5. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Cartwright, W. F. 1996. Annual report Mad River salmon and steelhead hatchery, 1995-1996. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Cartwright, W. F. 1997. Annual report Mad River salmon and steelhead hatchery, 1996-1997. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Cartwright, W. F. 1998. Annual report Mad River salmon and steelhead hatchery, 1997-1998. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Cartwright, W. F. 1999. Annual report Mad River salmon and steelhead hatchery, 1998-1999. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Cartwright, W. F. 2000. Annual report Mad River salmon and steelhead hatchery, 1999-2000. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Cartwright, W. F. 2001. Annual report Mad River salmon and steelhead hatchery, 2000-2001. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Chapman, D., C. Peven, T. Hillman, A. Giorgi, and F. Utter. 1994. Status of summer steelhead in the mid-Columbia River. Don Chapman Consultants, Inc, 318 p. (Available from Don Chapman Consultants, Inc., 3553 Rickenbacker, Suite 200, Boise, ID 83705.)

Chilcote, M. W., S. A. Leider, and J. J. Loch. 1986. Differential reproductive success of hatchery and wild summer-run steelhead under natural conditions. Transactions of the American Fisheries Society 115:726-735

Christianson, C. 1993. Operations plan for anadromous fish production facilities in the Columbia River Basin. Volume III, Oregon Department of Fish and Wildlife Hatcheries. 1992 Annual Report to the Bonneville Power Administration, Portland, Oregon, Project 92-043, 324 p. Available from Bonneville Power Administration, P. O. Box 351, Portland, OR 97208.

Cobb, J. N. 1930. Pacific salmon fisheries. Report of the U.S. Commissioner of Fisheries for 1930. p 409-709.

Columbia Basin Fish and Wildlife Authority (CBFWA). 2001. Reintroduction of Lower Columbia River Chum Salmon into Duncan Creek, project description. Internet Document, available www.cbfwa.org/2001/highpriority/projects/23040.htm

Colville Confederated Tribes, U.S. Fish and Wildlife Service, Washington Department of Fish and Wildlife and Yakama Indian Nation. 1995. Operation Plans for Anadromous Fish Production Facilities in the Columbia River Basin, Vol. III – Washington. Bonneville Power Administration project no. 92-043. Bonneville Power Administration, Portland OR.

Cook-Tabor. 1994. Summer chum in Hood Canal. U.S. Fish Wildlife Service, Olympia WA, 52 p. (Available from U. S. Department of the Interior, Fish and Wildlife Service, Western Washington Fishery Resource Office, 2825 Parkmont Lane, Bldg. A, Olympia, WA 98502.)

Cooper, M., D. Carie, and C. Hamstreet. 2002. Adult salmonid returns to Leavenworth, Entiat, and Winthrop National Fish Hatcheries in 2001. 62 p. USFWS, Leavenworth, WA.

Cramer, S. P. et al. 1995. The status of steelhead populations in California in regards to the Endangered Species Act. Document prepared for Association of California Water Agencies, 167 p. (Available from Environmental and Technical Services Division, NMFS, 525 N.E. Oregon St., Portland, OR 97232).

Crawford, B. A. 1979. The origin and history of the trout broodstocks of the Washington Department of Game. Washington Department of Fish and Wildlife. Olympia, WA.

Crawford, B. 1997. Letter to NMFS. Response to NMFS' draft "Review of Steelhead Stock Used in Snake River Basin Artificial Propagation Facilities." 4 p.

Delarm, M. R., and R. Z. Smith. 1990a. Assessment of present anadromous fish production facilities in the Columbia River Basin Volume 1: USFWS Hatcheries. Bonneville Power Administration. 89-045, 106 p. (Available from Bonneville Power Administration, Division of Fish and Wildlife-PJ, P.O. Box 3621, Portland, OR 97208.)

Delarm, M. R., and R. Z. Smith. 1990b. Assessment of present anadromous fish production facilities in the Columbia River Basin Volume 2: Idaho Department of Fish and Game Hatcheries. Bonneville Power Administration. 89-045, 77 p. (Available from Bonneville Power Administration, Division of Fish and Wildlife-PJ, P.O. Box 3621, Portland, OR 97208.)

Delarm, M. R., and R. Z. Smith. 1990c. Assessment of present anadromous fish production facilities in the Columbia River Basin Volume 3: Oregon Department of Fish and Wildlife Hatcheries. Bonneville Power Administration. 89-045, 177 p. (Available from Bonneville Power Administration, Division of Fish and Wildlife-PJ, P.O. Box 3621, Portland, OR 97208.)

Delarm, M. R., and R. Z. Smith. 1990d. Assessment of present anadromous fish production facilities in the Columbia River Basin Volume 4: Washington Department of Fish Hatcheries. Bonneville Power Administration. 89-045, 130 p. (Available from Bonneville Power Administration, Division of Fish and Wildlife-PJ, P.O. Box 3621, Portland, OR 97208.)

Delarm, M. R., and R. Z. Smith. 1990e. Assessment of present anadromous fish production facilities in the Columbia River Basin Volume 5: Washington Department of Wildlife Hatcheries. Bonneville Power Administration. 89-045, 122 p. (Available from Bonneville Power Administration, Division of Fish and Wildlife-PJ, P.O. Box 3621, Portland, OR 97208.)

Duran, D. R. 1995. Annual report Coyote Valley fish facility, 1994-1995. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Duran, D. R. 1996. Annual report Coyote Valley fish facility, 1995-1996. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Fish, F. F., and M. G. Hanavan. 1948. A report on the Grand Coulee Fish Maintenance. Project 1939-1947. USFWS. Spec. Sci. Rep 55.

Firman, J., R. Schroeder, D. Kenaston, and R. Lindsay. 2002. Work completed for compliance with the Biological Opinion for hatchery programs in the Willamette Basin, USACE funding: 2002. Task Order: NWP-OP-FH-02-01. ODFW. 28p.

Ford, M. J., et al.. 2001. Upper Columbia River steelhead and spring chinook salmon population structure and biological requirements. Final report, March 2001. Available at http://www.nwfsc.noaa.gov/pubs/nwfscpubs.html.

Fortier, R. E. 1994. Annual report Coyote Valley fish facility, 1993-1994. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Fuss, H., J. Byrne, and C. Ashbrook. 1998. Stock characteristics of hatchery reared salmonids at Washington Department of Fish and Wildlife Columbia River hatcheries. WDFW. Annual Report H98-03. 65 p.

Fuss, H. 2002. Production of juvenile and adult chinook salmon from releases of hatchery adults in the Deschutes River, Washington. Annual Report to the Hatchery Scientific Review Group. June, 2002. WDFW, Olympia, WA 14p.

Fuss, H. 2001. Production of juvenile and adult chinook salmon from releases of hatchery adults in the Deschutes River, Washington. Annual Report to the Hatchery Scientific Review Group. June, 2001. WDFW, Olympia, WA 17p.

Gallagher, K. I. 1994a. Annual report Mad River salmon and steelhead hatchery, 1991-1992. California Department of Fish and Game, Inland Fisheries Administrative Report No. 94-3. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Gallagher, K. I. 1994b. Annual report Mad River salmon and steelhead hatchery, 1992-1993. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Gallagher, K. I. 1994c. Annual report Mad River salmon and steelhead hatchery, 1993-1994. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Gallagher, K. I. 1995. Annual report Mad River salmon and steelhead hatchery, 1994-1995. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Garcia, J. D. 2002. Annual report Coyote Valley fish facility, 2001-2002. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 1992. Annual report Noyo River egg collecting station, 1991-1992. California Department of Fish and Game, Inland Fisheries Administrative Report No. 92-14. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 1993. Annual report Noyo River egg collecting station, 1992-1993. California Department of Fish and Game, Inland Fisheries Administrative Report No. 93. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 1995a. Annual report Noyo River egg collecting station, 1993-1994. California Department of Fish and Game, Inland Fisheries Administrative Report No. 95-4. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 1995b. Annual report Noyo River egg collecting station, 1994-1995. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 1996. Annual report Noyo River egg collecting station, 1995-1996. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 1997. Annual report Noyo River egg collecting station, 1996-1997. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 1998. Annual report Noyo River egg collecting station, 1997-1998. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 1999. Annual report Noyo River egg collecting station, 1998-1999. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 2000. Annual report Noyo River egg collecting station, 1999-2000. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 2001. Annual report Noyo River egg collecting station, 2000-2001. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 2002. Annual report Noyo River egg collecting station, 2001-2002. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 1995c. Annual Report Van Arsdale fisheries station, 1994-1995. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 1996b. Annual Report Van Arsdale fisheries station, 1995-1996. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 1997b. Annual Report Van Arsdale fisheries station, 1996-1997. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 1998b. Annual Report Van Arsdale fisheries station, 1997-1998. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 1999b. Annual Report Van Arsdale fisheries station, 1998-1999. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 2000b. Annual Report Van Arsdale fisheries station, 1999-2000. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 2001b. Annual Report Van Arsdale fisheries station, 2000-2001. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Grass, A. F. 2002b. Annual Report Van Arsdale fisheries station, 2001-2002. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Hamstreet, C. O., and D. G. Carie. 2002. Spring and summer chinook salmon spawning ground surveys on the Entiat River, 2001. 18 p. USFWS, Leavenworth, Washington.

Hatchery Scientific Review Group (HSRG), Nooksack/Samish Briefing Book, April 2002.

Hershberger, W. K., and D. Dole. 1987. Genetic identification of salmon and steelhead stocks in the mid-Columbia River. Report for Don Chapman Consultants, Inc., Boise, ID.

Hedgecock, D., M. Banks, S. Blankenship, and M. Calavetta. 1995. Genetic evidence for admixture and hybridization of spring- and winter-run chinook in an artificial propagation program. Unpub. manuscr. Available from the Santa Cruz Laboratory, NMFS, Santa Cruz, CA. 23 p.

Hiser, C. A. 1993. Annual report Iron Gate salmon and steelhead hatchery, 1991-1992. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Hiser, C. A. 1994a. Annual report Iron Gate salmon and steelhead hatchery, 1992-1993. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Hiser, C. A. 1994b. Annual report Iron Gate salmon and steelhead hatchery, 1993-1994. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Hiser, C. A. 1995. Annual report Iron Gate salmon and steelhead hatchery, 1994-1995. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Hopley, Bill. 1994. Historical production of coho salmon from Washington State Hatcheries on the lower Columbia River. WDFW, Olympia, WA.

Howell, P., K. Jones, D. Scarnecchia, L. LaVoy, W. Kendra, and D. Orrmann. 1985a. Stock assessment of Columbia River anadromous salmonids. Volume I. U.S. Dept. Energy, Bonneville Power Administration. Project No. 83-335, 558 p.

Howell, P., K. Jones, D. Scarnecchia, L. LaVoy, W. Kendra, and D. Orrmann. 1985b. Stock assessment of Columbia River anadromous salmonids. Volume II. U.S. Dept. Energy, Bonneville Power Administration. Project No. 83-335, 1032 p.

Hulett, P. 2002. Use of wild broodstocks for hatchery steelhead production: potentials and limitations. Summary of the Eighth Pacific Coast Steelhead Management Meeting, March 5-7, 2002. Pacific States Marine Fisheries Commission and NMFS, Portland, OR.

Hunter, B. 1987. Memorandum: Management Goals and Constraints for Noyo River Egg Taking Station. Available from CDFG. 14 p.

Hutchison, B. 1993. Operations plan for anadromous fish production facilities in the Columbia River Basin. Volume II, Idaho Department of Fish and Game Hatcheries. 1992. Annual Report to the Bonneville Power Administration, Portland, Oregon, Project 92-043, 91 p. (Available from Bonneville Power Administration, P. O. Box 351, Portland, OR 97208.)

Hymer, J., R. Pettit, M. Wastel, P. Hahn, and K. Hatch. 1992. Stock summary reports form Columbia River anadromous salmonids. Volume III: Washington subbasins below McNary Dam. Bonneville Power Administration. Project No. 88-108, 1,077 p.

IDF&G (Idaho Department of Fish and Game). 2003. Data from IDF&G website located at http://www2.state.id.us/fishgame/Fish/ProgramsInfo/anadcounts/shrtrns.htm

IEAB (Independent Economic analysis Board). 2002. Artificial production Review, report to the Northwest Power Planning Council, July 2002. Portland, OR.

Jateff, B. 2001. Summary report for the 1998 brood year Methow Basin spring chinook salmon hatchery program. Washington Department of Fish and Wildlife.

Jones, W. 2001. South Fork Noyo River coho salmon egg collecting station. A summary report of 2000 - 01 operations. Available from the Santa Cruz Laboratory, NMFS, Santa Cruz, CA. 28 p.

Kiefer, S., M. Rowe, and K. Hatch. 1992. Stock summary reports for Columbia River anadromous salmonids Volume V: Idaho. Project report. U.S. Department of Energy, Bonneville Power Administration, Div. Fish Wildl. Project No. 88-108. (Available from Bonneville Power Administration, Division of Fish and Wildlife, P.O. Box 3621, Portland, OR 97208.)

Kostow, K. 1991. Broodstock histories for the lower Columbia River coho. ODFW, Portland, OR.

Kostow, K. 1995. Biennial Report on the Status of Wild Fish in Oregon. Oregon Department of Fish and Wildlife Rep., 217 p. + appendix. (Available from ODFW, P.O. Box 59, Portland, OR, 97207.)

Kostow, K., M. Lewis, M. Evenson, M. Ford (NMFS) and the staff of Cole M. Rivers Hatchery. 1998a. Rogue River Coho Hatchery Program: Background Information, Alternative Management Options and Risk Assessment. ODFW, Portland, OR.

Lewis, M., K. Kostow, R. Klumph, K. Braun, J. Casteel and the staff of Nehalem Hatchery. 2000A. Nehalem River Coho Hatchery Program: Background Information, Alternative Management Options and Risk Assessment. ODFW, Portland, OR.

Kostow, K., E. Olsen, M. Jennings (CTWSIR), and J. Newton. 2000b. Hood River Steelhead Hatchery Programs: Winter Steelhead Stock 50, Summer Steelhead Stock 50 and Summer Steelhead Stock 24. Goals, Risk/Benefit Analysis and Assessment of Alternative Operational Protocols. ODFW, Portland, OR.

Kostow, K. E., A. R. Marshall, and S. R. Phelps. (*in press*) Clackamas paper. Transactions of the Amer. Fish. Soc.

Leider, S. A., P. L. Hulett, J. J. Loch and M. W. Chilcote. 1990. Electrophoretic comparison of the reproductive success of naturally spawning transplanted and wild steelhead trout through the returning adult stage. Aquacult. 88:239-252.

Leider, S. A., P .L. Hulett, and T. Johnson. 1994. Preliminary assessment of genetic conservation management units for Washington steelhead. Report #94-15. WDFW, Olympia, WA.

Lewis, M., K. Kostow, R. Klumph, K. Braun, J. Casteel and the staff of Nehalem Hatchery. 2000. Nehalem River Coho Hatchery Program: Background Information, Alternative Management Options and Risk Assessment. ODFW, Portland, OR.

Marshall, A. 1997. Genetic analysis of Abernathy Creek juvenile chinook. Investigation of natural reproduction by Rogue River stock hatchery-origin chinook. WDFW. 13p.

Marshall, A. R. 1999. Genetic Analysis of Bear Creek/Cottage Lake Creek Naturally Spawning Fall-Run Chinook. Washington Department of Fish and Wildlife Genetics Unit. 8 p.

Marshall, A. 1999. Genetic analyses of 1998 Skokomish River chinook samples. Washington Department of Fish and Wildflife memo. 4 May 1999. 6 p.

Marshall, A. 2000. Genetic analyses of 1999 Hood Canal area chinook samples. Washington Department of Fish and Wildflife memo. 31 May 2000. 9 p.

Marshall, A. R., C. Smith, R. Brix, W. Dammers, J. Hymer, and L. LaVoy. 1995. Genetic diversity units and major ancestral lineages for chinook salmon in Washington. *In* C. Busack and J. B. Shaklee (editors), Genetic diversity units and major ancestral lineages of salmonid fishes in Washington, p. 111-173. Wash. Dep. Fish Wildl. Tech. Rep. RAD 95-02. (Available from Washington Department of Fish and Wildlife, 600 Capital Way N., Olympia WA 98501-1091.)

Matthews, G. M., and R. S. Waples. 1991. Status review for Snake River spring and summer chinook salmon. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-F/NWC-200:75p.

McEwan, D., and T. A. Jackson. 1996. Steelhead restoration and management plan for California. CDFG, 234 p. (Available from CDFG, Inland Fisheries Division, 1416 Ninth Street, Sacramento CA 95814).

McEwan, D., and J. Nelson. 1991. Steelhead restoration plan for the American River. California Department of Fish and Game, Inland Fisheries Division. 40 p. (Available from CDFG, Inland Fisheries Division, 1416 Ninth Street, Sacramento CA 95814).

Mealey, S. P. 1997. Letter to NMFS. Appendix A. Broodstock history of Idaho hatchery facilities. Appendix B. Supplementation Programs. 13 p.

Montgomery Watson, 1996a. Hatchery evaluation report. Umatilla Hatchery summer steelhead. Integrate Hatchery Operations Team (IHOT). U.S. Department of Energy. Bonneville Power Administration. Project Number 95-2. 73 p.

Montgomery Watson, 1996b. Hatchery evaluation report. Round Butte Hatchery summer steelhead. Integrate Hatchery Operations Team (IHOT). U.S. Department of Energy. Bonneville Power Administration. Project Number 95-2. 73 p.

Moran, P. 1998. Genetic analysis of fin clips from marked and unmarked Rapid River chinook salmon. Interagency memorandum for IDF&G 6 pp.

Mullan, J. W., K. R. Williams, G. Rhodus, T. W. Hillman, and J. D. McIntyre. 1992. Production and habitat of salmonids in the mid-Columbia River tributary streams. U.S. Fish and Wildlife Service, Monograph I. 489 p.

Myers, J. M., R. G. Kope, G. J. Bryant, D. Teel, L. J. Lierheimer, T. C. Wainwright, W. S. Grant, F. W. Waknitz, K. Neely, S. T. Lindley, and R. S. Waples. 1998. Status review of chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo NMFS-NWFSC-35, 443 p.

Myers, J., C. Busack, D. Rawding, and A. Marshall. 2002. Identifying historical populations of chinook and chum salmon and steelhead within the Lower Columbia River and Upper Willamette River Evolutionarily Significant Units. 10 May 2002. Co-Manager Review Draft. Willamette/Lower Columbia River Technical Recovery Team Document. 70 p + Appendices.

Narum, S. R., C. Beasley, J. Whiteaker, A. Talbot, and M. S. Powell. 2002. Admixture of ESA-listed and unlisted stocks of spring chinook salmon (*Oncorhynchus tshawytscha*; Walbaum) within the Methow River, Washington. Unpubl. manuscr.

NMFS (National Marine Fisheries Service). 1993. Interim policy on artificial propagation of Pacific salmon under the Endangered Species Act. Federal Register [Docket 921186-2286, 5 April 1993] 58(63):17573-17576.

NMFS (National Marine Fisheries Service). 1997a. West Coast Coho Salmon Biological Review Team (BRT). 1997. Status Review Update for Coho Salmon from the Oregon and Northern California Coasts. National Marine Fisheries Service, Seattle, WA.

NMFS (National Marine Fisheries Service). 1997b. Endangered and threatened species: listing of several evolutionary [sic] significant units (ESUs) of west coast steelhead. Federal Register 62:43937-43954.

NMFS (National Marine Fisheries Service), U.S. Fish and Wildlife Service, Washington Department of Fish and Wildlife, Confederated Tribes of the Yakama Indian Nation, Confederated Tribes of the Colville Indian Reservation, Confederated Tribes of the Umatilla Indian Reservation, Chelan County Public Utility District, Douglas County Public Utility District. 1998. Biological Assessment and Management Plan, Mid-Columbia River Hatchery Program. Final Report, April 1998.

NMFS (National Marine Fisheries Service). 1998. Endangered and threatened species: proposed endangered status for two chinook salmon ESUs and proposed threatened status for five chinook salmon ESUs; proposed redefinition, threatened status, and revision of critical habitat for one chinook salmon ESU; proposed designation of chinook salmon critical habitat in California, Oregon, Washington, Idaho. Federal Register [Docket No. 980225050-8050-01; I.D. 022398C] 63(45):11482-11520.

NMFS (National Marine Fisheries Service). 1999a. Updated review of the status of the Upper Willamette River and Middle Columbia River ESUs of steelhead (*Oncorhynchus mykiss*). 44 p.

NMFS (National Marine Fisheries Service). 1999b. Endangered and threatened species: Threatened status for three chinook salmon Evolutionarily Significant Units in Washington and Oregon, and Endangered status for one chinook salmon ESU in Washington; final rule. Partial 6-month extension on final listing determinations for four Evolutionarily Significant Units of West Coast chinook salmon; proposed rule. Federal Register 64:14308-14328.

NMFS (National Marine Fisheries Service). 1999c. Endangered and Threatened Species: Threatened Status for Two ESUs of Chum Salmon in Washington and Oregon, for Two ESUs of Steelhead in Washington and Oregon, and for Ozette Lake Sockeye Salmon in Washington; Rules. Federal Register 64:14508-14517.

NMFS (National Marine Fisheries Service).. 2001. Status review update for coho salmon (*Oncorhynchus kisutch*) from the Central California Coast and the California portion of the Southern Oregon/Northern California Coasts Evolutionarily Significant Units. Available from the Santa Cruz Laboratory, NMFS, Santa Cruz, CA. 112 p.

NMFS (National Marine Fisheries Service). 2002a. Draft hatchery genetics and management plan for Don Clausen Fish Hatchery. Three sections plus appendices. Available from the Santa Cruz Laboratory, NMFS, Santa Cruz, CA.

NMFS (National Marine Fisheries Service). 2002b. Endangered Species Act section 7 biological opinion on the issuance of a section 10(a)(1)(A) permit to the Monterey Bay Salmon and Trout Project. Available from the Santa Cruz Laboratory, NMFS, Santa Cruz, CA. 39 p.

NOAA Fisheries. 2002. Resource management plan –ESA 4(d) Rule evaluation and recommended determination: Ozette Lake sockeye salmon resource management plan: hatchery and genetic management plan component. Evaluation of plan provided by the Makah Tribe (for the Bureau of Indian Affairs), and the Washington Department of Fish and Wildlife on October 30, 2000. Sustainable Fisheries Division, NOAA Fisheries, Northwest Region. Portland, OR. 54p.

Natural Resources Consultant (NRC). 1996. Artificial propagation of anadromous Pacific salmonids, 1950 to present. Includes electronic database. (Available from Environmental and Technical Services Division, NMFS, 525 N.E. Oregon St., Portland, OR 97232.)

Nelson, W. R. and J. Bodle. 1990. Ninety Years of Salmon Culture at Little White Salmon National Fish Hatchery. Ecological Report 90(17). U.S. Fish and Wildlife Service, Washington D.C.

Nicholas, J. 1995. Status of Willamette spring-run chinook salmon relative to the Federal Endangered Species Act. Report to the National Marine Fisheries Service. Oregon Department of Fish and Wildlife, 44 p.

NWFIC (Northwest Indian Fisheries Commission). 1994. Summary of tribal releases. Letter submitted to the ESA Administrative Record for West Coast Steelhead, 16 September 1994. Available from Environmental and Technical Services Division, NMFS, 525 N. E. Oregon Street, Portland, OR 97232 III. E. 11.

NWFIC (Northwest Indian Fisheries Commission). 2002. Future Brood Document. Internet Document available www.nwifc.wa.gov/fisheriesdata/index.asp

Olsen, E., P. Pierce, M. McLean, and K. Hatch. 1992. Stock summary reports for Columbia River anadromous salmonids. Volume I: Oregon. U.S. Department of Energy., Bonneville Power Administration. Project No. 88-108.

Olsen, E. A., P. M. P. Beamesderfer, M. L. McLean, and E. S. Tinus. 1994. Salmon and steelhead stock summaries for the Grande Ronde Basin: an interim report. Oreg. Dep. Fish Wildl. Proj. Rep. 88-108, 132 p. (Available from Environmental and

Technical Services Division, NMFS, 525 N.E. Oregon St., Suite 500, Portland, OR 97232)

ODFW (Oregon Department of Fish and Wildlife). 1986. Steelhead management plan 1986-1992. 146 p. (Available from Oregon Department of Fish and Wildlife, P.O. Box 59, Portland, OR, 97207).

ODFW (Oregon Department of Fish and Wildlife). 2003. 2002 Fisheries Management and Evaluation Plan-Upper Willamette spring chinook in freshwater fisheries of the Willamette basin and Lower Columbia River mainstem. 221p.

Osborn, J. 2001. Lake Chelan relicensing - spring (steelhead) spawning ground surveys. Memo to Lake Chelan Natural Sciences Working Group, 24 April 2001, Wenatchee WA.

Phelps, S., J. Uehara, D. Hendrick, A. Blakley, and R. Brix. 1995. Genetic diversity units and major ancestral lineages for chum salmon in Washington. *In* C. Busack and J. B. Shaklee, (eds.) Genetic diversity units and major ancestral lineages of salmonid fishes in Washington. WDFW Technical Report #RAD 95-02, Olympia, WA. 55 p.

Phelps, S. R., S. A. Leider, P. L. Huett, B. M. Baker, and T. Johnson. 1997. Genetic analysis of Washington steelhead. Preliminary results incorporating 36 new collections from 1995 and 1996. Washington Department of Fisheries, Olympia, WA.

Quinones, A. R. 1994. Annual Report Warm Springs salmon and steelhead hatchery, 1993-1994. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Quinones, A. R. 1995. Annual Report Warm Springs salmon and steelhead hatchery, 1994-1995. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Quinones, A. R. 1996. Annual Report Warm Springs salmon and steelhead hatchery, 1995-1996. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Quinones, A. R. 1997. Annual Report Warm Springs salmon and steelhead hatchery, 1996-1997. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Quinones, A. R. 1998. Annual Report Warm Springs salmon and steelhead hatchery, 1997-1998. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Quinones, A. R. 1999. Annual Report Warm Springs salmon and steelhead hatchery, 1998-1999. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Radford, L. 1996. Cooperative artificial propagation programs for salmon and steelhead, 1994-1995. California Department of Fish and Game, Inland Fisheries Administrative Report No. 96-2. CDFG, 1416 Ninth St., Sacramento, CA 95814. Ramsden, G. R.

Radford, L. 1997. Cooperative artificial propagation programs for salmon and steelhead, 1993-1994. California Department of Fish and Game, Inland Fisheries Administrative Report No. 97-3. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Radford, L. 1998a. Cooperative artificial propagation programs for salmon and steelhead, 1995-1996. California Department of Fish and Game, Inland Fisheries Administrative Report No. 98-4. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Radford, L. 1998b. Cooperative artificial propagation programs for salmon and steelhead, 1996-1997. California Department of Fish and Game, Inland Fisheries Administrative Report No. 98-5. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Ramsden, G. R. 1993. Annual Report Trinity River salmon and steelhead hatchery, 1991-1992. California Department of Fish and Game, Inland Fisheries Administrative Report No. 93-3. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Ramsden, G. R. 1994a. Annual report Trinity River salmon and steelhead hatchery, 1992-1993. California Department of Fish and Game, Inland Fisheries Administrative Report No. 94-4. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Ramsden, G. R. 1994b. Annual report Trinity River salmon and steelhead hatchery, 1993-1994. California Department of Fish and Game, Inland Fisheries Administrative Report CDFG, 1416 Ninth St., Sacramento, CA 95814.

Ramsden, G. R. 1995. Annual report Trinity River salmon and steelhead hatchery, 1994-1995. California Department of Fish and Game, Inland Fisheries Administrative Report CDFG, 1416 Ninth St., Sacramento, CA 95814.

Ramsden, G. R. 1996. Annual report Trinity River salmon and steelhead hatchery, 1995-1996. California Department of Fish and Game, Inland Fisheries Administrative Report CDFG, 1416 Ninth St., Sacramento, CA 95814.

Ramsden, G. R. 1997. Annual report Trinity River salmon and steelhead hatchery, 1996-1997. California Department of Fish and Game, Inland Fisheries Administrative Report CDFG, 1416 Ninth St., Sacramento, CA 95814.

Ramsden, G. R. 1998. Annual report Trinity River salmon and steelhead hatchery, 1997-1998. California Department of Fish and Game, Inland Fisheries Administrative Report CDFG, 1416 Ninth St., Sacramento, CA 95814.

Ramsden, G. R. 2000. Annual report Trinity River salmon and steelhead hatchery, 1999-2000. California Department of Fish and Game, Inland Fisheries Administrative Report CDFG, 1416 Ninth St., Sacramento, CA 95814.

Ramsden, G. R. 2001. Annual report Trinity River salmon and steelhead hatchery, 2000-2001. California Department of Fish and Game, Inland Fisheries Administrative Report CDFG, 1416 Ninth St., Sacramento, CA 95814.

Ramsden, G. R. 2002. Annual report Trinity River salmon and steelhead hatchery, 2001-2002. California Department of Fish and Game, Inland Fisheries Administrative Report CDFG, 1416 Ninth St., Sacramento, CA 95814.

Reisenbichler, R. R., J. D. McIntyre, M. F. Solazzi, and S. W. Landino. 1992. Genetic variation in steelhead of Oregon and Northern California. Transactions of the Am. Fish. Soc. 121:158-169.

Reynolds, F. L., T. J. Mills, R. Benthin, and A. Low. 1993. Restoring central valley streams: A plan for action. CDFG, Sacramento, CA, 184 p.

Rowan, G.D. 1997. Umatilla Satellite Facilities Operation and Maintenance. Bonneville Power Administration. Annual Report 8343500.

Rushton, K. W. 1996. Annual report Iron Gate salmon and steelhead hatchery, 1995-1996. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Rushton, K. W. 1997. Annual report Iron Gate salmon and steelhead hatchery, 1996-1997. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Rushton, K. W. 1998. Annual report Iron Gate salmon and steelhead hatchery, 1997-1998. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Rushton, K. W. 1999. Annual report Iron Gate salmon and steelhead hatchery, 1998-1999. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Rushton, K. W. 2001. Annual report Iron Gate salmon and steelhead hatchery, 1999-2000. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Rushton, K. W. 2002a. Annual report Iron Gate salmon and steelhead hatchery, 2000-2001. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Sampson D. 1998. Hatchery evaluation report summary for Wallow Hatchery Summer Steelhead — (Grande Ronde Stock) — Summer Steelhead (Imnaha Stock). Available at www.streamnet.org/ihot_audit/wallowa-final.pdf.

Schiewe, M. 1992. Memo to J. G. Smith: ESA status of Snake River chinook salmon hatchery populations.

Schroeder, R., K. Kenaston, and R. Lindsay. 2002. Spring chinook salmon in the Willamette and Sandy Rivers. Project F-163-R-07. Annual Progress Report, ODFW. 35p.

Scribner, T., T.K. Meekin, J. Hubble, W. Fiander. 1993. Spring chinook spawning ground surveys of the Methow River Basin. Yakima Indian Nation, Department of Fisheries Resource Management. December, 1993.

Sea Resources. 2001. Chum Salmon Restoration. Internet Document, available, www.searesources.org/Archive/projects.htm

Shaklee, J. and S. W. Young. 2000. Non-lethal stock of origin assessment of Nooksack Basin chinook salmon smolts using microsatellite DNA markers. WDFW unpublished memo, July 2000.

Shelldrake, T. 1993. Operations plan for anadromous fish production facilities in the Columbia River Basin. Volume I, U. S. Fish and Wildlife Service Hatcheries. 1992 Annual Report to the Bonneville Power Administration, Portland, Oregon, Project 92-043, 158 p. Available from Bonneville Power Administration, P. O. Box 351, Portland, OR 97208.

Stanley, J. R. 1976. American River steelhead (Salmo gairdneri gairdneri) management, 1956-1974. (Administrative Report No. 76-2.) CDFG, Sacramento, CA.

Streig, D. 1991. History of fish cultural activities in Santa Cruz County with special references to Scott and Waddell creeks. Monterey Bay Salmon and Trout Project. Davenport, CA. Available from the Santa Cruz Laboratory, NMFS, Santa Cruz, CA. 24 p.

Streig D. 1993. Monterey Bay salmon and trout project: Project background and description. Monterey Bay Salmon and Trout Project, Davenport, California (unpubl. rep.) 24 p. (Available from Environmental and Technical Services Division, NMFS, 525 N.E. Oregon St., Suite 500, Portland, OR 97232)

Technical Recovery Team (TRT). 2000. Identifying populations of Chinook salmon in Puget Sound. M. Ruckleshaus, E. Buhle, L. Holsinger, and T. Beechie, NMFS-Northwest Fisheries Science Center; K. Currens, Northwest Indian Fisheries Commission, and A. Marshall and C. Busack, Washington Department of Fish and Wildlife. Puget Sound TRT Draft . 14 August 2000.

Thorgaard, G. 1983. Chromosomal differences among rainbow trout populations. Copeia. 1983(3): 650-662.

University of Washington. 2002. Summer chum return to Big Beef Creek. Internet Document available, www.washington.edu/newsroom/news/2002archive/ 03-02archive/k030702a.html

USFWS (United States Fish and Wildlife Service). 1979. Effect of time and size of release on the tendency of chinook salmon and steelhead trout reared at Coleman National Fish Hatchery to migrate downstream and adapt to seawater. FAO, Red Bluff, CA, FY 1980 annual Work Plan 3 p.

USFWS (United States Fish and Wildlife Service). 1998. Lower Snake River Compensation Plan Status Review Symposium. Report on a symposium held at the Doubletree Hotel Riverside, Boise, ID on 3,4,5 February 1998. Available at http://lsnakecomplan.fws.gov/Publications.html.

USFWS (United States Fish and Wildlife Service). 2001. Biological Assessment of Artificial Propagation at Coleman National Fish Hatchery and Livingston Stone National Fish Hatchery: Program description and incidental take of chinook salmon and steelhead trout. Red Bluff, CA. 12 Sections plus Appendices.

USFWS (United States Fish and Wildlife Service). 2002. Winthrop National Fish Hatchery Update. USFWS, P. O. Box 429, Winthrop, WA.

USFWS (United States Fish and Wildlife Service). 2003. Letter from D. Diggs (Assistant Regional Director USFWS, Portland, Oregon) to M. Ford (Division Director, Northwest Fisheries Science Center, Seattle, WA) 14 January 2003. 19 p.

Utter, F. M., D. W. Chapman, and A. R. Marshall. 1995. Genetic population structure and history of chinook salmon of the Upper Columbia River. Am. Fish. Soc. Symp. 17:149-165.

Wahle, R. J., and R. Z. Smith. 1979. A historical and descriptive account of Pacific Coast anadromous salmonid rearing facilities and a summary of their releases by region, 1960-76. U.S. Dept. Commer., NOAA Tech. Rep. NMFS SSRF-736, 40 p.

Waknitz, F. W., G. M. Matthews, T. Wainwright, and G. A. Winans. 1995. Status review for mid-Columbia River summer chinook salmon. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-22.

Wallis, J. 1 961. An evaluation of the McKenzie River Salmon Hatchery. Oregon Fish Commission Research Laboratory Report. 56 p.

Wallis, J. 1962. An evaluation of the Willamette River Salmon Hatchery. Oregon Fish Commission Research Laboratory Report. 94 p.

Wallis, J. 1963a. An evaluation of the Big Creek Salmon Hatchery. Oregon Fish Commission Research Laboratory, Clackamas, OR. 64 p.

Wallis, J. 1963b. An evaluation of the Klaskanine River salmon hatchery. Oregon Fish Commission Research Laboratory, Clackamas, OR. 83 p.

WDFG (Washington Department Fish and Game). 1932. Annual Report for 1930-31. Washington Fish and Game, Seattle, WA.

WDFG (Washington Department Fish and Game). 1916. Annual Report for 1914-15. Washington Fish and Game. Seattle, WA.

WDFW (Washington Department of Fish and Wildlife). 1993. Washington State Salmon and Steelhead Stock Inventory. Appendix One, Puget Sound Stocks. Olympia, WA.

WDFW (Washington Department of Fish and Wildlife). 1995. Genetic Diversity Units and Major Ancestral Lineages of Salmonid Fishes in Washington. Technical Report, Number RAD 95-02.

WDFW (Washington Department of Fish and Wildlife). 1996. 1996 Broodstock Collection. WDFW Hatcheries Program, Assessment and Development Division/Mid-Columbia River Projects, 113 Second St., Suite 7, Wenatchee, WA 98801.

WDFW (Washington Department of Fish and Wildlife) and Point No Point Treaty Tribes (PNPTT). 2001. Summer chum salmon conservation initiative. Supplemental report No. 3 – annual report for the 2000 summer chum salmon return to the Hood Canal and Strait of Juan de Fuca region. December, 2001. Washington Department of Fish and Wildlife. Olympia, WA. 123p.

WDFW (Washington Department of Fish and Wildlife). 2002. Section 10 Direct Take Permit Application - Application for a Permit to Enhance the Propagation or Survival of Endangered or Threatened Species under the Endangered Species Act. WDFW, Olympia, WA.

WDFW and PNPTT (Washington Department of Fish and Wildlife and Point No Point Treaty Tribe). 2001. Summer Chum Salmon Conservation Initiative. Internet Document available at www.wa.gov/wdfw/fish/chum/chum-7b.htm

WDFW (Washington Department of Fish and Wildlife), and Puget Sound Treaty Tribes. 2002. Puget Sound Chinook Salmon Hatcheries, Resource Management Plan, a component of Comprehensive Chinook Salmon Management Plan, 23 August 2002. 103 p.

WDF (Washington Department of Fisheries). 1938. Annual Report for 1937. Washington Department of Fisheries, Seattle, WA.

WDF (Washington Department of Fisheries). 1939. Annual Report for 1938. Washington Department of Fisheries, Seattle, WA.

WDF (Washington Department of Fisheries). 1941. Annual Report for 1940. Washington Department of Fisheries, Seattle, WA.

WDF (Washington Department of Fisheries), WDW (Washington Department of Wildlife), and WWTIT (Western Washington Treaty Indian Tribes). 1993. 1992 Washington State salmon and steelhead stock inventory (SASSI). WDFW Olympia, WA. 212 p. and 5 regional volumes. (Available from WDFW, 600 Capitol Way N., Olympia, WA 98501-1091.)

Weitkamp, L., et al. 1995. Status Review of Coho Salmon from Washington, Oregon and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-24,.

Wevers, M. J., J. Wetherbee, and W. Hunt. Santiam and Calapooia Subbasin fish management plan. Oregon Department of Fish and Wildlfie, Corvallis, OR. 179 p.

Williams, G. 1993. Annual Report on Warm Springs salmon and steelhead hatchery, 1992-1993. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Wilson, B. A. 1997. Annual report Coyote Valley fish facility, 1996-1997. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Wilson, B. A. 1998. Annual report Coyote Valley fish facility, 1997-1998. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Wilson, B. A. 1999. Annual report Coyote Valley fish facility, 1998-1999. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Wilson, B. A. 2000. Annual report Coyote Valley fish facility, 1999-2000. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Wilson, B. A. 2001a. Annual Report Coyote Valley fish facility, 2000-2001. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Wilson, B. A. 2001b. Annual Report Warm Springs salmon and steelhead hatchery, 2000-2001. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Wilson, B. A. 2002. Annual Report Warm Springs salmon and steelhead hatchery, 2001-2002. California Department of Fish and Game, Inland Fisheries Administrative Report. CDFG, 1416 Ninth St., Sacramento, CA 95814.

Wold, E. 1993. Operations plan for anadromous fish production facilities in the Columbia River Basin. Volume V, Washington Department of Wildlife Hatcheries. 1992 Annual Report to the Bonneville Power Administration, Portland, OR. Project 92-043, 131 p. Available from Bonneville Power Administration, P. O. Box 351, Portland, OR 97208.

Appendix - List of HGMP's

Hatchery and Genetic Management Plans (HGMPs) that were used in preparing this report.

Puget Sound Chinook (WDFW and Tribal)

Big Beef Creek Fall Chinook
Whitehorse Pond Summer Chinook
Chambers Creek Fall Chinook Yearling
Elwha River Summer /Fall Chinook
Garrison Springs Fall Chinook Fingerling
George Adams Fall Chinook Fingerling
Glenwood Springs Fall Chinook
Hamma Hamma Fall Chinook
Hoodsport Fingerling Fall Chinook
Hoodsport Yearling Fall Chinook
Issaquah Fall Chinook
NF Nooksack Native Chinook Restoration Program (Kendall Creek Hatchery)
Skagit Fingerling Fall Chinook
Skagit Spring Chinook Fingerling
Skagit River Summer Chinook
Skagit Yearling Spring Chinook
Minter Creek Fall Chinook Fingerling
Rick's Pond Fall Chinook
Samish Hatchery Summer / Fall Chinook Fingerling
Samish Hatchery Summer / Fall Chinook Yearling
Soos Creek Fall Chinook Fingerling
Soos Creek/Icy Creek Fall Chinook Yearling
Tumwater Falls Fall Chinook Fingerling
Tumwater Falls Fall Chinook Yearling
University of Washington Portage Bay Fall Chinook
Voights Creek Fall Chinook Fingerling
Wallace River Summer Chinook Fingerling
Wallace River Summer Chinook Yearling
White River Spring Chinook (Minter Creek and Hupp Springs Hatcheries)
Lummi Tribe Lummi Bay Hatchery Fall Chinook
Tulalip Tribe's Bernie Gobin Hatchery Spring, Summer and Fall Chinook Salmon
Stillaguamish Tribe Stillaguamish Summer/Fall Chinook
Suquamish Tribe Grovers Creek Fall Chinook
Nisqually Tribe Nisqually Fall Chinook

Hood Canal Summer Chum

WDFW Big and Little Quilcene River Summer Chum

Ozette Lake Sockeye

Makah Tribe Ozette Lake Sockeye – Umbrella Creek

Lower Columbia River Coho

Eagle Creek NFH Coho
Little White Salmon NFH Coho

Lower Columbia River Steelhead

Eagle Creek NFH Winter Steelhead
WDFW Cowlitz River "Late" Winter Steelhead
WDFW Cowlitz River Summer Steelhead
WDFW Cowlitz River "Early" Winter Steelhead
WDFW Kalama River "Wild" Summer Steelhead
WDFW Kalama River "Wild" Winter Steelhead
WDFW Lewis River Summer Steelhead
WDFW Lewis River Winter Steelhead

Lower Columbia River Chinook

Little White Salmon NFH Spring Chinook
Little White Salmon NFH Upriver Bright Chinook Salmon
Spring Creek NFH Tule Fall Chinook
WDFW Cowlitz River Fall Chinook
WDFW Cowlitz River Spring Chinook
WDFW Lewis River Spring Chinook
Sea Resources Fall Chinook

Lower Columbia River Chum

None.

Willamette River Steelhead

None.

Upper Willamette River Spring Run Chinook

None.

Middle Columbia River Steelhead

WDFW Touchet River Summer Steelhead

WDFW Walla Walla Basin Summer Steelhead

Upper Columbia River Steelhead

Colville Tribe Okanogan Basin Summer Steelhead

Middle Columbia River Chinook

Warm Springs River NFH Spring Chinook

Upper Columbia River Chinook

Carson NFH Spring Chinook
WDFW East Bank, Rocky Reach and Wells Summer Chinook
WDFW Priest Rapids Fall Chinook

Snake River Steelhead

WDFW Tucannon River Summer Steelhead
ODFW Little Sheep Creek Summer Steelhead
WDFW Lyons Ferry Summer Steelhead
WDFW Grande Ronde Summer Steelhead
Hagerman NFH B-run Summer Steelhead
IDFG North Fork Clearwater River B-run Summer Steelhead
IDFG East Fork Salmon River Summer Steelhead
IDFG Salmon River Basin A-run Summer Steelhead

Snake River Chinook

ODFW Imnaha River Spring/Summer Chinook
WDFW Tucannon River Spring Chinook
Dworshak NFH Spring Chinook
IDFG Clearwater River Basin Spring Chinook
Kooskia NFH Spring Chinook

Oregon Coast Coho

None.

Southern Oregon/ Northern California Coho

None.

Central California Coast Coho

None.

Northern California Steelhead

None.

Central California Coho

None.

South Central California Steelhead

None.

California Coast Chinook

None.