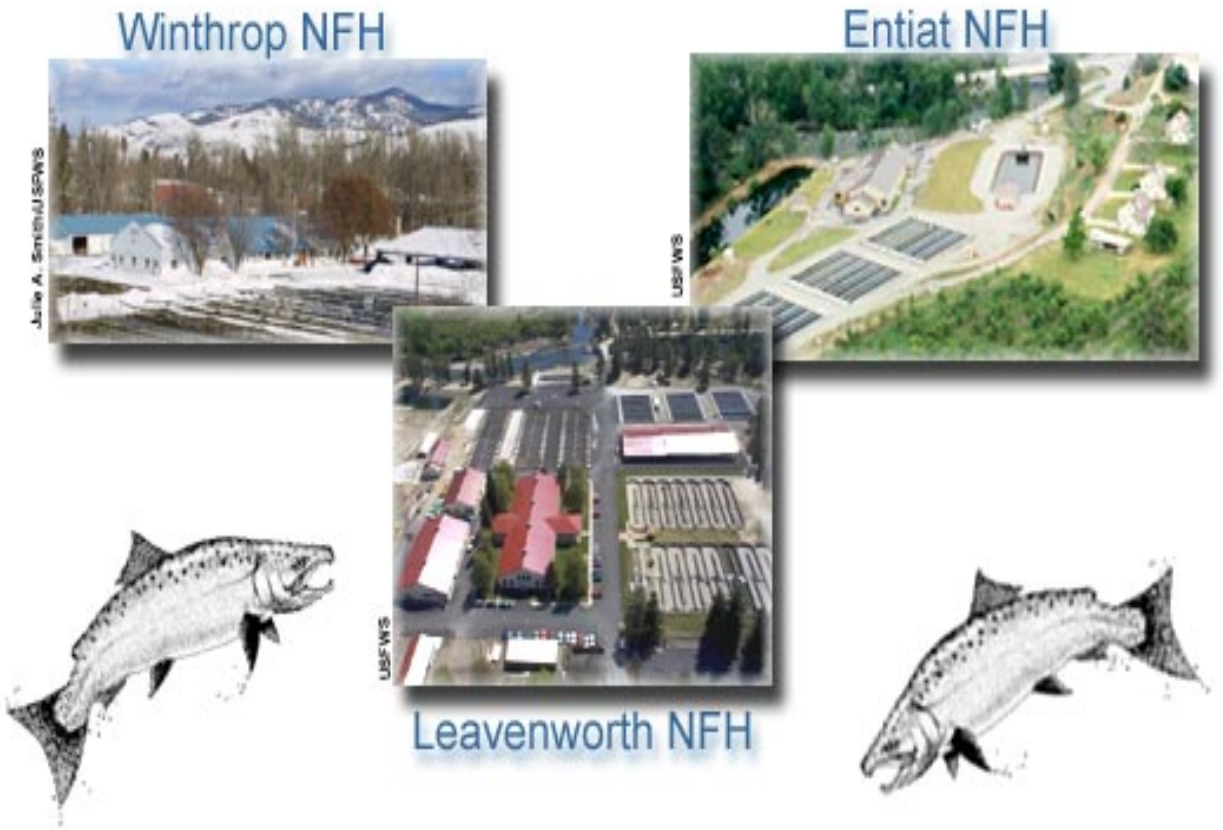
U.S. Fish & Wildlife Service

Fish Production Review of the Leavenworth National Fish Hatchery Complex, 2005



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Mid-Columbia River Fishery Resource Office
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March 2006

Fish Production Review of the Leavenworth National Fish Hatchery Complex, 2005

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EXECUTIVE SUMMARY

Leavenworth, Entiat, and Winthrop National Fish Hatcheries (NFH) are mitigation hatcheries established by the Grand Coulee Fish Maintenance Project (1937) to compensate for anadromous fish losses above Grand Coulee Dam. The hatcheries are currently funded by the U.S. Bureau of Reclamation (BOR) and operated by the U.S. Fish and Wildlife Service (USFWS). All three of the facilities, referred to as the "Leavenworth Complex", currently produce spring Chinook salmon and Winthrop NFH also has a summer steelhead program. In cooperation with the Yakama Nation, coho salmon are raised for a re-introduction effort in the upper Columbia Basin by every Leavenworth Complex facility, however, only Winthrop NFH provides complete propagation of this species. The Columbia River Fisheries Management Plan under the U.S. v. Oregon decision of 1969 set production goals for the facilities.

The Mid-Columbia River Fishery Resource Office (MCRFRO) evaluates the Leavenworth Complex hatchery production programs, provides technical assistance, and assists the coordination of Leavenworth Complex operations and production. This report summarizes the monitoring and evaluation primarily of the spring Chinook salmon programs at each Leavenworth Complex facility. Other species that are produced or reared are not evaluated extensively in this report. The Washington Department of Fish and Wildlife is the primary agency evaluating the upper Columbia River steelhead programs for which Winthrop NFH is part. Additionally, all Leavenworth Complex coho salmon programs are evaluated by the Yakama Nation.

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On the cover: Pictorial collage developed by Leavenworth Complex staff.

INTRODUCTION

Authorization and Funding of the Leavenworth Complex

Completion of Grand Coulee Dam in 1939 (Figure 1) blocked anadromous salmonids from 1,140 miles of the upper Columbia River drainage. To compensate for this loss the Grand Coulee Fish Maintenance Project in 1937 initially authorized the construction of mitigation hatcheries to restore and enhance fish runs in tributaries below the dam. The Mitchell Act of 1938 reauthorized hatchery construction and the Bureau of Reclamation (BOR) constructed the Leavenworth, Entiat, and Winthrop National Fish Hatcheries (NFH) and funded them through a transfer of funds to the US Fish and Wildlife Service (USFWS) until 1945. Pursuant to a Memorandum of Agreement with BOR (1949), the USFWS funded, managed, and operated the three hatchery "Leavenworth Complex" from 1945 – 1993.

In 1991, the Department of Interior Inspector General recommended that the USFWS and BOR develop an agreement for BOR to resume funding responsibilities for the Leavenworth Complex, since mitigation requirements were not completed by 1949 but continue indefinitely. As a result of the subsequent interagency agreement, on October 1, 1993, BOR assumed funding of the Leavenworth Complex operations, maintenance, and evaluation. The USFWS has continued the management of these facilities to present day.

Figure 1. Aerial photograph of Grand Coulee Dam. Photo courtesy of US Bureau of Reclamation.

Laws, Treaties, and Agreements Governing Operations

Numerous laws, treaties, and agreements govern Leavenworth Complex operations. Those of primary significance are outlined here.

Grand Coulee Fish Maintenance Project:

The original objectives were:

"*…to bring by stream rehabilitation and supplemental planting, the fish populations in the 677 miles of tributary streams between Grand Coulee Dam and Rock Island Dam up to figures commensurate with the earlier undisturbed conditions and with the natural food supply in these streams."*

"…to produce in addition, by combination of artificial spawning, hatching, feeding, rearing, and planting in these streams, a supplemental downstream migration equivalent to that normally produced by the 1,100 miles of streams and tributaries above Grand Coulee Dam."

The initial program consisted of two parts, the trapping and translocation of salmon from Rock Island Dam (1939–1943) to upstream tributaries and secondly the development of artificial propagation facilities. The transfer of fish to tributary streams was completed in 1943, and artificial production began in 1940 which continues through ongoing Leavenworth Complex operations.

Mitchell Act:
The 1938 Mitchell Act authorized establishment of salmon culture stations in the Columbia River Basin and authorized the conduct of investigations, engineering and biological surveys, and experiments necessary for the conservation of fishery resources.

US vs. Oregon:
The US vs. Oregon decision resulted in the Columbia River Fisheries Management Plan that sets production levels for the Leavenworth Complex and other Columbia River hatcheries. Deviations from established production levels are negotiated through the Production Advisory Committee (PAC) consisting of tribal and agency representatives.

Endangered Species Act:
The Leavenworth Complex must comply with the Endangered Species Act (ESA) of 1973. Section 7 requires that actions of federal agencies not be likely to jeopardize the continued existence of listed species or modify their critical habitat. Steelhead and spring Chinook raised at Winthrop NFH are included the Upper Columbia River (UCR) Evolutionary Significant Units for these species and are currently ESA-listed for protection.

US / Canada Pacific Salmon Treaty:
In March, 1985 the United States and Canada agreed to cooperate in the management, research and enhancement of Pacific salmon stocks of mutual concern by ratifying the US / Canada Pacific Salmon Treaty. Under the US / Canada Pacific Salmon Treaty (1985), the Pacific Salmon Commission selected the Leavenworth NFH as an indicator stock for contribution from the mid-Columbia River system to the mixed-stock US and Canada ocean fisheries. Contribution rates and status of indicator stocks are

important in evaluating effectiveness of this treaty. Leavenworth NFH annually marks 200,000 yearling spring Chinook salmon smolts with coded-wire-tags (CWT's) to assist in implementation of this treaty.

Integrated Hatchery Operations Team:
The Integrated Hatchery Operations Team (IHOT, 1996), formed by the Northwest Power Planning Council, is an interagency and tribal group whose purpose is to examine existing policy affecting hatcheries in the Columbia River Basin. The team seeks to assist in the development and implementation of regional artificial propagation guidelines, plans, policies and performance measures including the operation of hatchery programs in compliance with regionally adopted hatchery performance standards, fish health, ecological interactions, and genetics policies for salmonids. The Leavenworth Complex has been involved with development of the IHOT hatchery operation plans (1996, Volume III) and attempts to operate within approved guidelines.

Description of Leavenworth Complex Area

The Leavenworth Complex is located in North Central Washington State on the east side of the north Cascade Mountains (Figure 2). Peaks along the North Cascades vary from 5,000 to 10,000 feet, and few major tributaries drain this area to the east. The Columbia River forms the boundary between these mountains to the west and the Columbia Plateau to the east which rises to 2,500 feet and is dry with only a few minor streams. Annual precipitation in the Columbia Plateau may be less than 8 inches, while the Cascade Mountains may receive in excess of 120 inches.

Leavenworth Complex hatcheries are located on streams draining the North Cascades at elevations between 980 and 1,760 feet above sea level. Leavenworth NFH is situated on Icicle Creek near Leavenworth, Washington. Icicle Creek flows into the Wenatchee River, tributary to the Columbia River. Fish returning to Leavenworth NFH must travel 800 km (497 miles; 2.8 miles Icicle Creek, 26 miles Wenatchee River, 468 miles Columbia River), and must negotiate passage through seven Columbia River dams. Entiat NFH is located west of Entiat, Washington on the Entiat River, 10 km above its confluence with the Columbia River. Fish returning to Entiat NFH must travel a total of 790 km and negotiate passage through eight Columbia River hydroelectric dams. Entiat NFH is a substation of the Leavenworth NFH Complex. Winthrop NFH is located near Winthrop, Washington on the Methow River, 72 km above its confluence with the Columbia River. Total distance from the hatchery to the Pacific Ocean is 915 km, and nine hydroelectric dams are located within the migration corridor. Winthrop NFH is a substation of the Leavenworth NFH Complex.

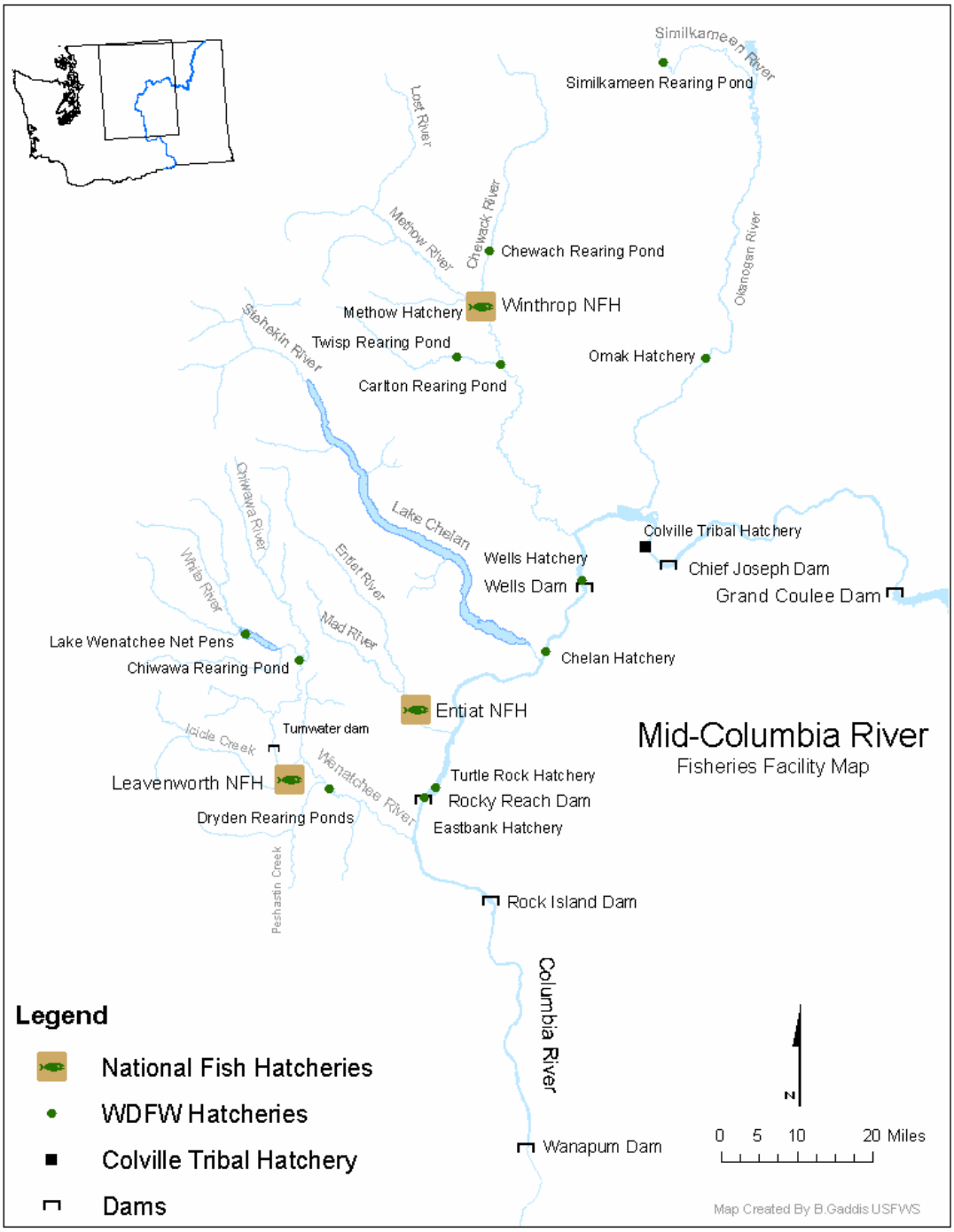


Figure 2. Map of Upper Columbia River watershed detailing major fish production facilities and hydro-system impoundments.

Facilities

Leavenworth NFH:
Rearing facilities include two – 15' x 150' adult holding ponds, 45 – 8' x 80' raceways, 14 – 10' x 100' covered raceways, 72 troughs, 108 starter tanks, plus 40 small and 22 large Foster- Lucas ponds (FL's not used for Chinook production, currently used for coho acclimation by the Yakama Nation). Hatchery water rights total 99,010 L/min, though average flow to the hatchery is 70,410 L/min. Water sources include seven wells, Icicle Creek, and Snow and Nada Lakes located in the Alpine Lakes Wilderness.

Entiat NFH:
Rearing facilities include 43 starter tanks, 30 raceways and two adult holding ponds. Hatchery water rights total 59,440 L/min, although only around 30,190 L/min are available for production. Water sources for the hatchery are the Entiat River, Packwood Spring and six wells.

Winthrop NFH:
Rearing facilities at Winthrop NFH include 34 starter tanks, 46 raceways, and 16 Foster-Lucas ponds. Hatchery water rights total 115,980 L/min and water use ranges from 33,050 - 107,280 L/min. Water sources include two wells, Methow River, and one spring water source.

Hatchery Production History

Species Reared:
Historically, several trout and salmon species have been reared at the Leavenworth Complex. Species reared have included: spring, summer/fall Chinook salmon (*Oncorhynchus tshawytscha*), steelhead and rainbow trout (*O. mykiss*), coho salmon (*O. kisutch*), sockeye and kokanee salmon (*O. nerka*), cutthroat trout (*O. clarki*), and brook trout (*Salvelinus fontinalis*). From 1980 – 2005, approximately 103.6 million (M) spring Chinook salmon, 2.8M steelhead trout, 2.3M coho salmon, 2.0M rainbow trout, 1.7 M kokanee salmon, 1.0M summer Chinook salmon, 0.8M brook trout, and 0.2M cutthroat trout have been reared at the Leavenworth Complex. Presently, all three hatcheries produce spring Chinook salmon, and Winthrop NFH also produces steelhead trout. All three facilities actively support various production components of the Yakama Nation coho reintroduction program with Winthrop NFH providing a complete production cycle. Additionally, all facilities have a few rainbow trout on station for use during National Fishing Week, Kids Fishing Day, and other educational programs.

Stock Origins for Chinook Salmon:
Leavenworth NFH has reared and released Chinook salmon annually since 1940, except for brood years (BY) 1967 and 1968. Leavenworth NFH spring Chinook salmon were first collected from commingled upriver stocks intercepted at Rock Island Dam (1940-1943). Some early imports of spring Chinook salmon from the lower Columbia River (1942) and McKenzie River, Oregon (1941) were part of homing studies, and probably few, if any, contributed to future production. Occasionally Leavenworth NFH has imported eggs from other Columbia River hatcheries, primarily Carson NFH, and also Cowlitz and Little White Salmon NFH's. Fish and/or eggs have not been imported to Leavenworth NFH since 1985 and brood has consisted of adults that volunteer into the hatchery ladder. The program is intended to function as a segregated harvest augmentation program and the Icicle Creek stock utilized by Leavenworth NFH is not included in the ESA-listed UCR spring Chinook salmon ESU. Genetic analysis indicates current

brood is more closely related to the lower Columbia River stocks than the natural population in the Wenatchee River (Ford *et al*. 2001). Inclusion of stock other than Leavenworth NFH is believed minimal as few natural or other hatchery adults have been observed in the adult holding ponds at this facility (Table 1).

Table 1. The occurrence and disposal of stray coded-wire tagged spring Chinook observed at Leavenworth NFH, 1998-2005.

RETURN YR.	CWT	#RC'D	BY	%MARKED	DEPOSITION	RELEASE ORIGIN	EXPANDED
2005*	NO STRAYS RECOVERED AT LEAVENWORTH NFH IN 2005.						
2004	050974	1	2001	12.7%	SPAWNED	DWORSHAK NFH	8
2004	630876	1	2001	99.6%	SPAWNED	CHIWAWA SFH	1
2004	631448	1	2001	98.6%	EXCESSED	CHIWAWA SFH	1
2004	631451	1	2001	99.6%	EXCESSED	CHIWAWA SFH	1
2003	054517	1	1999	23.7%	EXCESSED	ENTIAT NFH	4
2002	NO STRAYS RECOVERED AT LEAVENWORTH NFH IN 2002.						
2001	053716	1	1996	18.8%	EXCESSED	DWORSHAK NFH	5
2001	630740	2	1997	97.5%	EXCESSED	CHIWAWA SFH	2
2000	054212	1	1997	49.8%	EXCESSED	DWORSHAK NFH	2
2000	630740	2	1997	97.5%	SPWN/EXCS	CHIWAWA SFH	2
1999	053251	1	1994	5.7%	SPAWNED	LITTLE WHITE SALMON NFH	18
1999	621955	1	1995	98.4%	EXCESSED	ENTIAT NFH	1
1998	053812	1	1994	41.5%	SPAWNED	ENTIAT NFH	2
1998	053814	1	1994	15.7%	SPAWNED	ENTIAT NFH	6
1998	635839	1	1994	97.9%	EXCESSED	DRYDEN POND	1
1998	635840	1	1994	99.2%	EXCESSED	DRYDEN POND	1

ESTIMATED TOTAL STRAYS	**56**
TOTAL HATCERY RETURN 1998-2005	**30,154**
% OF STRAYS TO LEAVENWORTH NFH	**0.19%**

*in 2005 1:3 CWT adults were sampled and identified. Prior to 2005 all CWT adults were 100% sampled. The number of estimated "wild" scale patterns expanded from a sub-sample (sub-sample varies annually based on return, up to 1:5 in 2001) was 7. All were surplused (7/30,154 = 0.023%).

Entiat NFH released spring Chinook salmon originated from commingled upriver stocks intercepted at Rock Island Dam in 1942 and 1944. No spring Chinook salmon were released from Entiat NFH from 1945 to 1975. In 1974, spring Chinook salmon production resumed and egg sources have included Cowlitz River (1974), Carson NFH (1975-1982), Little White Salmon NFH (1976, 1978, 1979, 1981), Leavenworth NFH (1979-1981, 1994), and Winthrop NFH (1988). Returning adults that voluntarily entered the hatchery were the primary broodstock in 1980 and from 1982 to present. The program is intended to function as a segregated harvest augmentation program and Entiat NFH stock are not included in the ESA-listed UCR spring Chinook salmon ESU. Inclusion of stock other than Entiat NFH is believed minimal as few natural or other hatchery adults have been observed in the adult holding ponds at this facility (Table 2).

Table 2. The occurrence and disposal of stray coded-wire tagged spring Chinook observed at Entiat NFH, 1998-2005.

RETURN YR.	CWT	#RC'D	BY	%MARKED	DEPOSITION	RELEASE ORIGIN	EXPANDED
2005*	050790	1	2001	56.8%	EXCESSED	LEAVENWORTH NFH	4
2004	054415	1	2000	12.0%	DIP	LEAVENWORTH NFH	8
2004	630474	1	1999	98.3%	EXCESSED	DRYDEN POND	1
2003	054911	1	1999	16.5%	EXCESSED	LEAVENWORTH NFH	6
2002	054258	1	1998	11.3%	SPAWNED	LEAVENWORTH NFH	9
2001	NO STRAYS RECOVERED AT ENTIAT NFH IN 2001.						
2000	092262	1	1996	44.6%	EXCESSED	UMATILLA SFH	2
1999	053511	1	1994	9.5%	SPAWNED	LEAVENWORTH NFH	11
1999	053710	1	1996	94.7%	SPAWNED	WINTHROP NFH	1
1998	052962	1	1995	98.7%	SPAWNED	DWORSHAK NFH	1

ESTIMATED TOTAL STRAYS	**43**
TOTAL HATCERY RETURN 1998-2005	**9,765**
% OF STRAYS TO ENTIAT NFH	**0.44%**

*in 2005 1:2 CWT adults were dissected and identified. Prior to 2005 all CWT adults were 100% sampled. The number of observed "wild" scale patterns estimated from a sub-sample (sub-sample varies annually based on return, up to 1:3 in 2001 & 2002) was 18, of these 12 were surplused (12/9,753 = 0.123%) and 6 were spawned (6/9,753 = 0.062%).

Winthrop NFH spring Chinook salmon originated from commingled upriver stocks intercepted at Rock Island Dam (1940-1943) and imports from other Columbia River drainage hatcheries, primarily Carson NFH stock. Surplus eggs and fish from Leavenworth NFH have occasionally been used to meet production goals; however this practice was discontinued in 1992. Chinook salmon have been reared and released at Winthrop from 1942-1961 and from 1974 to the present. The last non-local stock introduction occurred in 1994. Historically, Winthrop NFH has operated as a segregated harvest augmentation program and Winthrop NFH stock was not included in the ESA-listed UCR spring Chinook salmon ESU. Beginning in 1998, the Methow Composite stock (Chewuch and Methow River origin) program was developed, and Winthrop NFH management objectives were modified to support conservation of localized stocks. In 2001, all pure non-localized (ie. Carson) stock on station at Winthrop NFH (brood years 1999 and 2000) were transferred out of basin as part of an interagency agreement (Appendix 1). Excess adult returns to Winthrop NFH from 2001 onward have been encouraged to spawn naturally in the Methow River and localized brood stocks have been utilized as available. In collaboration with Methow State Fish Hatchery, Winthrop NFH has continued the process of transitioning from the out of basin stock to the ESA-listed Methow Basin Composite stock. The last complete release of Carson stock occurred in 2000 (brood year 1998) and some "mixed" (Carson stock crossed with Methow Composite stock, known as MetComp 2, treated as non-listed w/ 100% adipose clipped) has occurred since 2000. Prioritized spawning is expected to return increasingly pure Methow Composite stock to the facility in the future. Inclusion of stock other than Winthrop NFH or Methow Composite stock is minimal considering few natural or other "out of basin" hatchery adults have been observed in the adult holding ponds at this facility (Table 3).

Table 3. The occurrence and disposal of stray coded-wire tagged spring Chinook observed at Winthrop NFH, 1998-2005*.

RETURN YR.	CWT	#RC'D	BY	%MARKED	DEPOSITION	RELEASE ORIGIN	EXPANDED
2005	NO OUT OF BASIN STRAYS RECOVERED AT WINTHROP NFH IN 2005						
2004	NO OUT OF BASIN STRAYS RECOVERED AT WINTHROP NFH IN 2004						
2003	NO OUT OF BASIN STRAYS RECOVERED AT WINTHROP NFH IN 2003						
2002	NO OUT OF BASIN STRAYS RECOVERED AT WINTHROP NFH IN 2002						
2001	NO OUT OF BASIN STRAYS RECOVERED AT WINTHROP NFH IN 2001						
2000	053706	1	1996	44.5%	UNKNOWN	ENTIAT NFH	2
2000	053707	1	1996	45.0%	UNKNOWN	ENTIAT NFH	2
2000	053708	1	1996	24.9%	UNKNOWN	ENTIAT NFH	4
2000	053763	1	1996	30.1%	UNKNOWN	ENTIAT NFH	3
2000	053848	1	1996	11.2%	UNKNOWN	LEAVENWORTH NFH	9
2000	053912	1	1997	33.8%	UNKNOWN	ENTIAT NFH	3
1999	NO OUT OF BASIN STRAYS RECOVERED AT WINTHROP NFH IN 1999						
1998	NO OUT OF BASIN STRAYS RECOVERED AT WINTHROP NFH IN 1998						

ESTIMATED TOTAL STRAYS	**24**
TOTAL HATCERY RETURN 1998-2005	**3,467**
% OF STRAYS TO WINTHROP NFH	**0.68%**

*Does not include adults from Methow SFH. All adults regardless of mark were 100% sampled. The number of observed "wild" scale patterns was estimated as two. Both of these fish were spawned (2/3,467 = 0.058%).

Description of Current Hatchery Practices and Performance Targets

Leavenworth Complex Spring Chinook Programs:

Returning Leavenworth Complex spring Chinook adults are primarily collected via voluntary entrance to hatchery fish ladders in the months of mid-May to early-July. Collected adults are retained in holding ponds through early September. Throughout the return broodstock is randomly collected so that a representative portion of the entire run contributes to egg collection (with the exception of Winthrop NFH that has on occasion collected adults in a manner to prioritize inclusion of listed stocks). Adults' surplus to production needs at Leavenworth and Entiat are donated to area tribes. Excess Winthrop NFH adults are primarily forced to spawn naturally in the Methow River. Formalin (167 ppm for 1 hour) treatment is administered to holding ponds and antibiotic treatment of female brood is administered one to two times prior to spawning to combat vertical transmission of bacterial kidney disease (BKD). Spawning occurs from mid-August until early September targeting a male to female ratio of 1:1. At Leavenworth NFH a back up male is utilized after initial fertilization by a primary male. Winthrop NFH prioritizes crosses of preferred ESA-listed stock over random run spawning and a male to female ratio of 1:1. In this manner gametes are held separate and spawned after individual brood has been identified or transfers have occurred to and from the adjacent Methow State Fish Hatchery. If numbers of returning broodstock are insufficient to meet hatchery production objectives each Leavenworth Complex station will rear fewer fish. In the extreme event of very poor adult returns, hatchery production may be compensated using an alternative brood as directed by state, tribal, and federal fishery managers on a case by case basis.

As part of the fish health program at the Leavenworth Complex, portions of the returning adults are tested for viruses and specific pathogens. The focus is on the detection of BKD, Infectious Pancreatic Necrosis Virus (IPNV), and Infectious Hematopoietic Necrosis Virus (IHNV). The USFWS-Olympia Fish Health Center (OFHC) provides health profiles of broodstock utilized for production. Sampling protocol includes testing all females for the presence and extent of BKD. The Enzyme-Linked Immunosorbent Assay (ELISA) is used to test for BKD from females used for propagation. Infection of BKD in salmonids is divided annually into six degrees or ranks from non-detected to very high. These levels are a guide to cull eggs prior to shocking. Additionally, bacteriology (kidney/spleen) is conducted on a minimum of sixty males and virology (ovarian fluid) on a minimum of 150 females (Ray Brunson pers. comm.).

Adult return evaluation is tasked primarily to the Mid-Columbia River Fisheries Resource Office which samples portions of the returning adults to document gender, age, fork length, and records any external marks or internal tags. All detected passive-integrated-transponder (PIT) tags are submitted to the Pit Tag Information System (PTAGIS). All other recovered tags such as radio or jaw tags are returned to the appropriate investigating agency. The FRO summarizes all adult return data by both return and brood year to describe population and brood characteristics.

Following spawning, fertilized eggs are water hardened in disinfectant and kept separated by female until ELISA results are available (generally within one month). If possible the higher ELISA ranked eggs are culled from the production lots. Eggs are then shocked, inventoried and pooled by remaining ELISA ranks for further incubation. Eggs hatch by mid-December, and fry are ready for ponding to either indoor starter tanks at Leavenworth NFH and Winthrop NFH or to outdoor raceways at Entiat NFH. Wells or infiltration galleries (Winthrop NFH only) provide the primary water source during early rearing. With the exception of occasional studies, most juveniles are hand fed throughout rearing. In June, fingerlings are marked, tagged, inventoried and split to additional ponds. The MCRFRO evaluates CWT retention rates a minimum of 30 days post tag and at a rate of 500 individuals checked per tag code. In an effort to reduce rearing densities, a portion of the fingerlings may be moved to adult holding ponds in October at Leavenworth NFH and in December at Entiat NFH (to accommodate the holding of coho brood stock for the Yakama Nation). In an effort to minimize stress, prevent disease, and optimize the aquatic environment rearing parameters target a density index (lbs./in.*ft^3) of less than 0.2, a flow index (lbs./in.* GPM) less than 0.6 and raceway turnover rate of less than 30 minutes. Water sources include a mix of river, well, and reuse at Leavenworth, well and reuse at Entiat, and well, infiltration gallery, and river at Winthrop. Throughout the rearing cycle, routine (ie. monthly) health examinations are conducted on a minimum of 60 fish per lot. Basic biometric (length, weight, Fulton condition factor) data is collected by hatchery staff and OFHC personnel conduct fish health examinations. Whenever abnormal behavior or mortality is observed, fish health personnel diagnose and recommend the appropriate treatment/protocol. In April after 20 months of on station rearing, yearling spring Chinook smolts are forced released directly from each facility to the Icicle, Entiat, or Methow Rivers.

All Leavenworth Complex data are inventoried, filed, and submitted to the Columbia River Fisheries Program Office (CRFPO) using the Columbia River Information System (CRIS) database. This data is subsequently incorporated into other databases such as StreamNet or the Regional Mark Information System (RMIS).

Current spring Chinook hatchery practices and performance targets for the Leavenworth Complex are summarized (Table 4). Spring Chinook adult broodstock management performance and spawning practice data for Leavenworth (Table 5), Entiat (Table 6), and Winthrop (Table 7) NFH's are displayed. Leavenworth NFH spring Chinook monthly production summaries describing the average rearing environment (Table 8) and juvenile performance (Table 9) for brood years 1997 -1998 are shown. Entiat NFH spring Chinook monthly production summaries describing the average rearing environment (Table 10) and juvenile performance (Table 11) for brood years 2001-2003 are shown. Winthrop NFH spring Chinook monthly production summaries describing the rearing environment (Table 12) and juvenile performance (Table 13) for brood year 2002 are shown.

Table 4. Spring Chinook production protocols and current practices for the Leavenworth Complex by hatchery, life stage, and attribute.

Life Stage	Attribute	Leavenworth NFH Chinook	Entiat NFH Chinook	Winthrop NFH Chinook	Winthrop NFH Steelhead	Winthrop NFH Coho
Adults	***collection***	Hatchery ladder	Hatchery ladder	Hatchery ladder	Wells Dam SFH	Hatchery ladder, Wells Dam SFH
	ladder operation	Continuous (throughout run). Pulsed during high returns	Continuous (throughout run).	Varies depending on return & stock availability	N/A	Varies depending on return & stock availability
	brood target	1,000	250	400	N/A	280
	prophylaxis	One antibiotic injection to brood females. Formalin treat AHP	Double antibiotic treatment to brood females. Formalin treat AHP	Double antibiotic treatment to brood females. Formalin treat AHP	N/A	Formalin Treatment
	stock	1. Hatchery return 2.Wenatchee	1.Hatchery return 2.Entiat	1.MetComp 2.Methow SFH 3.MetComp Cross	1.Wells Dam SFH	1.Winthrop 2.Wenatchee
	water quality monitoring	Temp.& flow rates	Temp.& flow rates	Temp.& flow rates	Temp.& flow rates	Temp.& flow rates
	spawning	Male:female = 1:1 (back up male)	Male:female = 1:1	Male:female = 1:1 (cross by stock 1st priority)	N/A	Male:female = 1:1
	health monitoring	BKD 100% females, virology/bacteriology	BKD 100% females, virology/bacteriology	BKD 100% females, virology/bacteriology	N/A	BKD 100% females, virology/bacteriology
	adult monitoring	Sex/age/length/Tag ID	Sex/age/length/Tag ID	Sex/age/length/Tag ID (prior to spawn)	N/A	Sex/age/length/Tag ID
	adult pre-spawn survival	98%	98%	98%	N/A	98%
Eggs	***green egg target***	2,000,000	500,000	750,000	110,000 eyed eggs received from Wells Dam SFH	320000
	prophylaxis	Disinfect, water harden, formalin treat	Disinfect, water harden, formalin treat	Disinfect, water harden, formalin treat	Performed at Wells SFH	Disinfect, water harden, formalin treat
	incubation units	Heath trays	Heath trays	Heath trays	Heath trays	Heath trays
	water source	Well	Well/Spring	Infiltration galleries	Infiltration galleries	Infiltration galleries
	water quality monitoring	Temp., flow rates, and gases if suspect	Temp., flow rates, and gases if suspect	Temp., flow rates, and gases if suspect	Temp., flow rates, and gases if suspect	Temp., flow rates, and gases if suspect
	culling	By ELISA rank	By ELISA rank	By ELISA rank	N/A	N/A
	shocking	Eggs pooled by rank / take and inventoried	Eggs pooled by rank / take and inventoried	Eggs kept separate by female and inventoried	Performed at Wells SFH	Eggs kept separate by female and inventoried

Table 4. Spring Chinook production protocols and current practices for the Leavenworth Complex by hatchery, life stage, and attribute (continued).

Life Stage	Attribute	Leavenworth NFH Chinook	Entiat NFH Chinook	Winthrop NFH Chinook	Winthrop NFH Steelhead	Winthrop NFH Coho
Fry	*% green egg to fry*	≥95%	≥95%	≥95%	≥95%	≥95%
	rearing unit	Starter tanks	8X80 raceways	Starter tanks & Foster-Lucas ponds	Starter troughs & tanks	Starter tanks
	water source	Well	Well	Infiltration galleries	Infiltration galleries	Infiltration galleries
	water quality monitoring	Temp.& flow rates, dissolved gases when needed	Temp.& flow rates, dissolved gases when needed	Temp.& flow rates, dissolved gases when needed	Temp.& flow rates, dissolved gases when needed	Temp.& flow rates, dissolved gases when needed
	feed type	Bio-Starter	Bio-Starter	Bio-Starter	Bio-Starter	Bio-Starter
	feeding frequency	6-8 times/day	4-5 times/day	8 times/day	8 times/day	8 times/day
	feed amount (%BW/Day)	1.0% BW/Day	1.8%BW/Day	2%BW/Day	2%BW/Day	2%BW/Day
	feed application	Hand	Hand	Hand	Hand	Hand
	cleaning frequency	Daily	Every other day	Daily	Daily	Daily
	monitoring	Monthly biometrics	Monthly biometrics	Monthly biometrics	Monthly biometrics	Monthly biometrics
Sub-yearlings	*rearing units*	8X80 raceways	8X80 raceways	8X80's (covered), converted FL's	Foster-Lucas ponds	Converted FL's
	water source	Well/river	Well/spring/re-use	River & infiltration galleries	Infiltration galleries	River & infiltration galleries
	water quality monitoring	Temp., dissolved gases when needed, & flow rates	Temp., dissolved gases when needed, & flow rates	Temp., dissolved gases when needed, & flow rates	Temp., dissolved gases when needed, & flow rates	Temp., dissolved gases when needed, & flow rates
	feed	BioMoist-Grower/LowPhos1000	BioMoist-Grower	BioMoist-Grower	BioMoist-Grower	BioMoist-Grower
	feeding frequency	4-6 times/day	1-2 Times per day	4-6 times/day	4-6 times/day	4-6 times/day
	feed amount	1% BW/Day	1.1% BW/Day	1.0% to 1.5% BW/Day	1.0% to 1.5% BW/Day	1.0% to 1.5% BW/Day
	feed application	Hand	Hand	Hand	Hand	Hand
	cleaning frequency	Every other day	Every three days	Every other day	Every day	Every other day
	marking	25%CWT, 100% Adclip, inventory, 15K PIT's	25%CWT, 100% Adclip, inventory, 3K PIT's	100%CWT, Adclip% (varies), inventory, 4.5K PIT's	100% Adclip, inventory	100% CWT, inventory
	monitoring	Monthly fish health & biometrics, CWT retentions	Monthly fish health & biometrics, CWT retentions	Monthly fish health & biometrics, CWT retentions	Monthly fish health & biometrics	Monthly fish health & biometrics, CWT retentions

Table 4. Spring Chinook production protocols and current practices for the Leavenworth Complex by hatchery, life stage, and attribute (continued).

Life Stage	Attribute	Leavenworth NFH Chinook	Entiat NFH Chinook	Winthrop NFH Chinook	Winthrop NFH Steelhead	Winthrop NFH Coho
Yearlings	***rearing units***	8X80's, 10X100's (covered), AHP's	8X80's, AHP's	8X80's (covered), converted FL's	Converted FL's	Converted FL's
	water source	River/well/1st pass re-use in emergency situation	Well/spring/re-use	River & Infiltration galleries	River & Infiltration galleries	River & Infiltration galleries
	water quality monitoring	Temp., dissolved gases when needed, & flow rates	Temp., dissolved gases when needed, & flow rates	Temp., dissolved gases when needed, & flow rates	Temp., dissolved gases when needed, & flow rates	Temp., dissolved gases when needed, & flow rates
	feed	BioMoist-Grower	BioMoist-Grower	BioMoist-Grower	BioMoist-Grower	BioMoist-Grower
	feeding frequency	Daily	Daily	Twice daily	Four times daily	Twice daily
	feed amount (%BW/Day)	1.0% BW/Day	0.6%BW/Day	< 1.0%BW/Day	< 1.0%BW/Day	< 1.0%BW/Day
	feed application	Hand	Hand	Hand	Hand	Hand
	cleaning frequency	1-2 times/ week	Twice per week	Every other day	Every day	Every other day
	monitoring	Monthly fish health & biometrics	Monthly fish health & biometrics	Monthly fish health & biometrics	Monthly fish health & biometrics	Monthly fish health & biometrics
	rearing parameters	Temp $\leq 60^0$F	Temp $\leq 49^0$F	Temp $\leq 60^0$F	Temp $\leq 60^0$F	Temp $\leq 60^0$F
		$d0_2$ >6 ppm	$d0_2$ >6 ppm	$d0_2$ >6 ppm	$d0_2$ >6 ppm	$d0_2$ >6 ppm
		Turnover rate$\leq$ 30 min	Turnover rate$\leq$ 30 min	Turnover rate$\leq$ 30 min	Turnover rate$\leq$ 30 min	Turnover rate$\leq$ 30 min
		Density index $\leq$ 0.20	Density index $\leq$ 0.09	Density index $\leq$ 0.11	Density index $\leq$ 0.20	Density index $\leq$ 0.15
		Flow index $\leq$ 0.60	Flow index $\leq$ 0.66	Flow index $\leq$ 0.50	Flow index $\leq$ 1.00	Flow index $\leq$ 1.00
	condition factor	3.90E-04	3.50E-04	3.50E-04	3.50E-04	3.50E-04
	size	16-20 fpp	16-18 fpp	15-18 fpp	5-7 fpp	15-18 fpp
	release type	forced	forced	forced	forced & volitional	forced
	release time	3rd week of April	mid-April	mid-April	mid-April	mid-April
	release goal	1,625,000	400,000	600,000	100,000	250,000
	fry to smolt survival	$\geq$95%	$\geq$95%	$\geq$ 95%	$\geq$ 95%	$\geq$ 95%
	smolt to adult survival	0.35%-0.40%	0.27%-0.30%	0.23%-0.27%	0.5%-2.5%	0.15%

Table 5. Leavenworth NFH spring Chinook adult brood stock management, performance, and spawning practices, 1994-2005.

Return Year	Hatchery Return	Surplus	Returned to Stream[1]	Jump Outs DIP's	Kept for Propagation			Green, Bad Spent	Used for Production	Pre-spawn Survival[2]	Spawn Ratio		Green Eggs Taken	Average Fecundity
					Males	Jacks	Females				Males	Females		
1994	1,019	32	0	41	462	10	460	7	925	96.0%	1.03	1.00	2,361,879	4,746
1995	462	29	0	16	163	26	197	8	378	96.5%	0.96	1.00	965,402	4,398
1996	1,148	78	0	32	465	48	497	22	988	97.2%	1.02	1.00	2,060,619	4,104
1997	2,839	1,833	0	28	452	7	500	12	947	99.0%	0.92	1.00	2,054,509	4,680
1998	1,541	538	0	66	404	5	495	18	886	95.7%	0.83	1.00	2,263,338	4,614
1999	1,745	740	15	86	383	40	469	12	880	95.1%	0.91	1.00	1,884,538	3,953
2000	4,457	3,428	15	25	437	51	487	14	961	99.4%	1.00	1.00	1,917,429	3,857
2001	6,259	4,875	1,488	32	414	15	430	3	856	99.5%	1.00	1.00	1,814,183	4,306
2002	6,459	5,070	0	35	494	8	484	12	974	99.5%	1.03	1.00	2,098,464	4,182
2003	4,825	3,392	61	184	377	9	447	5	828	96.2%	0.86	1.00	2,360,935	5,268
2004	2,308	924	0	33	453	40	494	3	984	98.6%	1.18	1.00	1,826,216	3,691
2005	2,560	1,830	44	8	331	8	337	5	671	99.7%	1.01	1.00	1,295,015	3,843
AVE	2,969	1,897	135	49	403	22	441	10	857	97.7%	0.98	1.00	1,908,544	4,304
MAX	6,459	5,070	1,488	184	494	51	500	22	988	99.7%	1.18	1.00	2,361,879	5,268
MIN	462	29	0	8	163	5	197	3	378	95.1%	0.83	1.00	965,402	3,691
STDEV	2,050	1,857	426	47	88	18	89	6	175	1.7%	0.09	0.00	415,476	461

[1]MCRFRO records indicate all adults in 1999, 2000, and 986 of the 1,488 in 2001 were passed upstream of the returned to stream component. In 2001, 487 and in 2002-2004, 350 adults were annually live outplanted to Peshastin/Ingalls Creeks.

[2]Pre-spawn survival is the hatchery return minus the # of DIP's/Jumpouts, divided by the hatchery return.

Table 6. Entiat NFH spring Chinook adult brood stock management, performance, and spawning practices, 1994-2005.

Return Year	Hatchery Return	Surplus	Returned to Stream	Jump Outs DIP's	Kept for Propagation			Green, Bad Spent	Used for Production	Pre-spawn Survival[1]	Spawn Ratio		Green Eggs Taken	Average Fecundity
					Males	Jacks	Females				Males	Females		
1994	80	0	0	7	27	4	42	0	73	91.3%	1.0	1.40	168,000	4,000
1995	121	0	0	4	55	3	58	1	116	96.7%	1.0	1.00	232,000	4,000
1996	175	0	0	4	62	7	102	0	171	97.7%	1.0	1.50	387,600	3,800
1997	275	0	0	19	102	2	139	13	243	93.1%	1.0	1.30	500,400	3,762
1998	216	0	0	5	69	14	126	0	209	97.7%	1.0	1.50	441,000	3,500
1999	724	246	0	15	144	34	281	3	456	97.9%	1.0	1.60	1,067,800	3,840
2000	1,919	1,478	0	7	115	17	150	2	280	99.6%	1.0	1.10	540,000	3,650
2001	2,666	2,350	0	9	128	11	165	0	304	99.7%	1.0	1.20	635,250	3,850
2002	1,834	1,558	0	5	130	5	135	0	270	99.7%	1.0	1.00	508,101	3,763
2003	884	542	0	31	126	25	143	4	293	96.5%	1.1	1.00	607,750	4,250
2004	759	452	0	5	118	12	150	2	278	99.3%	1.0	1.20	600,000	4,054
2005	763	466	0	1	127	17	144	6	282	99.9%	1.0	1.00	504,000	3,500
AVE	868	591	0	9	100	13	136	3	248	97.4%	1.0	1.2	515,992	3,831
MAX	2,666	2,350	0	31	144	34	281	13	456	99.9%	1.1	1.6	1,067,800	4,250
MIN	80	0	0	1	27	2	42	0	73	91.3%	1.0	1.0	168,000	3,500
STDEV	839	782	0	8	37	10	59	4	99	2.8%	0.0	0.2	225,444	223

[1]Pre-spawn survival is the hatchery return minus the # of DIP's/Jumpouts, divided by the hatchery return.

Table 7. Winthrop NFH spring Chinook adult brood stock management, performance, and spawning practices, 1994-2005.

Return Year	Hatchery Return	Surplus	Returned to Stream	Hatchery Transfers	Jump Outs DIP's	Brood Kept for Propagation	Green, Bad Spent	Used for Production	Pre-spawn Survival[1]	Male:Female Ratio	Green Eggs Taken	Average Fecundity
1994	29	0	0	0	0	29	0	29	100.0%	1.0 : 1.2	67,900	4,244
1995	14	0	0	0	1	14	0	13	92.9%	1.0 : 1.1	31,500	4,500
1996	205	3	0	0	4	203	2	196	98.0%	1.0 : 1.1	367,500	3,500
1997	231	4	0	0	10	231	0	217	95.7%	1.0 : 1.7	556,000	4,000
1998	110	0	0	0	34	110	2	74	69.1%	1.0 : 1.4	198,000	4,500
1999	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	224,430	n/a
2000	1,092	0	0	0	33	1,091	1	1,058	97.0%	1.0 : 1.2	2,219,200	3,800
2001	385	0	2	0	53	383	0	330	86.2%	1.0 : 1.5	804,000	3,799
2002	388	0	0	0	11	385	3	374	97.2%	1.0 : 2.1	943,500	3,809
2003	904	0	471	0	35	433	0	398	96.1%	1.0 : 1.5	972,000	4,000
2004	452	24	0	84	10	368	0	334	97.8%	1.0 : 1.9	832,200	3,800
2005	499	75	0	20	4	479	0	400	99.2%	1.0 : 1.3	855,000	3,672
AVE	392	10	43	9	18	339	1	311	93.6%	1.0 : 1.5	672,603	3,966
MAX	1,092	75	471	84	53	1,091	3	1,058	100.0%	1.0 : 2.1	2,219,200	4,500
MIN	14	0	0	0	0	14	0	13	70.0%	1.0 : 1.1	31,500	3,500
STDEV	344	23	142	25	18	297	1	287	8.9%	1.0 : 0.3	598,518	326

[1]Pre-spawn survival is the hatchery return minus the # of DIP's/Jumpouts, divided by the hatchery return.

Table 8. Leavenworth NFH juvenile spring Chinook average monthly brood production inventory and rearing environment parameters for brood years 1997-1998.

Month	Life Stage	Temp[1] ^{0}F Ave	Water Source[2] % Well	Water Source[2] % River	Flow GPM[3]	Flow Index (lbs./in.* GPM)[4]	Density Index (lbs./in.*ft^3)[4]	Number on Hand	Total Weight (lbs.)
August	Egg	NA	100%	0%	NA	NA	NA	NA	NA
September		NA	100%	0%	NA	NA	NA	NA	NA
October		NA	100%	0%	NA	NA	NA	NA	NA
November	Alevin	NA	100%	0%	NA	NA	NA	1,724,000	1,437
December	Fry	46.8	100%	0%	3,161	0.43	0.13	1,717,939	1,894
January		46.6	100%	0%	3,792	0.51	0.20	1,711,899	3,249
February		44.5	90%	10%	5,050	0.54	0.16	1,705,880	5,481
March	Sub-yearling	44.4	90%	10%	6,035	0.59	0.09	1,699,882	8,085
April		44.9	40%	60%	6,939	0.73	0.11	1,693,906	13,734
May		45.0	40%	60%	8,007	0.78	0.06	1,687,950	18,865
June		48.5	0%	100%	16,208	0.55	0.07	1,682,015	32,064
July		56.0	0%	100%	16,624	0.71	0.09	1,676,102	49,223
August		57.3	0%	100%	19,730	0.67	0.10	1,670,209	58,958
September		52.0	0%	100%	21,237	0.69	0.11	1,664,336	69,019
October		44.8	0%	100%	20,445	0.74	0.14	1,658,485	72,620
November	Yearling	38.0	0%	100%	19,935	0.77	0.14	1,652,654	74,141
December		35.0	0%	100%	20,220	0.76	0.14	1,646,843	74,530
January		34.2	0%	100%	25,768	0.60	0.15	1,641,053	75,295
February		35.1	0%	100%	25,944	0.60	0.15	1,635,283	76,276
March		38.1	0%	100%	23,644	0.69	0.16	1,629,534	81,144
April		41.6	0%	100%	NA	NA	NA	1,623,805	90,354

Unless otherwise indicated, all values are for end of the month totals or values obtained for the last ten days of the month and not daily averages for the month. Dissolved oxygen is measured during critical periods of disease, elevated temperatures, restricted flows, or fouled water. Minimum $d0_2$ for Leavenworth is 6 mg/L (T. Collier, pers. comm. 2006). Total gas pressure or % saturated gas was measured at time of well installation and is not regularly monitored. Degassing systems have been installed and fish health profile monitoring has not indicated elevated gas trauma (D.Davies pers. comm. 3/27/02).

[1]Temperature data is electronically measured every two hours and averaged for the month.

[2]Data indicates approximate water source useage. Actual useage depends on a variety of factors including disease and maintaining water (through well water inclusion) temperatures to minimize the formation of slush ice in winter and not to exceed 68^0 F during summer months.

[3]Estimated GPM used by brood including re-use. Calculated by dividing total weight (lbs.) by the average length (inches) multiplied by the flow index.

[4]Index averaged from Leavenworth NFH lot history records from brood years 1997 and 1998.

Table 9. Leavenworth NFH juvenile spring Chinook monthly culture and performance averages for brood years 1997-1998.

Month	Life Stage	Ave Size (#/lb)	Ave Size (gms)	Length Ave (in)	Length Ave (mm)	Condition Factor (C = lbs /in)	Feed Fed Per Day (lbs.)	Feeding Rate %BW/day[1]	Food Conversion (lbs. Fed/lb. Gain)	Comments
August	Egg	NA	NA	NA	NA	NA	NA	NA	NA	Eggs collected from broodstock
September		NA	NA	NA	NA	NA	NA	NA	NA	Fertilzed and placed in Heath stacks
October		NA	NA	NA	NA	NA	NA	NA	NA	Eyed at 750 Temperature Units (TU's)
November	Alevin	1,200.0	0.4	1.3	33	3.97E-04	NA	NA	NA	Shocked and picked, hatch @ 1,040 TU's
December	Fry	906.9	0.5	1.4	36	3.93E-04	19	1.00%	NA	Fry ponded in 91ft^3 nursery tanks
January		526.9	0.9	1.7	43	4.00E-04	22	0.68%	1.36	(~15K per tank) and on feed @ 2,067 TU's.
February		311.2	1.5	2.0	51	3.96E-04	70	1.28%	1.39	End of February ~55K per raceway placed
March	Sub-yearling	210.3	2.2	2.3	58	3.96E-04	115	1.42%	1.39	in 8'X80' raceways.
April		123.3	3.7	2.7	69	3.98E-04	129	0.94%	1.37	
May		89.5	5.1	3.0	77	3.98E-04	291	1.54%	1.39	Coded-wire tagging and adipose clipping,
June		52.5	8.7	3.6	92	3.99E-04	249	0.78%	1.36	fish split during marking into (45) 8'X80' rcwys,
July		34.1	13.3	4.2	107	3.96E-04	680	1.38%	1.39	and (14) 10'X100' rcwys.
August		28.3	16.0	4.5	113	3.98E-04	858	1.46%	1.37	
September		24.1	18.8	4.7	120	3.97E-04	456	0.66%	1.35	
October		22.8	19.9	4.8	122	3.96E-04	469	0.65%	1.35	After broodstock are removed a
November	Yearling	22.3	20.4	4.8	123	3.98E-04	170	0.23%	1.40	portion of the fish in 8'X80's are moved to
December		22.1	20.5	4.9	123	3.97E-04	78	0.10%	1.52	two adult holding ponds (150' X 15'X 4'deep).
January		21.8	20.8	4.9	124	3.97E-04	28	0.04%	3.45	
February		21.4	21.2	4.9	124	3.96E-04	54	0.07%	2.12	
March		20.1	22.6	5.0	127	3.96E-04	227	0.28%	6.86	
April		18.0	25.3	5.2	132	3.98E-04	427	0.47%	2.57	Release window is late April. Forced release.

[1]Factor utilized to determine feed aplication rates calculated as the % of body weight(BW) in total mass divided by total pounds fed.

Table 10. Entiat NFH juvenile spring Chinook monthly brood production inventory and rearing environment parameters averaged for brood years 2001-2003.

Month	Life Stage	Temp[1] ^{0}F Ave	Water Source % Well	Water Source % River	Flow GPM[2]	Flow Index (lbs./in.* GPM)	Density Index (lbs./in.*ft^3)	Number on Hand	Total Weight (lbs.)
August	Egg	NA	100%	0%	NA	NA	NA	NA	NA
September		NA	100%	0%	NA	NA	NA	541,760	NA
October		40.6	100%	0%	35	NA	NA	480,828	NA
November	Sac Fry	40.6	100%	0%	35	NA	NA	436,747	NA
December		40.6	100%	0%	35	NA	NA	436,747	NA
January		40.6	100%	0%	35	NA	NA	436,747	NA
February	Fry	49.6	100%	0%	1,700	NA	NA	424,325	353
March		48.1	100%	0%	1,700	0.31	0.04	422,777	644
April		47.3	100%	0%	1,700	0.35	0.08	421,783	1,328
May	Sub-yearlings	46.9	100%	0%	1,700	0.42	0.10	421,177	2,075
June		47.2	100%	0%	1,512	0.68	0.13	417,342	2,704
July		48.8	100%	0%	1,611	0.26	0.04	399,526	3,432
August		49.5	100%	0%	1,525	0.30	0.06	399,307	4,882
September		50.0	100%	0%	1,385	0.43	0.07	399,048	6,596
October		50.6	100%	0%	1,400	0.59	0.09	398,784	8,594
November		50.7	100%	0%	1,400	0.69	0.11	398,563	10,352
December		50.8	100%	0%	1,640	0.74	0.09	398,145	12,326
January	Yearling	50.4	100%	0%	1,700	0.71	0.09	397,398	14,346
February		50.0	100%	0%	1,640	0.80	0.11	396,438	17,088
March		49.1	100%	0%	1,700	0.84	0.11	395,337	19,866
April		47.0	100%	0%	1,700	0.88	0.12	394,743	21,930

[1]Temperature data is electronically measured every 15 minutes and averaged for the month.

[2]Data indicates monthly average for well GPM.

Table 11. Entiat NFH juvenile spring Chinook monthly culture and performance averages for brood years 2001-2003.

Month	Life Stage	Ave Size (#/lb)	Ave Size (gms)	Length Ave (in)	Length Ave (mm)	Condition Factor (C = lbs /in)	Feed Fed Per Day (lbs.)	Feeding Rate %BW/day	Food Conversion (lbs. Fed/lb. Gain)	Comments
August		NA	NA	NA	NA	NA	NA	NA	NA	Eggs collected from broodstock
September	Egg	NA	NA	NA	NA	NA	NA	NA	NA	Heath trays
October		NA	NA	NA	NA	NA	NA	NA	NA	Eyed at 650 Temperature Units (TU's) Shocked and picked
November		NA	NA	NA	NA	NA	NA	NA	NA	hatch @ 1,000 TU's
December	Alevin	NA	NA	NA	NA	NA	NA	NA	NA	
January		NA	NA	NA	NA	NA	NA	NA	NA	
February		1,200.0	0.4	1.3	34	NA	NA	NA	NA	Pond fry in 8X80
March	Fry	656.0	0.7	1.6	41	3.40E-04	11	1.68%	NA	in 8'X80' raceways.
April		317.5	1.4	2.1	54	3.40E-04	18	1.36%	1.87	
May		202.9	2.2	2.4	62	3.50E-04	23	1.11%	1.06	
June		154.3	2.9	2.7	69	3.50E-04	30	1.11%	1.20	Coded-wire tagged, adipose clip and
July		116.4	3.9	2.9	74	3.50E-04	40	1.16%	2.66	split fish from 7 raceways to 18
August	Sub-	81.8	5.6	3.3	85	3.50E-04	44	0.90%	1.88	
September	yearlings	60.5	7.5	3.9	98	3.60E-04	79	1.19%	1.62	
October		46.4	9.8	4.1	104	3.80E-04	72	0.83%	1.29	Coho trucked in and held in HP's
November		38.5	11.8	4.4	111	3.70E-04	113	1.09%	1.08	Coho trucked in and held in HP's
December		32.3	14.0	4.6	117	3.70E-04	84	0.68%	1.53	Coho spawned HP's cleaned and dissinfected.
January		27.7	16.4	4.8	122	3.60E-04	94	0.65%	1.50	Yearling Chinook ponded into HP's from raceways 1-7
February	Yearling	23.2	19.6	5.1	129	3.50E-04	107	0.62%	1.60	
March		19.9	22.8	5.3	135	3.40E-04	133	0.67%	1.50	
April		18.0	25.2	5.4	137	3.40E-04	134	0.61%	0.72	Release window is second week of April. Forced release.

Table 12. Winthrop NFH juvenile spring Chinook monthly brood production inventory and rearing environment parameters for brood year 2002 Methow Composite-1 stock only.

Month	Life Stage	Temp ^{0}F Ave	Water Source		Flow GPM	Flow Index (lbs./in.* GPM)	Density Index (lbs./in.*ft^3)	Number on Hand	Total Weight (lbs.)
			% Well	% River					
August	Egg	NA	100%	0%	NA	NA	NA	NA	NA
September		NA	100%	0%	NA	NA	NA	NA	NA
October		NA	100%	0%	NA	NA	NA	NA	NA
November	Alevin	NA	100%	0%	NA	NA	NA	NA	NA
December	Fry	47.0	100%	0%	1,029	0.36	0.06	557,595	511
January		47.3	100%	0%	1,673	0.36	0.05	566,027	1,048
February		46.0	100%	0%	2,460	0.36	0.05	565,228	1,874
March	Sub-yearling	47.0	100%	0%	2,441	0.49	0.06	565,043	2,941
April		45.6	100%	0%	4,567	0.33	0.06	559,413	4,182
May		45.0	100%	0%	6,565	0.28	0.03	547,144	5,695
June		48.5	90%	10%	6,618	0.39	0.05	544,957	9,495
July		51.8	90%	10%	6,552	0.43	0.05	542,614	10,852
August		54.5	90%	10%	6,588	0.46	0.05	541,555	12,115
September		53.0	100%	0%	11,238	0.34	0.07	541,209	17,164
October		46.6	50%	50%	11,058	0.39	0.08	540,684	20,589
November	Yearling	39.6	50%	50%	11,150	0.40	0.08	540,267	21,662
December		38.0	50%	50%	11,099	0.40	0.08	539,932	21,519
January		40.9	50%	50%	11,040	0.42	0.08	539,384	22,981
February		43.3	30%	70%	11,071	0.43	0.08	538,997	23,912
March		42.7	0%	100%	11,108	0.48	0.09	538,191	28,370
April		44.0	0%	100%	NA	NA	NA	537,360	31,042

Table 13. Winthrop NFH juvenile spring Chinook monthly culture and performance brood year 2002 Methow Composite-1 stock only.

Month	Life Stage	Ave Size (#/lb)	Ave Size (gms)	Length Ave (in)	Length Ave (mm)	Condition Factor (C = lbs /in)	Feed Fed Per Day (lbs.)	Feeding Rate %BW/day	Food Conversion (lbs. Fed/lb. Gain)	Comments
August	Egg	NA	NA	NA	NA	NA	NA	NA	NA	Eggs collected from broodstock
September		NA	NA	NA	NA	NA	NA	NA	NA	fertilzed and placed in Heath trays
October		NA	NA	NA	NA	NA	NA	NA	NA	
November	Alevin	NA	NA	NA	NA	NA	NA	NA	NA	
December	Fry	1,091.2	0.4	1.38	35	3.49E-04	2.7	0.54%	1.18	Trasferred to starter tanks
January		540.1	0.8	1.74	44	3.51E-04	14.5	1.39%	0.84	Trasferred to Foster-Lucas ponds
February		301.6	1.5	2.12	54	3.50E-04	20.5	1.09%	1.07	
March	Sub-yearling	192.1	2.4	2.46	62	3.50E-04	30.8	1.05%	1.15	
April		133.8	3.4	2.78	70	3.50E-04	42.1	1.01%	1.18	
May		96.1	4.7	3.10	79	3.50E-04	57.9	1.02%	1.45	Coded Wire Tagging and adipose clipping,
June		57.4	7.9	3.68	93	3.50E-04	79.5	0.84%	1.58	Transferred to 8x80's and converted FL's
July		50.0	9.1	3.85	98	3.50E-04	105.9	0.98%	0.86	
August		44.7	10.2	4.00	102	3.50E-04	153.7	1.27%	3.51	
September		31.5	14.4	4.49	114	3.50E-04	153.0	0.89%	3.63	
October		26.3	17.3	4.77	121	3.50E-04	137.9	0.67%	0.85	
November	Yearling	24.9	18.2	4.86	123	3.50E-04	58.1	0.27%	0.51	
December		25.1	18.1	4.85	123	3.50E-04	60.9	0.28%	1.76	
January		23.5	19.3	4.96	126	3.50E-04	41.2	0.18%	-8.92	
February		22.5	20.1	5.02	128	3.50E-04	71.9	0.30%	1.38	
March		19.0	23.9	5.32	135	3.50E-04	164.5	0.58%	5.48	Release window is
April		17.3	26.2	5.49	139	3.50E-04	163.1	0.53%	0.55	mid-April. Forced release.

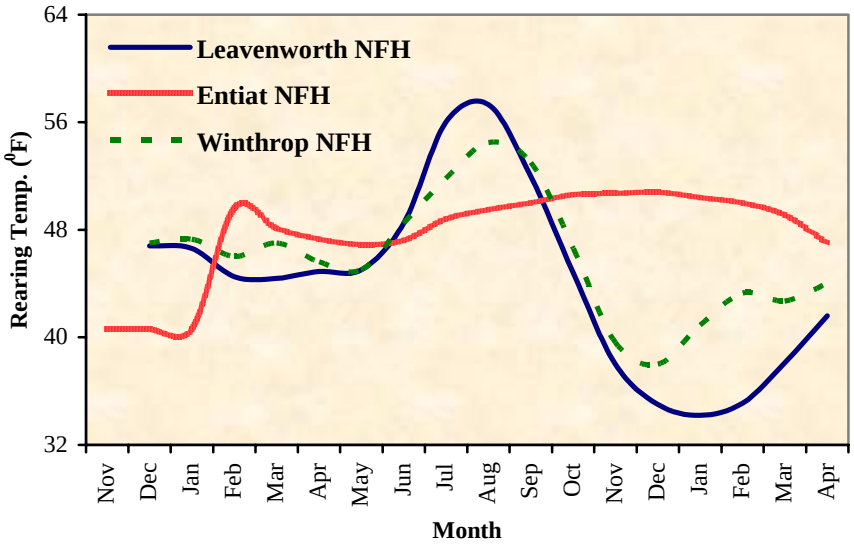


Figure 3. An example of spring Chinook rearing temperature (^{0}F) profiles for Leavenworth (brood years 1997-98 average), Entiat (brood years 2001-03 average), and Winthrop (brood year 2002) NFH's.

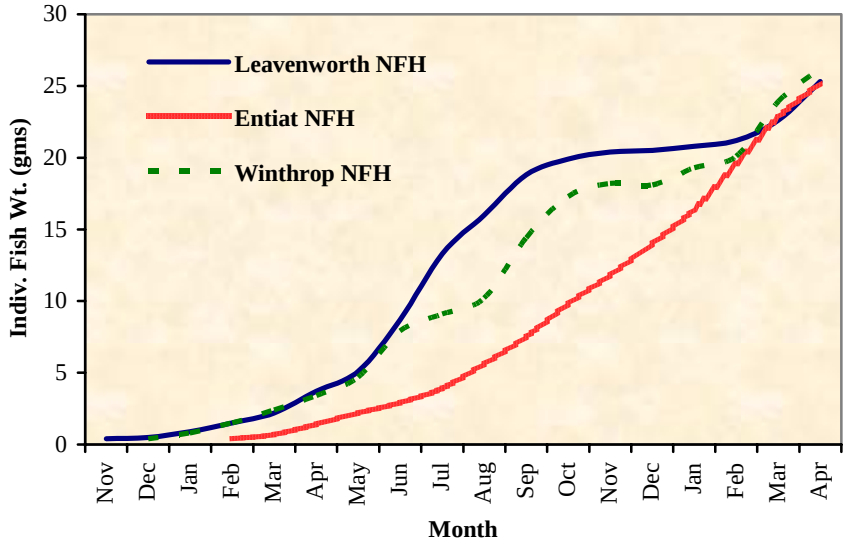


Figure 4. An example of juvenile spring Chinook growth (gms) profiles for Leavenworth (brood years 1997-98 average), Entiat (brood years 2001-03 average), and Winthrop (brood year 2002) NFH's.

As with most hatcheries the quantity and quality of the water source is the primary factor determining the structure and operation of each fish culture facility. Within the many characteristics of water no other single factor affects the development and growth of fish as much as water temperature (Piper et al. 1982). As previously mentioned, each Leavenworth Complex facility is unique in the use of water to culture spring Chinook. The figures above provide examples of the types of rearing temperature profiles (Figure 3) and subsequent fish growth (Figure 4) resulting from primarily river water use at Leavenworth NFH, to a mix of infiltration gallery/well water at Winthrop NFH, to strict well/re-use water at Entiat NFH.

Winthrop Summer Steelhead Program:

Winthrop NFH is the only Leavenworth Complex facility currently producing steelhead. Steelhead produced at Winthrop NFH are included in the upper Columbia River ESU which is currently listed as threatened under the Endangered Species Act (1973). The goals for this listed stock are to maintain its high biological significance, increase its viability from low to high, and increase harvest opportunity over time. Winthrop NFH steelhead are part of an integrated hatchery program incorporating some wild origin adults into the brood each year. However, Winthrop is lower in priority for the incorporation of pure wild stock (ie. wild x wild crosses) than the Wells SFH program. This is due in part to a harvest mitigation agreement with USBR as part of the Grand Coulee Fish Maintenance Project. The Winthrop NFH program utilizes adults captured from the upper Columbia River run at large at the Wells Hatchery or Wells Dam collection facilities. Adults are held, spawned, and eyed eggs are transferred to Winthrop NFH for incubation, rearing, and final release from the facility to the Methow River after 15 months of on station rearing. The release is semi-volitional (voluntary for a set time then forced) from mid-April to mid-May. Hatchery performance targets for this program are described (Table 4). Monthly production summaries describing the rearing environment (Table 14) and juvenile performance (Table 15) for brood year 2003 are shown. Juvenile steelhead are 100% adipose clipped, however, a unique CWT is not applied for adult return/harvest contribution evaluation. On average 118,400 juveniles (SD = 16,745) have been released from 1996-2005 at an average size of 6.5 fish per pound (SD = 1.1) from this facility. Recently, approximately 50,000 PIT tags were applied to this stock annually (brood years 2002-2004) as part of an Army Corps of Engineers lower Columbia River transportation study. This tagging is beginning to provide some preliminary data regarding juvenile outmigration and adult return characteristics (Table 16). The USFWS has explored the possibility of developing a unique Methow River steelhead stock as adults can and do return to the hatchery. However, this program would require two-years of on station rearing to mimic the natural production cycle of this stock. Unfortunately, this is not possible given the limited water and rearing space available under Winthrop NFH's current production programs.

Table 14. Winthrop NFH juvenile summer steelhead trout monthly brood production inventory and rearing environment parameters for brood year 2003.

Month	Life Stage	Temp ^{0}F Ave	Water Source % Well	Water Source % River	Flow GPM	Flow Index (lbs./in.* GPM)	Density Index (lbs./in.*ft^3)	Number on Hand	Total Weight (lbs.)
August	NA	NA	100%	0%	NA	NA	NA	NA	NA
September	NA	NA	100%	0%	NA	NA	NA	NA	NA
October	NA	NA	100%	0%	NA	NA	NA	NA	NA
November	NA	NA	100%	0%	NA	NA	NA	NA	NA
December	NA	NA	100%	0%	NA	NA	NA	NA	NA
January	NA	NA	100%	0%	NA	NA	NA	NA	NA
February	Egg	NA	100%	0%	NA	NA	NA	NA	NA
March	Alevin/Fry	47.0	100%	0%	90	0.89	0.74	118,569	116
April	Fry	46.0	100%	0%	199	0.60	0.13	121,314	210
May	Fry	45.2	100%	0%	199	0.85	0.19	119,724	356
June	Sub-yearling	47.8	100%	0%	398	0.61	0.14	119,187	612
July	Sub-yearling	50.8	100%	0%	703	0.50	0.06	118,566	1,069
August	Sub-yearling	53.0	100%	0%	701	0.79	0.10	118,241	2,119
September	Sub-yearling	52.8	100%	0%	1,403	0.54	0.07	117,998	3,396
October	Sub-yearling	50.6	100%	0%	1,392	0.70	0.09	117,874	4,954
November	Sub-yearling	48.8	100%	0%	1,369	0.99	0.13	117,530	8,133
December	Sub-yearling	42.0	30%	70%	2,006	0.74	0.10	117,196	9,338
January	Sub-yearling	42.9	30%	70%	1,344	1.11	0.16	115,359	9,486
February	Yearling	42.3	30%	70%	1,335	1.22	0.17	114,932	10,842
March	Yearling	42.3	100%	0%	1,313	1.47	0.22	114,746	13,993
April	Smolt	44.5	100%	0%	NA	NA	NA	114,708	17,540

Table 15. Winthrop NFH juvenile summer steelhead trout monthly culture and performance for brood year 2003.

Month	Life Stage	Ave Size (#/lb)	Ave Size (gms)	Length Ave (in)	Length Ave (mm)	Condition Factor (C = lbs /in)	Feed Fed Per Day (lbs.)	Feeding Rate %BW/day	Food Conversion (lbs. Fed/lb. Gain)	Comments
August	NA	NA	NA	NA	NA	NA	NA	NA	NA	
September	NA	NA	NA	NA	NA	NA	NA	NA	NA	
October	NA	NA	NA	NA	NA	NA	NA	NA	NA	
November	NA	NA	NA	NA	NA	NA	NA	NA	NA	
December	NA	NA	NA	NA	NA	NA	NA	NA	NA	
January	NA	NA	NA	NA	NA	NA	NA	NA	NA	
February	Egg	NA	NA	NA	NA	NA	NA	NA	NA	Eyed eggs received from Wells SFH
March	Alevin/Fry	1,022.1	0.4	1.453	36.91	3.19E-04	1.2	1.06%	0.57	Transferred to starter troughs
April	Fry	577.7	0.8	1.76	44.65	3.19E-04	3.3	1.56%	1.04	
May	Fry	336.3	1.3	2.10	53.42	3.20E-04	5.7	1.59%	1.87	Transferred to starter tanks
June	Sub-yearling	194.8	2.3	2.52	64.06	3.20E-04	13.5	2.20%	2.77	
July	Sub-yearling	110.9	4.1	3.04	77.29	3.20E-04	14.0	1.31%	1.69	Adipose clipping/transferred to FL's
August	Sub-yearling	55.8	8.1	3.83	97.18	3.20E-04	26.0	1.23%	1.76	
September	Sub-yearling	34.7	13.1	4.48	113.82	3.20E-04	48.4	1.43%	1.38	
October	Sub-yearling	23.8	19.1	5.08	129.11	3.20E-04	67.0	1.35%	1.63	
November	Sub-yearling	14.5	31.4	6.00	152.45	3.20E-04	89.9	1.11%	1.73	
December	Sub-yearling	12.6	36.2	6.29	159.79	3.20E-04	70.5	0.76%	0.69	Transferred to converted FL's
January	Sub-yearling	12.2	37.3	6.36	161.49	3.20E-04	25.7	0.27%	0.66	
February	Yearling	10.6	42.8	6.66	169.06	3.20E-04	61.8	0.57%	11.68	
March	Yearling	8.2	55.4	7.25	184.15	3.20E-04	81.6	0.58%	1.87	Release window is mid-April.
April	Smolt	6.5	69.4	7.82	198.58	3.20E-04	189.5	1.08%	0.90	Forced & volitional release.

Table 16. A summary of the Winthrop NFH steelhead program, brood years 1995-2004.

Brood Year	Beginning Release Dates		Number Released	Size @ Rel. #/LB	Number PIT Tagged	McNary Travel Time	Rel-McNary Survival	PIT Adults BON	PIT Survival
	1st Group	Last Group							
1995	04/22/96	04/23/96	141798	6.3	0	NA	NA	NA	NA
1996	04/23/97	04/24/97	104,098	5.2	0	NA	NA	NA	NA
1997*	04/29/98	05/22/98	127,020		0	NA	NA	NA	NA
1998	04/21/99	06/10/99	112,908	7.0	0	NA	NA	NA	NA
1999	04/12/00	05/22/00	105,510	5.4	0	NA	NA	NA	NA
2000	04/30/01	04/30/01	98,834	5.5	0	NA	NA	NA	NA
2001	04/30/02	04/30/02	150,488	8.0	0	NA	NA	NA	NA
2002	04/28/03	04/28/03	119,370	6.5	49,217	13.0	27.2%	87	0.18%
2003	04/27/04	04/28/04	113,603	6.0	49,475	24.3	37.1%	27	0.05%
2004	04/22/05	04/29/05	110,368	8.2	49,233	20.7	22.5%	NA	NA

Winthrop NFH steelhead are 100% adipose clipped, however, they are not marked with an identifiable coded-wire tag. All adult broodstock are collected and spawned at Wells SFH. Therefore, adult return data is limited. *Release files indicate Wells Hatchery produced the fish that were released at Winthrop NFH. Data of harmonic travel time (# of days from release to each Columbia River Dam, McNary, John Day & Bonneville) & survival generated by Columbia Basin Research, School of Aquatic & Fishery Sciences, University of Washington, http://www.cbr.washington.edu/dart/ Cormack/Jolly-Seber Estimates survival estimates are generated from capture histories for each fish that are based on data downloaded from the PTAGIS database system. The particular data used for these estimates contain only last detections and therefore do not take into account the full detection history for a fish at a given site and may not account for errors in detection sequence recording. This may lead to minor over censoring sequence recording. This may lead to minor over censoring of the data that in turn may lead to slightly higher standard errors in parameter estimates when compared to systems that use the full detections history of the fish.
The number of adult PIT tagged steelhead detected at Bonneville Dam adult ladders as of 2/21/06 with incomplete PIT survival shown.

Leavenworth Complex Coho Salmon Programs:

Coho salmon were once widely distributed within the Columbia River Basin (Fulton 1970: Chapman 1986). In the early 1900's coho were extirpated from the middle reach of the Columbia River including the Wenatchee and Methow River Basins (Mullan 1984). Mullan (1984) estimated historical populations of 23,000 to 31,000 annually in the Methow River drainage and 6,000 to 7,000 annually in the Wenatchee River drainage. The Yakama Nation seeks to return coho to these basins through a long-term multiphase mid-Columbia River reintroduction project (HGMP, 1999). The beginning phase of this project focuses on the use of artificial propagation of available lower Columbia River stock for acclimation and release to the Methow and Wenatchee River Basins. The Yakama Nation currently does not have a hatchery facility in these basins and through agreement with various agencies including the USFWS utilizes hatcheries from around the region to support the coho program. Each Leavenworth Complex hatchery is currently involved in the mid-Columbia coho reintroduction program to varying extents as described below.

Leavenworth NFH receives coho yearlings (primarily reared at the lower Columbia River hatcheries of Willard NFH, Eagle Creek NFH, and Cascade SFH) on station in winter for 1-4 month acclimation and subsequent release. Yearlings had initially been acclimated behind dam 5 in Icicle Creek; however, more recently they are acclimated in Leavenworth NFH's Yakama Nation renovated Foster-Lucas ponds prior to release into Icicle Creek.

Entiat NFH provides adult holding ponds for use during Wenatchee River coho brood collection and spawning operations in October through November annually. Hatchery staff assists the Yakama Nation in holding, spawning, fertilizing, and incubating approximately one million of coho eggs annually. A separate Yakama Nation funded isolation incubation quarantine facility was constructed on station to accommodate this program. Coho brood is transferred as eyed eggs off station primarily to lower Columbia River hatcheries (Willard NFH, Cascade NFH) for rearing and subsequent return to the Wenatchee Basin for release.

Winthrop NFH is the only Leavenworth Complex facility currently providing a complete coho production program. Adults return to the hatchery ladder and are spawned, incubated, reared, and released as yearlings for the most part back to the Methow River. Hatchery performance targets for the Winthrop NFH coho program are described (Table 4). Coho adult broodstock management, performance, and spawning practice data are displayed (Table 17). Monthly production summaries describing the rearing environment (Table 18) and juvenile performance (Table 19) for brood year 2003 are shown. On average 251,027 coho juveniles (SD = 110,720) have been reared on station from 1996-2005 to an average size of 17.3 fish per pound (SD = 2.0) for release in late-April to early-May each year (Table 20).

The Yakama Nation fisheries staff conducts the primary evaluation of the Leavenworth Complex coho programs.

Table 17. Winthrop NFH coho adult brood stock management, performance, and spawning practices, 2001-2005.

Return Year	Hatchery Return	Surplus	Returned to Stream	Hatchery Transfers	Jump Outs DIP's	Brood Kept for Propagation	Green, Bad Spent	Used for Production	Pre-spawn Survival	Male:Female Ratio	Green Eggs Taken	Average Fecundity
2001	334	10	128	0	3	206	0	193	99%	1.0 : 1.0	239,661	2,577
2002	52	0	0	0	8	52	0	44	85%	3.0 : 1.0	19,800	1,800
2003	208	66	0	0	40	142	0	102	81%	1.1 : 1.0	105,600	2,200
2004	119	20	0	0	12	99	0	87	90%	1.3 : 1.0	68,400	1,800
2005	354	0	55	0	17	299	0	282	95%	1.0 : 1.0	308,000	2,200
AVE	213	19	37	0	16	160	0	142	90%	1.5 : 1.0	148,292	2,115
MAX	354	66	128	0	40	299	0	282	99%	3.0 : 1.0	308,000	2,577
MIN	52	0	0	0	3	52	0	44	81%	1.0 : 1.0	19,800	1,800
STDEV	132	27	56	0	14	96	0	95	7%	1.0 : 1.0	121,007	326

Table 18. Winthrop NFH juvenile coho monthly brood production inventory and rearing environment parameters for brood year 2003.

Month	Life Stage	Temp ^{0}F Ave	Water Source		Flow GPM	Flow Index (lbs./in.* GPM)	Density Index (lbs./in.*ft^3)	Number on Hand	Total Weight (lbs.)
			% Well	% River					
August	NA	NA	100%	0%	NA	NA	NA	NA	NA
September	NA	NA	100%	0%	NA	NA	NA	NA	NA
October	Egg	NA	100%	0%	NA	NA	NA	NA	NA
November	Egg	NA	100%	0%	NA	NA	NA	NA	NA
December	Egg	NA	100%	0%	NA	NA	NA	NA	NA
January	Alevin	NA	100%	0%	NA	NA	NA	NA	NA
February	Fry	46.3	100%	0%	121	0.64	0.14	76,512	138
March	Fry	46.8	100%	0%	121	1.11	0.25	76,362	313
April	Fry	46.2	100%	0%	219	0.85	0.19	76,204	516
May	Sub-yearling	47.2	0%	100%	299	0.96	0.13	75,893	987
June	Sub-yearling	52.0	0%	100%	300	1.05	0.14	75,762	1,136
July	Sub-yearling	55.6	0%	100%	601	0.57	0.08	65,311	1,388
August	Sub-yearling	56.7	0%	100%	597	0.67	0.09	64,869	1,755
September	Sub-yearling	51.0	0%	100%	597	0.80	0.11	64,784	2,292
October	Sub-yearling	46.8	40%	60%	601	0.91	0.12	64,745	2,811
November	Sub-yearling	43.3	50%	50%	600	0.94	0.13	64,729	2,942
December	Sub-yearling	39.6	50%	50%	598	0.95	0.13	64,707	2,979
January	Yearling	37.8	40%	60%	600	0.95	0.13	64,687	2,992
February	Yearling	38.5	30%	70%	598	1.00	0.14	64,659	3,214
March	Yearling	42.8	10%	90%	600	1.05	0.14	64,622	3,474
April	Smolt	48.0	0%	100%	NA	NA	NA	64,604	3,983

Table 19. Winthrop NFH juvenile coho monthly culture and performance for brood year 2003.

Month	Life Stage	Ave Size (#/lb)	Ave Size (gms)	Length Ave (in)	Length Ave (mm)	Condition Factor (C = lbs /in)	Feed Fed Per Day (lbs.)	Feeding Rate %BW/day	Food Conversion (lbs. Fed/lb. Gain)	Comments
August	NA	NA	NA	NA	NA	NA	NA	NA	NA	
September	NA	NA	NA	NA	NA	NA	NA	NA	NA	
October	Egg	NA	NA	NA	NA	NA	NA	NA	NA	Eggs collected from broodstock
November	Egg	NA	NA	NA	NA	NA	NA	NA	NA	fertilzed and placed in Heath trays
December	Egg	NA	NA	NA	NA	NA	NA	NA	NA	
January	Alevin	NA	NA	NA	NA	NA	NA	NA	NA	
February	Fry	554.4	0.8	1.78	45	3.21E-04	0.9	0.67%	0.29	Transferred to starter tanks
March	Fry	244.0	1.9	2.34	59	3.20E-04	2.9	0.92%	0.51	
April	Fry	147.7	3.1	2.77	70	3.20E-04	4.4	0.85%	0.75	
May	Sub-yearling	76.9	5.9	3.44	87	3.20E-04	6.3	0.64%	0.97	Coded Wire Tagging
June	Sub-yearling	66.7	6.8	3.61	92	3.20E-04	7.6	0.67%	0.48	Transferred to converted FL's
July	Sub-yearling	47.1	9.6	4.05	103	3.20E-04	10.1	0.73%	2.10	
August	Sub-yearling	37.0	12.3	4.39	111	3.20E-04	11.5	0.65%	1.41	
September	Sub-yearling	28.3	16.1	4.80	122	3.20E-04	14.8	0.65%	1.21	
October	Sub-yearling	23.0	19.7	5.14	131	3.20E-04	17.7	0.63%	1.02	
November	Sub-yearling	22.0	20.6	5.22	133	3.20E-04	5.0	0.17%	0.29	
December	Sub-yearling	21.7	20.9	5.24	133	3.20E-04	4.2	0.14%	0.99	
January	Yearling	21.6	21.0	5.25	133	3.20E-04	2.9	0.10%	2.43	
February	Yearling	20.1	22.6	5.38	137	3.20E-04	7.2	0.22%	15.54	
March	Yearling	18.6	24.4	5.52	140	3.20E-04	17.0	0.49%	2.38	Release window is mid-April.
April	Smolt	16.2	28.0	5.78	147	3.20E-04	30.7	0.77%	1.77	Forced release.

Table 20. A summary of Winthrop NFH coho releases, brood years 1994-2003.

Brood Year	Release Dates		Production Numbers		Total Number	Est. #CWT's	Size @ Rel. #/LB
	Methow Rel. Date	Transfer Date	# Rel. to Methow	# Transferred[1]			
1994	05/15/96		235,281		235,281		15.4
1995	05/15/97		69,230		69,230		14.8
1996	4/20-5/7/98		169,199		169,199	39,622	15.1
1997							
1998	4/30-5/15/00		199,763		199,763	26,472	17
1999	04/30/01	3/21-3/23/01	260,319	144,892	405,211	133,989	19.8
2000	04/30/02		185,787		185,787	120,679	19.3
2001	04/28/03	3/17-3/18/03	242,401	160,615	403,016	232,840	19.9
2002	04/29/04		308,063		308,063	296,901	17.7
2003	04/29/05		283,695		283,695	146,587	16.7

Above data acquired from MCRFRO Leavenworth Complex CRIS release database (SR80's).

[1]Records indicate 144,892 brood year 1999 coho yearlings were transferred to the Butcher Creek acclimation ponds in the Wenatchee basin for release and 160,615 brood year 2001coho yearlings were transferred to Icicle Creek for release.

SPRING CHINOOK EVALUATION

Juvenile Production

Hatchery releases:

- Leavenworth NFH reduced yearling production from 2.2 million to a release goal of 1.625 million in release year 1993 (Appendix 2). The release date has remained consistent around the third week in April and although some attempt is made to coincide with a discharge event, this facility is constrained within a spill window negotiated with Chelan PUD for Rock Island Dam. A significant change occurred in this program beginning with brood year 2000 compared to the previous 1994-1999 period. Starting with brood year 2000, the size at release has decreased 15%, coded-wire tagging has increased from 17% to 50%, and the percent of adipose clipped juveniles has increased from 17% to 100%. Additionally, brood years 2000-2002 were part of a lower Columbia River transportation study which increased the portion of PIT tags from ~5,000 to 260,000 annually (Table 21). PIT tagging in recent years (2005 @~15K) is being conducted by the Fish Passage Center.

Table 21. Leavenworth NFH yearling spring Chinook releases for brood years 1994-2003.

Brood Year	Release Year	Release Date	Yearlings Released	Release Size (#/LB)	# CWT Tagged	% CWT Tagged	% Adipose Clipped	# PIT Tagged	% PIT Tagged
1994	1996	15-Apr	1,706,060	16.1	287,288	17%	17%	1,196	0.1%
1995	1997	17-Apr	919,025	18.3	299,190	33%	33%	1,198	0.1%
1996	1998	20-Apr	1,701,753	16.1	301,044	18%	18%	7,468	0.4%
1997	1999	19-Apr	1,636,402	17.3	187,841	11%	11%	7,404	0.5%
1998	2000	18-Apr	1,680,904	18.0	193,411	12%	12%	7,387	0.4%
1999	2001	17-Apr	1,630,089	16.8	242,732	15%	15%	7,592	0.5%
2000	2002	22-Apr	1,554,362	22.5	444,493	29%	100%	317,278	20.4%
2001	2003	21-Apr	1,288,893	16.3	771,756	60%	100%	240,558	18.7%
2002	2004	19-Apr	1,422,100	20.3	822,002	58%	100%	216,698	15.2%
2003	2005	15-Apr	1,476,046	19.9	782,602	53%	100%	14,825	1.0%
AVE		18-Apr	1,501,563	18.2	433,236	30%	50%	82,160	5.7%
MAX		22-Apr	1,706,060	22.5	822,002	60%	100%	317,278	20.4%
MIN		15-Apr	919,025	16.1	187,841	11%	11%	1,196	0.1%
STDEV		2.4	245,649	2.1	257,917	20%	43%	124,022	8.6%

- Entiat NFH currently has an annual yearling production goal of 400,000. Additionally, from 1994-2005 Entiat NFH reared and released approximately 187,000 – 421,000 subyearling spring Chinook during brood years 1994, 1997, and 1999 (Appendix 3). This program was discontinued due to exceptionally poor performance of this lifestage (Cooper et al. 2002). However, evaluations of Entiat NFH yearling spring Chinook performance in this report do include the nominal performance of the subyearling life stage. The release date traditionally has occurred during the first week of April; however, beginning in 2003 the release date has shifted towards mid-April generally coinciding with a discharge event. Similar to Leavenworth NFH, a significant change in the size at release occurred for this program beginning with brood year 2000 compared

to the previous 1994-1999 period with release size decreasing ~60%. Since 2000, the percent of CWT's stabilized around 45% and 100% adipose clipping was implemented. Additionally, brood years 2000-2002 were part of a lower Columbia River transportation study which increased the annual use of PIT tags from essentially none to 60,000 (Table 22). PIT tagging in recent years (2005 & 2006) has been conducted using tags from the Mid-Columbia River FRO. Currently no PIT tags are anticipated for this program after the 2007 release year.

Table 22. Entiat NFH yearling spring Chinook releases for brood years 1994-2003.

Brood Year	Release Year	Release Date	Yearlings Released	Release Size (#/LB)	# CWT Tagged	% CWT Tagged	% Adipose Clipped	# PIT Tagged	% PIT Tagged
1994	1996	1-Apr	335,593	13.4	100,448	30%	30%	1,200	0.4%
1995	1997	1-Apr	200,486	9.6	197,071	98%	98%	1,199	0.6%
1996	1998	1-Apr	350,784	10.4	124,536	36%	36%	0	0.0%
1997	1999	7-Apr	354,238	11.3	118,058	33%	33%	0	0.0%
1998	2000	4-Apr	359,667	11.9	109,394	30%	30%	0	0.0%
1999	2001	3-Apr	397,855	12.7	394,411	99%	99%	0	0.0%
2000	2002	7-Apr	533,720	20.9	159,363	30%	100%	59,401	11.1%
2001	2003	15-Apr	395,689	19.7	199,248	50%	100%	59,879	15.1%
2002	2004	14-Apr	386,833	17.3	193,630	50%	100%	58,625	15.2%
2003	2005	15-Apr	401,240	17.3	199,127	50%	100%	3,732	0.9%
AVE		6-Apr	371,611	14.5	179,529	51%	73%	18,404	4.3%
MAX		15-Apr	533,720	20.9	394,411	99%	100%	59,879	15.2%
MIN		1-Apr	200,486	9.6	100,448	30%	30%	0	0.0%
STDEV		5.9	81,729	4.0	85,528	27%	35%	28,246	6.6%

- Winthrop NFH currently has an annual yearling production goal of 600,000. Due to poor returns and the transition of brood stock at this facility, production goals are only recently being realized (Appendix 4). The release date has remained consistent around the second week in April with attempts to coincide with a discharge event. Similar to Leavenworth and Entiat NFH's a significant change in size at release occurred in this program beginning with brood year 2000 compared to the previous 1994-1999 period with release size decreasing ~36%. Coded-wire tagging has consistently remained near 100% with the percent adipose clipped varying depending on portion of brood in non-ESA-listed status. Additionally, brood years 2000-2002 were part of a lower Columbia River transportation study which increased the annual use of PIT tags from essentially 5,500 to 22,000 (Table 23). PIT tagging in recent years (2005 & 2006) has been conducted using tags from the Mid-Columbia River FRO. Currently no PIT tags are anticipated for this program after the 2007 release year.

Table 23. Winthrop NFH yearling spring Chinook releases for brood years 1994-2003.

Brood Year	Release Year	Release Date	Yearlings Released	Release Size (#/LB)	# CWT Tagged	% CWT Tagged	% Adipose Clipped	# PIT Tagged	% PIT Tagged
1994	1996	11-Apr	112,395	11.8	110,878	99%	99%	1,493	1.3%
1995	1997	9-Apr	14,620	12.8	14,620	100%	100%	0	0.0%
1996	1998	14-Apr	324,851	13.9	324,851	100%	100%	9,542	2.9%
1997	1999	15-Apr	545,062	13.2	513,724	94%	94%	7,490	1.4%
1998	2000	10-Apr	377,696	13.8	364,632	97%	97%	7,490	2.0%
1999	2001	17-Apr	175,869	14.0	171,496	98%	98%	7,422	4.2%
2000	2002	15-Apr	201,604	17.5	201,604	100%	0%	27,459	13.6%
2001	2003	15-Apr	461,678	20.3	439,785	95%	57%	19,962	4.3%
2002	2004	13-Apr	578,307	17.7	513,687	89%	7%	19,887	3.4%
2003	2005	15-Apr	550,214	16.1	527,836	96%	18%	3,600	0.7%
AVE		13-Apr	334,230	15.1	318,311	97%	67%	10,435	3.4%
MAX		17-Apr	578,307	20.3	527,836	100%	100%	27,459	13.6%
MIN		9-Apr	14,620	11.8	14,620	89%	0%	0	0.0%
STDEV		2.6	200,810	2.7	184,883	3%	43%	9,023	3.9%

Downstream Migration:

- Table 24 describes the travel time, arrival date, and survival of PIT-tagged spring Chinook smolts released from Leavenworth Complex facilities to McNary Dam for the period 1998-2005. Cormack/Jolly-Seber estimates of travel time (TT in days) and percent survival by release year from hatchery to McNary Dam are depicted. For the period of 2002-2005, survival over McNary Dam has exhibited a consistent trend for all three hatcheries which appears to reflect the distance and number of impoundments between release stations to McNary Dam. For the period of 2002-2005 Entiat NFH exhibits the current highest average survival (58.8%, SD = 4.9%), followed by Leavenworth NFH (54.8%, SD = 6.4%), then Winthrop NFH (49.9%, SD = 3.9%).

Table 24. Estimates of Leavenworth Complex PIT-tagged yearling spring Chinook travel time (days), arrival date, and survival to McNary Dam (McN), 1998-2005.

Hat	Leavenworth NFH				Entiat NFH				Winthrop NFH			
Year	Release Date	Days to McN	Ave. Date McN	%Surv. to McN	Release Date	Days to McN	Ave. Date McN	%Surv. to McN	Release Date	Days to McN	Ave. Date McN	%Surv. to McN
1998	20-Apr	20.1	10-May	56%	1-Apr	NA	NA	NA	14-Apr	24.8	8-May	55%
1999	19-Apr	25.3	14-May	58%	7-Apr	NA	NA	NA	15-Apr	24.8	9-May	56%
2000	18-Apr	32.9	20-May	59%	4-Apr	NA	NA	NA	10-Apr	27.3	7-May	49%
2001	17-Apr	34.8	21-May	50%	3-Apr	NA	NA	NA	17-Apr	35.9	22-May	43%
2002	22-Apr	25.6	17-May	56%	7-Apr	24.7	1-May	54%	15-Apr	25.6	10-May	50%
2003	21-Apr	24.5	15-May	63%	15-Apr	24.2	9-May	65%	15-Apr	23.2	8-May	55%
2004	19-Apr	25.3	14-May	48%	14-Apr	17.4	1-May	57%	13-Apr	32.2	15-May	49%
2005	15-Apr	31.8	16-May	52%	15-Apr	20.6	5-May	59%	15-Apr	27.5	12-May	46%
02'-05' AVE	19-Apr	26.8	16-May	54.8%	12-Apr	21.7	4-May	58.8%	14-Apr	27.1	11-May	49.9%
02'-05' MAX	22-Apr	31.8	17-May	63.0%	15-Apr	24.7	9-May	65.5%	15-Apr	32.2	15-May	55.3%
02'-05' MIN	15-Apr	24.5	14-May	48.1%	7-Apr	17.4	1-May	53.7%	13-Apr	23.2	8-May	45.8%
02'-05' STDEV	3.1	3.4	1.4	6.4%	3.9	3.4	3.7	4.9%	1.0	3.8	3.0	3.9%

*Summary of data conducted for the 2002-2005 only to include Entiat NFH in equal comparison, which did not release PIT-tagged spring Chinook yearlings from 1998-2001. All travel time and survival estimates are provided courtesy of Columbia Basin Research, School of Aquatic & Fishery Science, University of Washington,. For information regarding methods and assumptions visit online at: http://www.cbr.washington.edu/dart/dat/runs/fws_nfh.html.

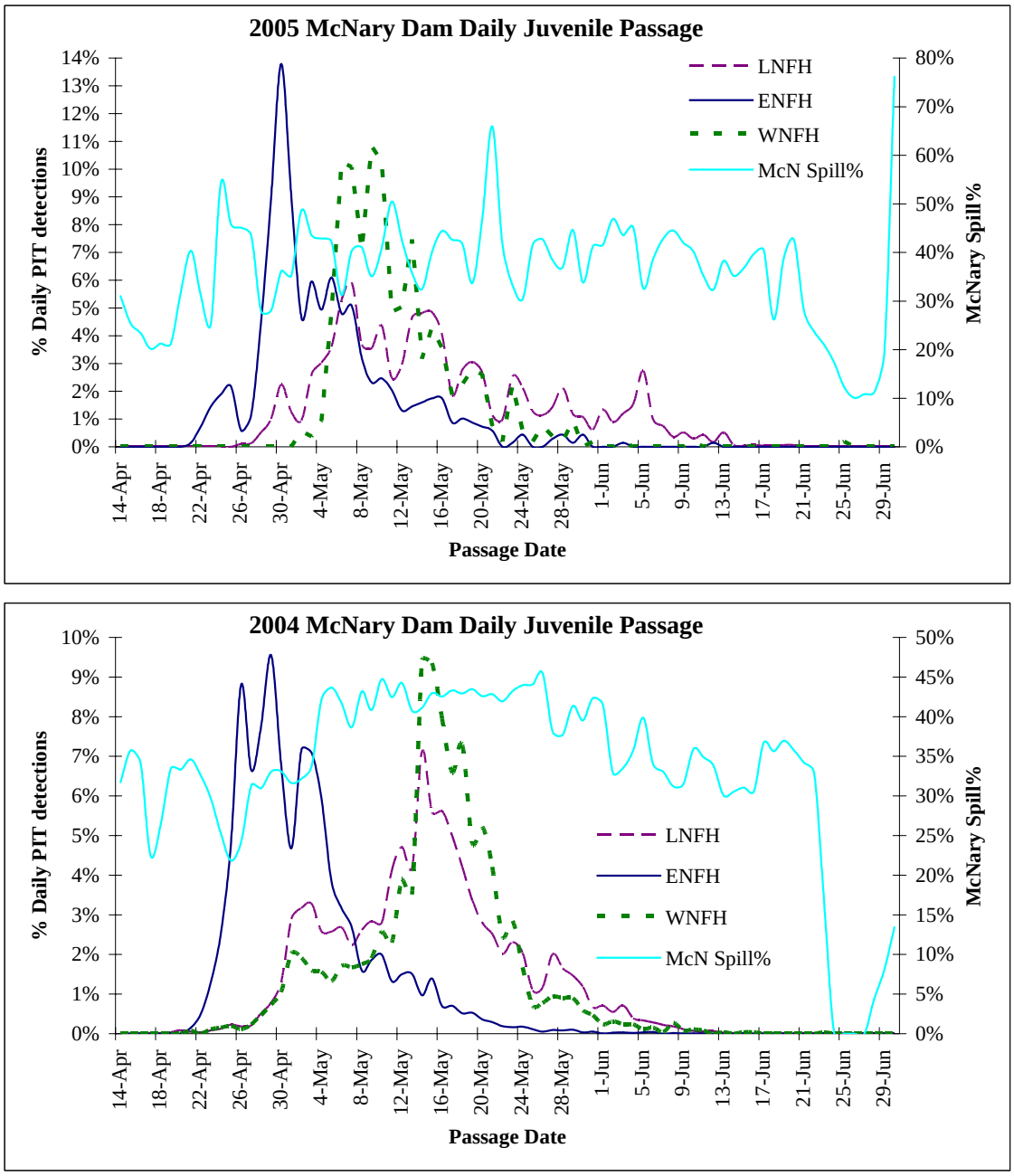
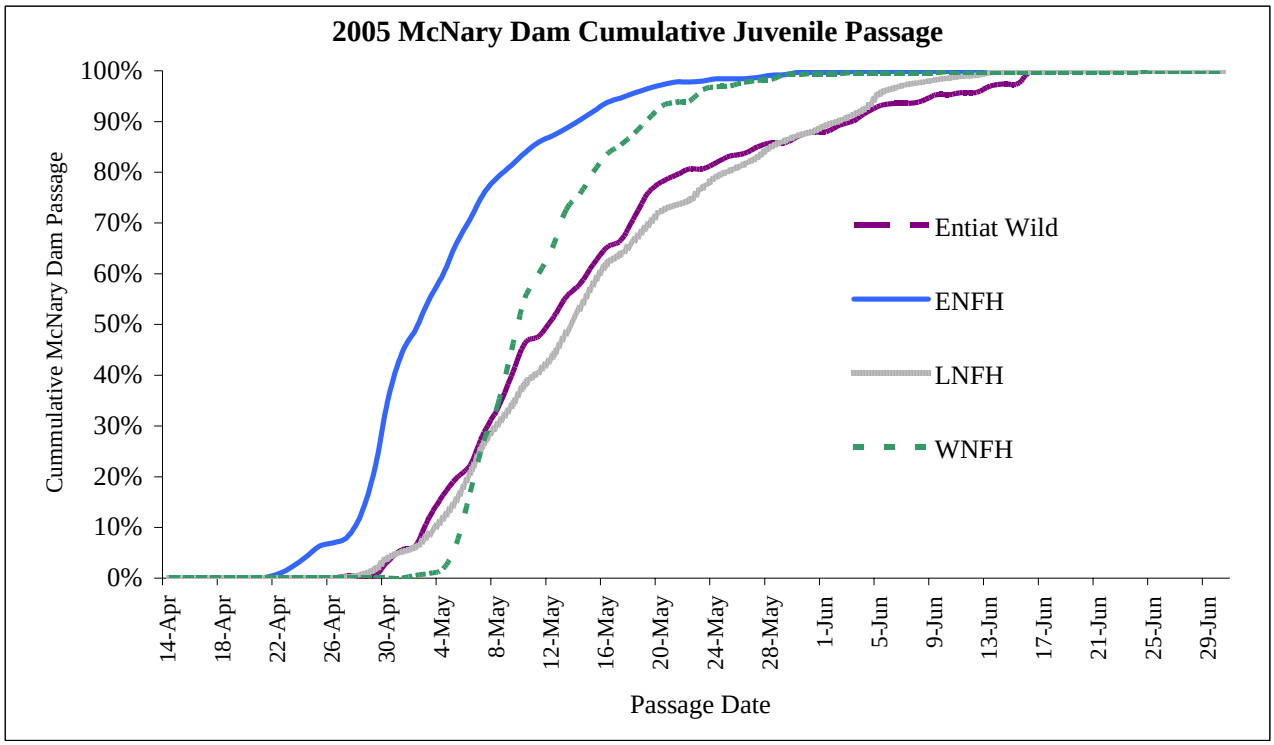


Figure 5. The PIT detected passage of Leavenworth Complex spring Chinook smolts over McNary Dam vs. spill percentage for release years 2004 (bottom) and 2005 (top).

- For the period of 2002-2005, the average passage date over McNary Dam has remained fairly consistent for smolts from all three hatcheries, with Entiat NFH generally arriving first (May 4th, SD = 3.7 days), followed by Winthrop NFH (May 11th, SD = 3.0 days), then Leavenworth NFH (May 16th, SD = 1.4 days). Leavenworth Complex smolts appear to arrive at McNary Dam during periods of spill. Similarity, in daily passage between hatcheries appears most closely related between Leavenworth and Winthrop NFH smolts (2005 correlation analysis = 0.83). Conversely, daily passage by Entiat NFH smolts does not appear closely related to the daily passage of either Leavenworth (corr.=0.46) or Winthrop NFH smolts (corr.=0.32) (Figure 5).



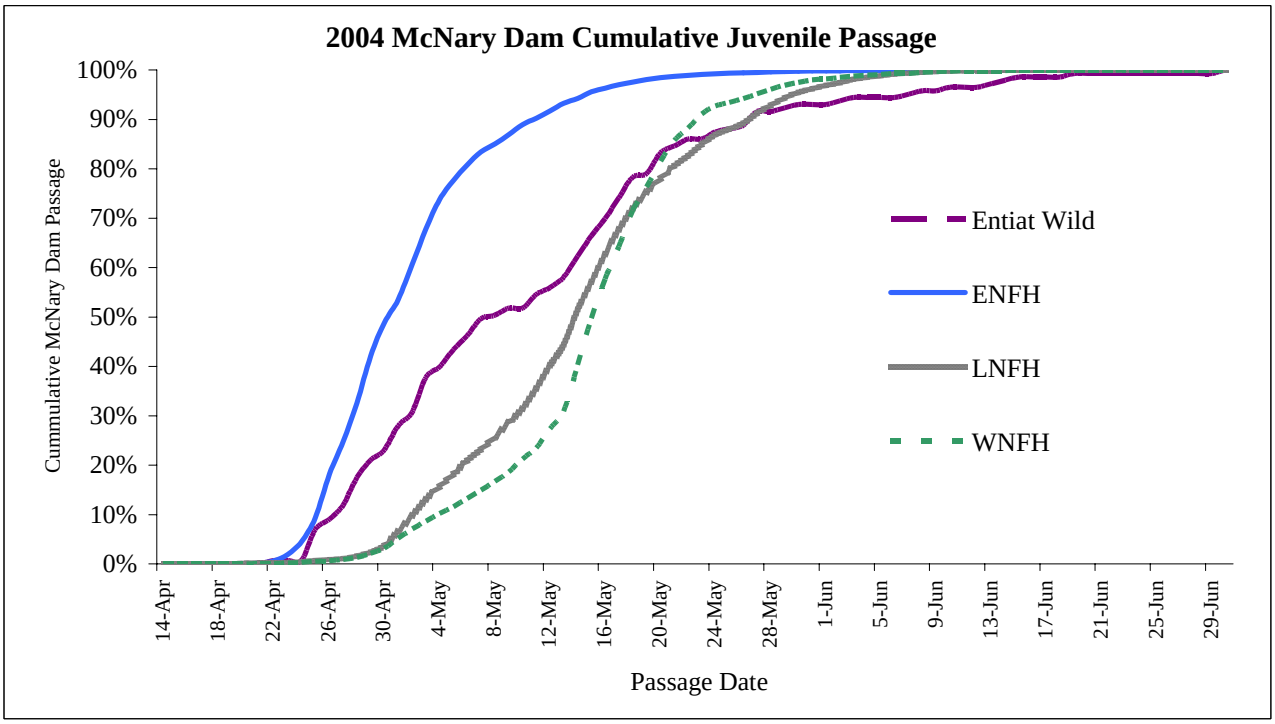


Figure 6. Cumulative passage of PIT-detected Leavenworth Complex and Entiat River wild spring Chinook passage over McNary Dam, 2004 (bottom) & 2005 (top).

- Figure 6 describes the 2004 (bottom graph) and 2005 (top graph) cumulative passage of Leavenworth Complex spring Chinook yearlings compared to Entiat River wild spring Chinook migrants captured, PIT-tagged and released from the Entiat River juvenile trap (includes fall

subyearling and spring yearling migrant life histories each year). For both 2004 and 2005 Leavenworth NFH appears to most closely mimic the Entiat wild spring Chinook migration pattern over McNary Dam. Similarity by correlation analysis of the 2005 daily PIT detected passage over McNary Dam (Entiat River wild spring Chinook daily passage not graphically shown) reveals that Entiat River wild spring Chinook migrants were more closely related to Leavenworth NFH (corr.=0.86) and Winthrop NFH (corr.=0.78) than to Entiat NFH (corr.=0.48).

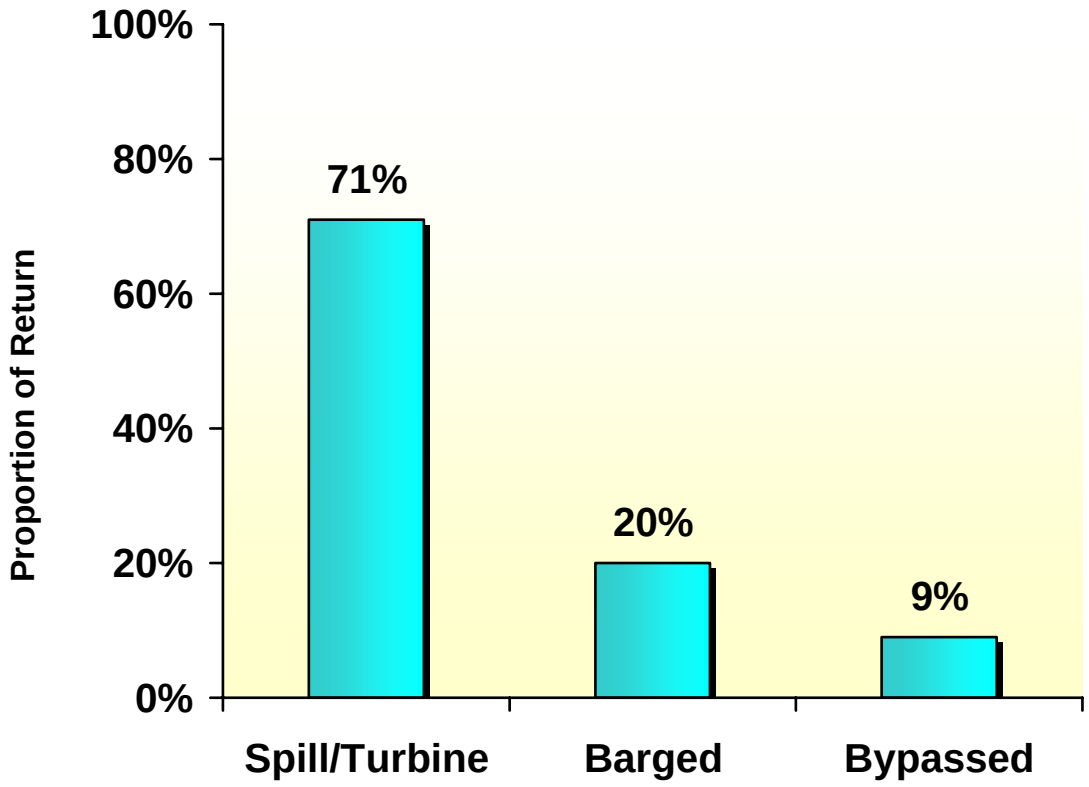


Figure 7. Route of juvenile passage based on returning Leavenworth NFH pit-tagged adult spring Chinook, 2004.

- Figure 7 reflects the juvenile route of passage by McNary Dam as determined from returning PIT-tagged adults in 2004 to LNFH. Each returning PIT-tagged adult may have a documented juvenile migration history at McNary Dam if it was detected as it moved through the juvenile bypass system and subsequently deposited to the river (bypassed) or a barge. For those PIT-tagged adults without a juvenile detection history, it is assumed that they passed McNary Dam either via spill or turbine where detection is not possible.

Adult Returns

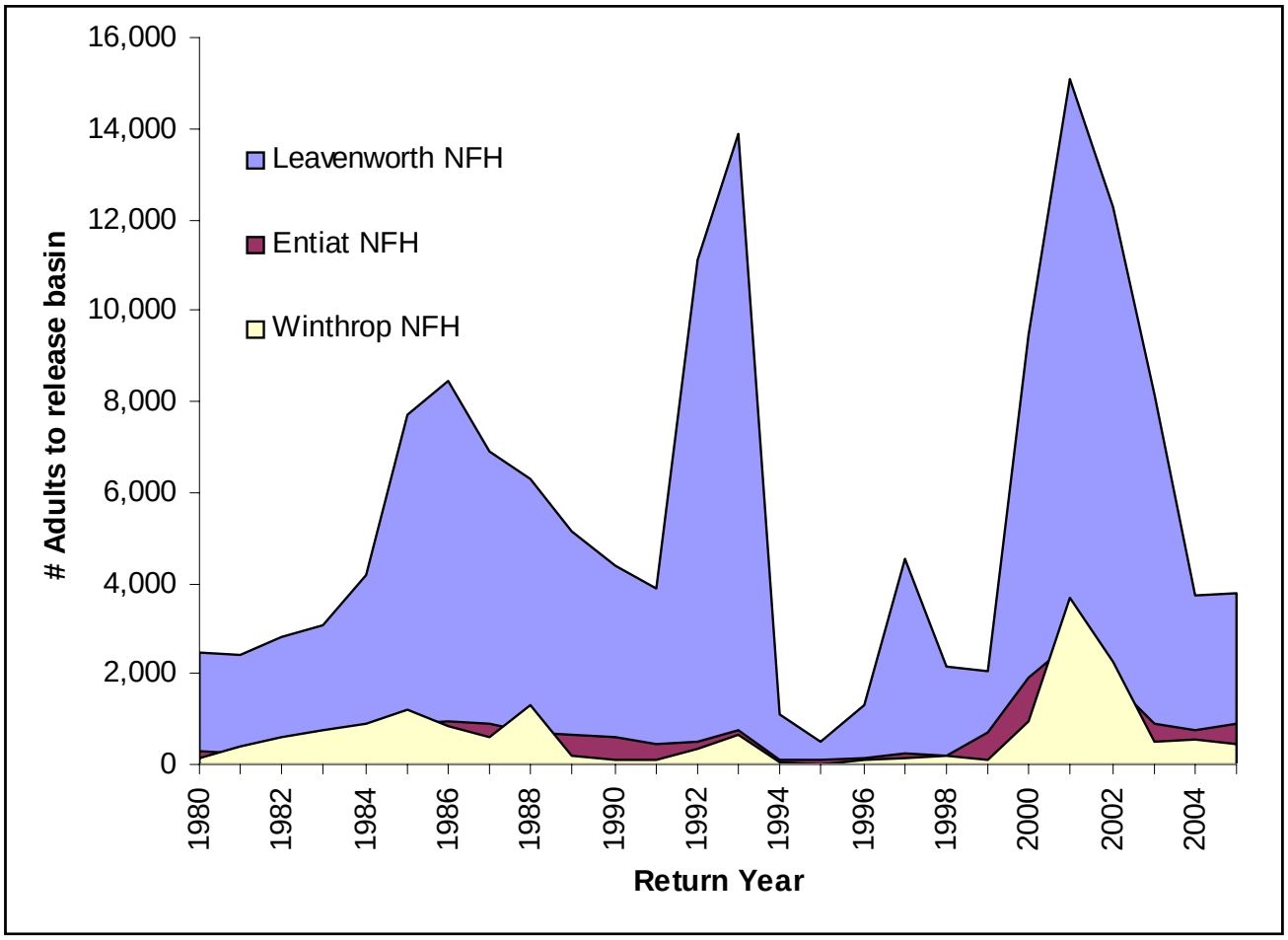


Figure 8. Leavenworth Complex adult spring Chinook return to release basin by hatchery, 1980 - 2005.

- Leavenworth Complex adult spring Chinook returns to the Wenatchee Basin have varied considerably over the past twenty-six years (1980-2005, Figure 8 & Table 25). Leavenworth NFH has averaged 5,649 (SD = 4,034) returning adults to the Wenatchee River Basin and was unable to achieve a minimum broodstock goal of 1,000 adults in only one (1995) of twenty-six years (1/26 years = 4%). Entiat NFH has averaged 740 (SD = 598) returning adults to the Entiat River Basin annually and failed to meet the minimum broodstock goal of 250 adults in six (1981-82, 1994-1996, & 1998) of twenty-six years (6/26 = 23%). Winthrop NFH has averaged 660 (SD = 798) returning adults to the Methow River Basin annually and failed to meet the minimum broodstock goal of 400 adults in twelve (1980-81, 1989-1992, 1994-1999) of twenty-six years (12/26 = 46%).

Table 25. Leavenworth Complex adult spring Chinook returns to release basin, 1980-2005.

Year	Leavenworth NFH	Entiat NFH	Winthrop NFH	Complex Total
1980	2,452	305	155	2,912
1981	2,420	247	399	3,066
1982	2,814	247	601	3,662
1983	3,090	672	755	4,517
1984	4,189	808	900	5,897
1985	7,714	912	1,201	9,827
1986	8,451	969	836	10,256
1987	6,905	913	594	8,412
1988	6,277	689	1,327	8,293
1989	5,134	669	195	5,998
1990	4,373	583	121	5,077
1991	3,858	437	92	4,387
1992	11,117	520	332	11,969
1993	13,862	730	646	15,238
1994	1,124	80	29	1,233
1995	484	121	14	619
1996	1,327	175	80	1,582
1997	4,533	275	144	4,952
1998	2,158	216	178	2,552
1999	2,073	724	118	2,915
2000	9,464	1,919	947	12,330
2001	15,082	2,666	3,695	21,443
2002	12,281	1,834	2,249	16,364
2003	8,161	884	515	9,560
2004	3,732	759	573	5,064
2005	3,793	884	464	5,141

Summary Data for 1980 - 2005				
AVE	5,649	740	660	7,049
MAX	15,082	2,666	3,695	21,443
MIN	484	80	14	619
STDEV	4,034	598	798	5,136
By %	80%	10%	9%	100%

Summary Data for 1980 - 1993				
AVE	5,904	622	582	7,108
MAX	13,862	969	1,327	15,238
MIN	2,420	247	92	2,912
STDEV	3,431	244	394	3,689
By %	83%	9%	8%	100%

Summary Data for 1994 - 2005				
AVE	5,351	878	751	6,980
MAX	15,082	2,666	3,695	21,443
MIN	484	80	14	619
STDEV	4,786	839	1,117	6,623
By %	77%	13%	11%	100%

- For the period of 1980 – 2005 the Leavenworth Complex has returned to the upper Columbia Basin approximately 7,049 (SD = 5,136) adults annually. Leavenworth NFH has contributed approximately 80% of this return with Entiat and Winthrop NFH's splitting the remaining 20%. Beginning in the early 1990's many of the Leavenworth Complex hatcheries reduced production or eliminated subyearling release programs (see Appendices 2-4). The effect that the reduced production had in lowering adult returns appears negligible with the Leavenworth Complex

returning ~7,000 adults annually for the period 1994-2005. Presently, Leavenworth NFH still contributes the majority of recent returns (~77%), however, Entiat and Winthrop NFH are contributing ~30-40% more adults annually (see Table 9 summary data for 1980-1993 vs. 1994-2005).

Adult Run Timing:

- Data is limited to address Leavenworth Complex adult return run timing. Historically, notes were kept by hatchery personnel to document the number of adults estimated by week in the holding ponds. Additionally, a mechanical lever was used at Leavenworth NFH (1991-2001) to estimate the in ladder return. However, this lever was found to vary between 42% greater to 19% less than the actual adult pond census (Cooper et al. 2002). Recently, PIT tags in returning adults combined with improved dam ladder PIT detection systems have produced some data regarding adult run timing characteristics. Figure 9 describes the 2003 adult PIT-tag expanded ((# juveniles released/# PIT tags (by BY)*each PIT detected adult)) spring Chinook return over Bonneville Dam for Leavenworth and Winthrop NFH. From this data approximately, half of the run passed Bonneville by April 7th for both hatcheries. Only a few (5) age-3 adults represented ENFH with pit tags in 2003.

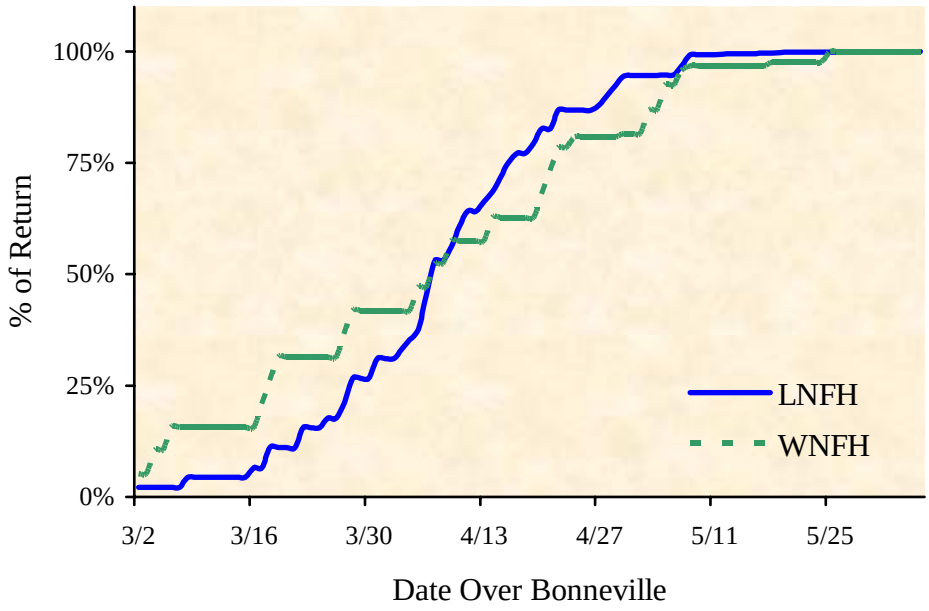


Figure 9. A comparison of run timing between Leavenworth and Winthrop NFH adult pit-tagged spring Chinook over Bonneville Dam, 2003.

- The 2003, Leavenworth NFH return timing to Bonneville by age class is shown (Figure 10). Age 5's, 4's, and 3's reached half of their age class return over Bonneville by April 6th, April 22nd, and May 12th, respectively. It took age 5's, 4's and 3's on average, 47, 35, and 21 days, respectively, to travel between Bonneville and Wells Dams for Winthrop NFH adults (not shown).

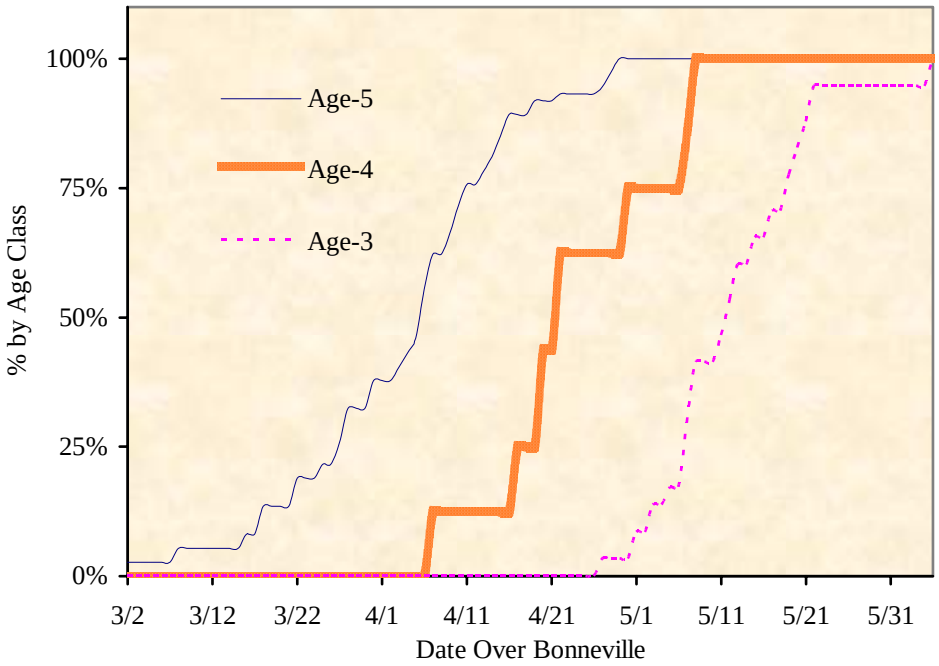


Figure 10. Comparisons of age-class run timing over Bonneville Dam for Leavenworth NFH adult pit-tagged spring Chinook, 2003.

- The installation of an adult PIT tag antennae at Leavenworth NFH has provided some data regarding daily timing of hatchery ladder entrance. The 2003 time of entry into Leavenworth NFH adult holding pond (Figure 11) shows that adult spring Chinook exhibit a nocturnal migration pattern with most adults entering in the evening through early morning. Note: in 2003 a large return occurred in which the ladder was occasionally pulsed in an effort to reduce the number of adults entering the pond and to maximize harvest fisheries. Operation of the ladder in this manner may have influenced the daily entry timing displayed.

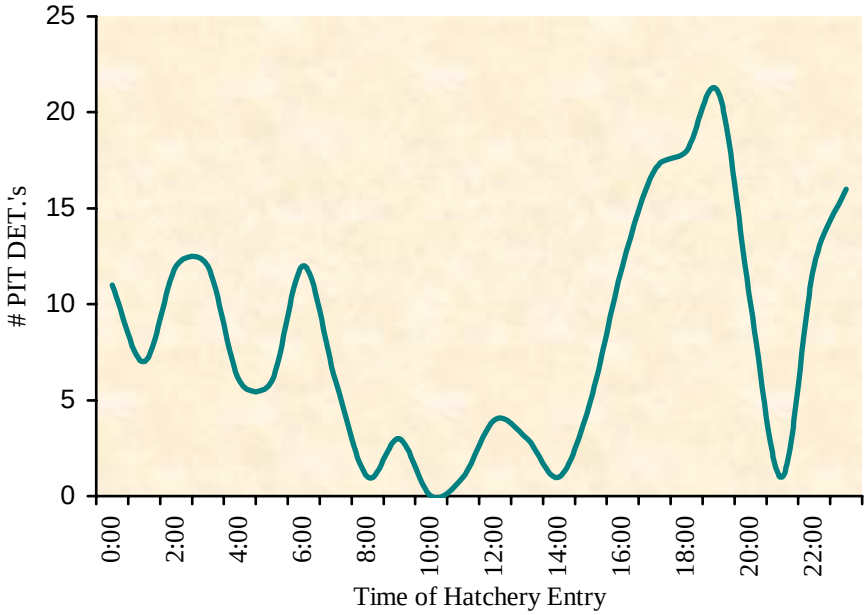


Figure 11. Hourly entry time of PIT-tagged adult spring Chinook into Leavenworth NFH ladder, 2004.

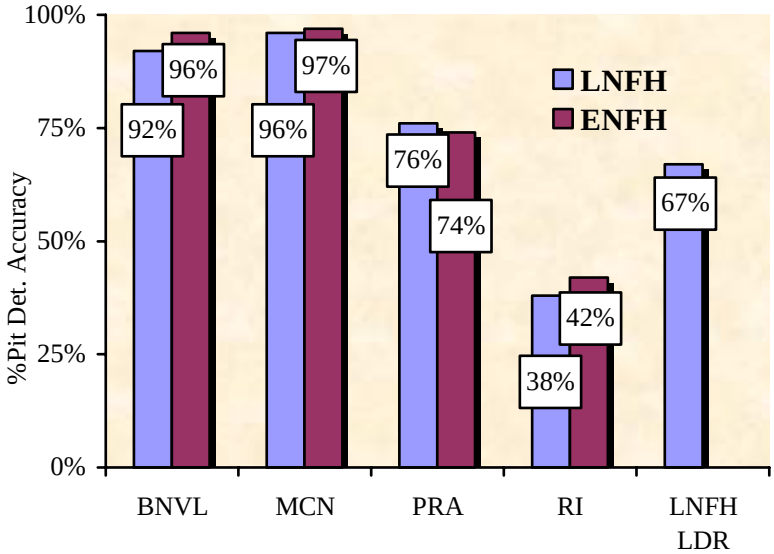


Figure 12. The 2004 estimated spring Chinook adult PIT-tag detection efficiency of Leavenworth and Entiat NFH's adult return compared to Columbia River Dams and Leavenworth NFH adult PIT-tag interrogation sites.

- Using PIT tags to evaluate passage, run timing etc. must be conducted with caution as the influence of barging (Figure 7) and the percent detection efficiency (Figure 12) may bias results. The above figure depicts a comparison of adult PIT-tag detection efficiency between those adults hand scanned in the Leavenworth and Entiat NFH hatchery adult holding ponds in 2004 and the percentage of those adults that were detected at various main stem dams and the Leavenworth NFH ladder itself. From this graph Bonneville, McNary, and Wells Dam (not shown

for similar evaluation on Winthrop NFH adults) interrogated 90%+ of the adults detected at Leavenworth NFH. While those same adults were only detected at a rate of 38-76% efficiency at Priest Rapids, Rock Island, and the Leavenworth NFH ladder antennae. However, adult PIT detections can be a valuable tool for predicting within season run estimates. In 2004 the actual within basin Leavenworth Complex return was compared against expanded adult PIT-tag interrogations at McNary Dam. PIT-tag expansions were within 76%-90%of within basin estimates (Figure 13). Additionally, PIT-tag expansions very closely approximated the actual age-class proportions of the return (not shown).

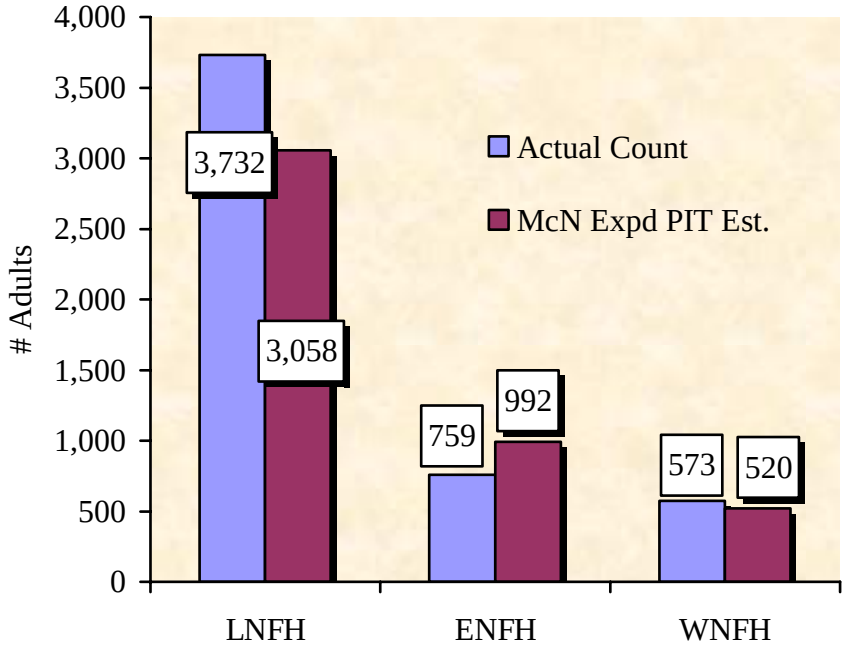


Figure 13. A comparison of Leavenworth Complex spring Chinook McNary Dam adult PIT-tag detections vs. actual return to basin estimates, 2004.

Return Deposition and Harvest:

- Table 26 and 27 describe the cumulative number of Leavenworth Complex returning adult spring Chinook by fishery and recovery location above Rock Island Dam for return years 1999-2003. This period reflects a time of high returns and increased harvest combined with high CWT tag rates which increases the ability to detect the various areas that adults return to. This information is regarded as a recent "best case" scenario and probably does not accurately reflect the long-term deposition history of the Leavenworth Complex. With that stated, the recent return history does describe how various harvest and management plans affect each Leavenworth Complex facility. Uniformly, marine harvest of adults irregardless of hatchery origin appears negligible with less than 1% observed. Additionally, main stem Columbia River harvest both by gill net and sport appear

similar between hatcheries (5-7% for each fishery) with the Leavenworth Complex contributing roughly 10-14% to lower Columbia River harvest fisheries. All facilities return greater than 85% of their respective runs above Rock Island. At this point management by each basin treats the return differently. In Icicle Creek a terminal sport/tribal harvest occurs and during large return years the ladder is pulsed to maximize this harvest on Leavenworth NFH adults. Conversely, no direct harvest occurs for either Entiat or Winthrop NFH adults. Therefore, at Entiat NFH the hatchery ladder is open throughout the run in an effort to collect all returning adults in a effort to minimize natural spawning/straying while Winthrop NFH adults are encouraged to spawn naturally in the Methow River and the ladder at this facility is managed to assist this process.

- For Leavenworth NFH, the Icicle Creek sport and treaty/ceremonial fisheries harvest a significant portion of the return (Table 27). However, the opportunity for harvest is limited in the short (~2.8 miles) section of Icicle Creek open for fishing and a large number of adults quickly travel this length and enter the hatchery ladder. Occasionally, the ladder is closed to increase harvest and most likely this practice improves tribal catch as the area open for treaty harvest is immediately adjacent to the ladder in the spill way pool. For the period of 1999-2004, Icicle tribal harvest has averaged 2,499 (29.5% of annual Icicle return, SD = 1,863) adults and the sport harvest has averaged 1,076 (12.7% of annual Icicle return, SD = 798) adults (MCRFRO database). WDFW in collaboration with the USFWS conducts annual creel census surveys of the Icicle spring Chinook fishery. These estimates indicate the average number of angler hours per fish caught is inversely related to Icicle Creek escapement (1999-2004 linear regression, Angler Hours/Fish = 58 – 0.004*Icicle Escapement, p=0.04, R^2=69%, SE=13.7), and varies somewhat annually depending on flow, temperature, and water clarity (Figure 14). For the period of 1999-2004 Icicle Creek spring Chinook sport harvest efforts have averaged 27 hours/fish (SD = 22 hrs/fish). Although annual total harvest data is provided by the Yakama Nation (Roger Dick, Yakama Nation, pers. comm.), no similar angler CPUE estimate was acquired from the Icicle Creek tribal fishery. The terminal harvest fisheries in Icicle Creek appear to have very little impact on non-target species. From 2000-2004 WDFW has sampled ~17% of sport caught Icicle spring Chinook (Viola 2005). This sample rate estimates that very few upper Wenatchee ESA-list hatchery spring Chinook adults are intercepted in this fishery (~2% in 2004), no "wild" scale patterns have been observed, and 14 steelhead (presumed kelts w/7 each in 2001 & 2002) were incidentally caught and released (Viola 2000, 2001, 2003, 2004, 2005). No information regarding the interception of bull trout in the sport fishery was found. Additionally, harvest data from the Yakama Nation indicates no bull trout have been harvested in the tribal fisheries (Roger Dick, Yakama Nation, pers. comm.). Although annual total harvest data is provided by the Yakama Nation no similar angler CPUE estimate was acquired from the Icicle Creek tribal fishery.

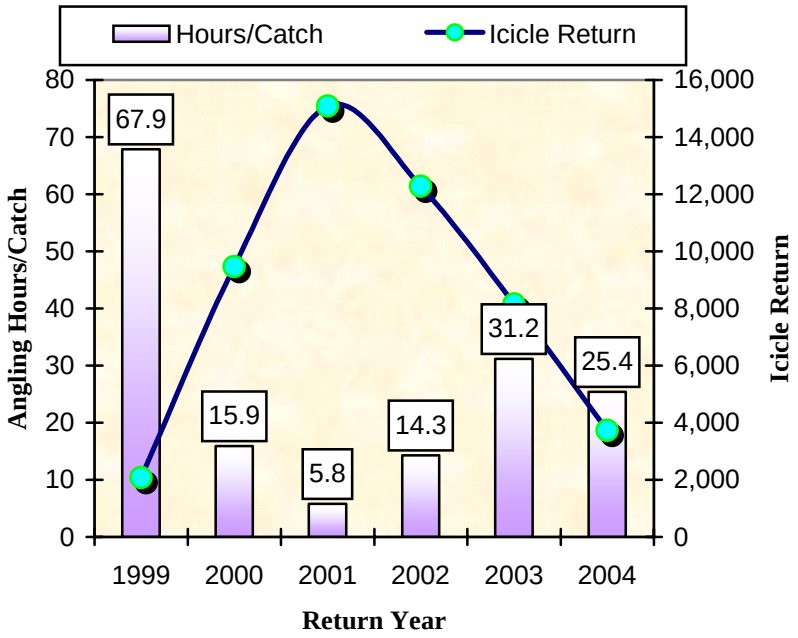


Figure 14. Angler effort for the Icicle Creek spring Chinook sport fishery vs. escapement, 1999-2004.

- For Leavenworth NFH the greatest single contribution of adults is through hatchery surpluses (Table 26) which are donated primarily to area tribes. Spawning ground recoveries primarily occur in Icicle Creek or through a previous (2001-2004) outplant program to nearby Peshastin and Ingalls Creeks (Table 27 & Appendix 5). Additional information regarding spawning ground recoveries will be discussed in the straying section.

- Entiat NFH adults are primarily recovered at the hatchery as a directed fishery for these fish on the Entiat River is currently not available. The vast majority of Entiat NFH adults are donated to area tribes when brood stock goals have been obtained (Table 26). The majority of documented natural spawning of these adults occurs in the Entiat River (Table 27 & Appendix 6). Additional information regarding spawning ground recoveries will be discussed in the straying section.

- Winthrop NFH is similar to Entiat NFH in that there is no available harvest opportunity in the Methow River Basin as most returning spring Chinook stocks are ESA-listed. However, Winthrop NFH benefits, unlike Entiat NFH, from a late 1990's programmatic change from a harvest mitigation hatchery to an integrated conservation /supplementation facility. The vast majority of Winthrop NFH returning adults are encouraged to spawn naturally in the Methow River (Tables 26, 27, & Appendix 7). Additionally, the contributions of Winthrop NFH adults to selective fisheries are anticipated to decline in the future as most releases are now of within basin ESA-listed stock and not adipose fin clipped.

Table 26. Cumulative summary of returning adult spring Chinook deposition for the Leavenworth Complex, 1999-2003.

Recovery / Fishery Location	Leavenworth NFH		Entiat NFH		Winthrop NFH	
	#	%	#	%	#	%
Hatchery Brood	6,323	11.2%	1,973	20.9%	2,498	26.8%
Hatchery Donated Surplus	17,505	30.9%	6,174	65.3%	0	0.0%
Treaty Ceremonial	14,526	25.6%	78	0.8%	40	0.4%
Freshwater Sport	6,262	11.0%	9	0.1%	19	0.2%
Columbia River Gill Net	4,175	7.4%	512	5.4%	651	7.0%
Spawning Ground	4,053	7.1%	211	2.2%	5,426	58.2%
Columbia River Sport	3,686	6.5%	469	5.0%	659	7.1%
Test Fishery Net	0	0.0%	0	0.0%	1	0.0%
Freshwater Net	0	0.0%	2	0.0%	4	0.0%
Estuary Sport	0	0.0%	1	0.0%	0	0.0%
Ocean Troll	148	0.3%	19	0.2%	18	0.2%
Ocean Trawl	9	0.0%	0	0.0%	0	0.0%
Commercial Seine	0	0.0%	4	0.0%	0	0.0%
Above Rock Island	48,122	84.9%	8,464	89.5%	7,921	85.0%
Grand Total	56,685	100.0%	9,452	100.0%	9,316	100.0%

Table 27. Cumulative summary of Leavenworth Complex returning spring Chinook deposition by specific recovery location above Rock Island Dam, 1999-2003.

Fishery type or Recovery Location	Site Name	Leavenworth NFH		Entiat NFH		Winthrop NFH		Leavenworth Complex	
		#'s	%	#'s	%	#'s	%	#'s	%
Freshwater Sport	COLUMBIA NEAR WELLS	0	0.0%	0	0.0%	3	0.0%	3	0.0%
	ICICLE CR 45.0474	6,110	12.7%	0	0.0%	0	0.0%	6,110	9.5%
Freshwater Sport Total		**6,110**	**12.7%**	**0**	**0.0%**	**3**	**0.0%**	**6,113**	**9.5%**
Hatchery	DRYD DAM+TUM FCF+CHI	14	0.0%	0	0.0%	0	0.0%	14	0.0%
	DRYDEN DAM FCF	0	0.0%	0	0.0%	1	0.0%	1	0.0%
	ENTIAT NFH	25	0.1%	8,027	94.8%	1	0.0%	8,053	12.5%
	LEAVENWORTH HATCHERY	23,745	49.3%	5	0.1%	0	0.0%	23,750	36.8%
	METHOW HATCHERY	0	0.0%	1	0.0%	727	9.2%	728	1.1%
	WELLS HATCHERY	0	0.0%	0	0.0%	3	0.0%	3	0.0%
	WELLS W LADDE+METHOW	29	0.1%	49	0.6%	155	2.0%	233	0.4%
	WELLS W LADDER TRAP	2	0.0%	43	0.5%	173	2.2%	218	0.3%
	WINTHROP NFH	9	0.0%	15	0.2%	1,432	18.1%	1,456	2.3%
Hatchery Total		**23,826**	**49.5%**	**8,141**	**96.2%**	**2,492**	**31.5%**	**34,458**	**53.4%**
Spawning Ground	CHEWUCH R 48.0728	0	0.0%	9	0.1%	437	5.5%	445	0.7%
	CHIWAWA +CHICKAMIN	55	0.1%	0	0.0%	0	0.0%	55	0.1%
	CHIWAWA R 45.0759	64	0.1%	0	0.0%	0	0.0%	64	0.1%
	DRYDEN DAM FCF	8	0.0%	0	0.0%	0	0.0%	8	0.0%
	ENTIAT R 46.0042	0	0.0%	305	3.6%	33	0.4%	338	0.5%
	ICICLE CR 45.0474	3,073	6.4%	0	0.0%	0	0.0%	3,073	4.8%
	LTL WENATCHEE 450985	61	0.1%	0	0.0%	0	0.0%	61	0.1%
	METHOW R 48.0002	0	0.0%	0	0.0%	4,826	60.9%	4,826	7.5%
	NASON CR 45.0888	288	0.6%	10	0.1%	0	0.0%	298	0.5%
	SIMILKAMEEN R 490325	0	0.0%	0	0.0%	10	0.1%	10	0.0%
	TWISP R 48.0374	0	0.0%	0	0.0%	45	0.6%	45	0.1%
	WENATCHEE R 45.0030	488	1.0%	0	0.0%	0	0.0%	488	0.8%
	WHITE R 45.1116	0	0.0%	0	0.0%	3	0.0%	3	0.0%
	WHITE+NAPEEQUA+PANTH	16	0.0%	0	0.0%	0	0.0%	16	0.0%
	WINTHROP NFH OUTFALL	0	0.0%	0	0.0%	71	0.9%	71	0.1%
Spawning Ground Total		**4,053**	**8.4%**	**324**	**3.8%**	**5,426**	**68.5%**	**9,803**	**15.2%**
Treaty Ceremonial	ICICLE CR 45.0474	14,133	29.4%	0	0.0%	0	0.0%	14,133	21.9%
Treaty Ceremonial Total		**14,133**	**29.4%**	**0**	**0.0%**	**0**	**0.0%**	**14,133**	**21.9%**
Grand Total		**48,122**	**100.0%**	**8,464**	**100.0%**	**7,921**	**100.0%**	**64,507**	**100.0%**

*from 2001 to 2003 ~1,187 hatchery adults from LNFH were outplanted to Peshastin and Ingalls Creeks to spawn naturally. These #'s are included in the LNFH hatchery return.

Straying:

- Prior to the implementation of extensive CWT marking little was known regarding the extent and magnitude of hatchery origin spawners within each release basin. However, the recent large returns beginning in 2001 may have provided a glimpse of the hatchery influence. Prior to 2001 most spawning ground surveys recorded few redds, few fish, and even fewer carcasses recovered in which to discern rearing origin. Under the low return era of the mid-1990's the influence of any hatchery program may have been muted as the minimum detectable sample size was simply unavailable. The following series of figures is an attempt to address the effects of Leavenworth Complex programs upon the natal spawning populations. Natal is a term used lightly as the Leavenworth Complex contribution rates described here do not discern between wild or other hatchery spawners. Attempts have been made to compare each program in equal light. Unfortunately, each basin has a unique set of attributes (# of hatchery programs, # of agencies conducting surveys, etc.) which complicates the ability to perform a uniform analysis. Many of these analyses are conducted with a "best guess" approach so the reader is encouraged to use caution in the absolute values presented.

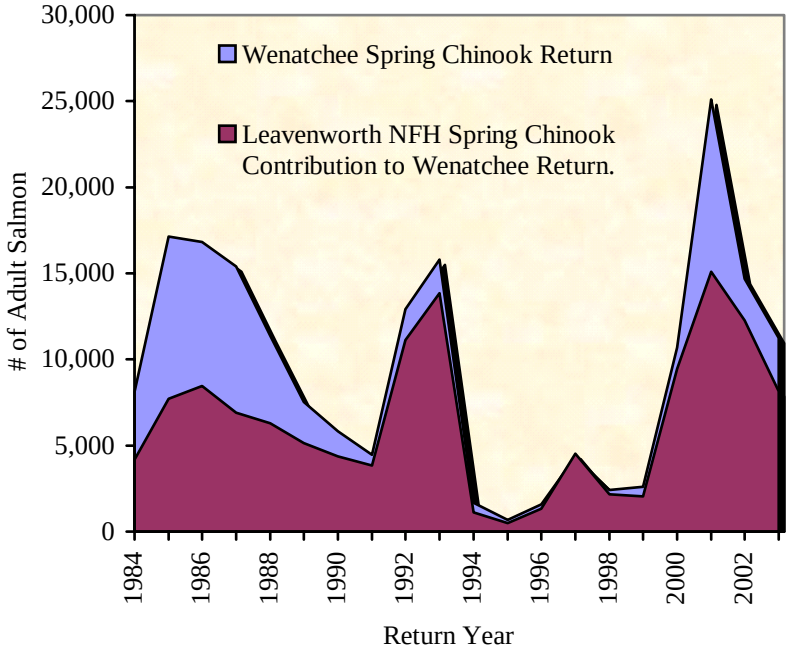


Figure 15. Contribution of Leavenworth NFH return to the Wenatchee Basin spring Chinook escapement, 1984-2003.

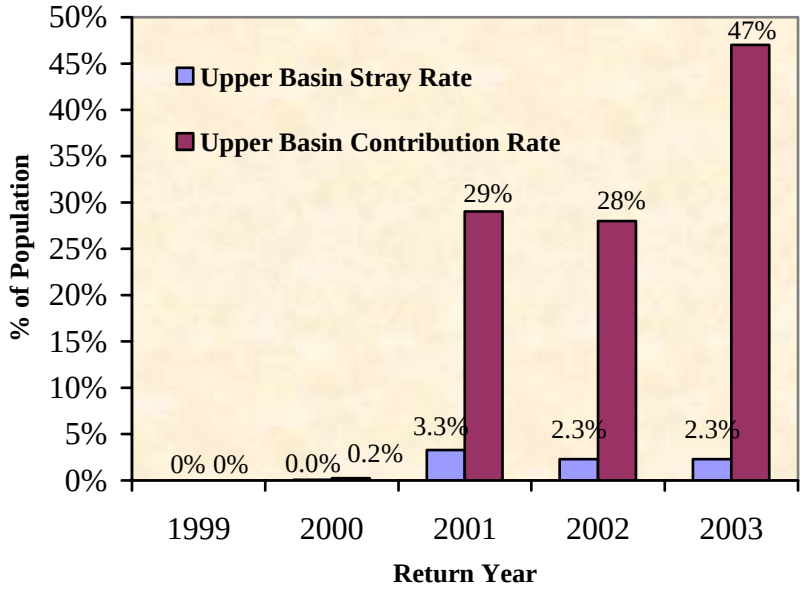


Figure 16. A comparison of the estimated Leavenworth NFH spring Chinook within basin stray and contribution rates to the upper Wenatchee spawning population.

- Leavenworth NFH is the dominant contributor of spring Chinook to the Wenatchee Basin (Figure 15). For the period of 1984-2003 this facility is estimated (based on the difference in dam counts between Rock Island and Rocky Reach) to have contributed on average 72.5% (SD = 16.9%) of the Wenatchee River spring Chinook escapement. Given the magnitude of this program it is not surprising that some adults contribute to the spawning populations present within the basin. Leavenworth NFH's impact on the within basin spawning aggregates is focused on the upper Wenatchee (Figure 16). This impact was determined by removing the number of LNFH spawning ground recoveries in the lower Wenatchee (below Tumwater Dam), primarily from the tributaries of Icicle and Peshastin Creeks. The number of LNFH adults in these creeks is probably linked to management decisions and not the inherit fidelity of the population itself (location of hatchery on Icicle and intentional outplanting of hatchery adults to Peshastin/Ingalls Creeks 2001-2004). Leavenworth NFH contribution to the upper Wenatchee Basin was evaluated using CWT tag recoveries expanded by the estimated recovery rate (# of carcass recovered/estimated spawning escapement) and by the percentage of marked fish representing each CWT release group. All carcass recoveries regardless of location, origin, age, sex, or mark are assumed equal and random. In this case a single Leavenworth NFH recovery on the spawning ground could potentially represent a large number of potential adults (ie. one LNFH CWT carcass recovered at a 20% carcass recovery rate = 1/.2 = 5 estimated CWT adults, the CWT adult represents a release group in which 10% of the release population was tagged such that 5/.1 = 50 expanded Leavenworth NFH adults on the spawning grounds). The expanded estimate of the number of Leavenworth NFH origin adults on the spawning grounds is compared against the hatchery's Wenatchee Basin return to arrive at the proportion of Leavenworth NFH adults attempting to spawn in the Upper Wenatchee. Additionally, the

number of Leavenworth adults in the Upper Wenatchee was compared against the spawning escapement estimate provided by WDFW (A. Murdoch pers. comm.). For the period of 2001-2003 in which Leavenworth NFH recoveries were primarily discovered, the average Leavenworth NFH population Upper Basin stray rate has remained consistent and averaged 2.6% (SD = 0.6%) while the contribution this recovery rate has had upon the estimated spawning escapement has averaged 34.6% (SD = 10.5%).

- The 2001-2003 return year contribution by Leavenworth NFH origin adults to the spawning population by each upper Wenatchee Basin tributary has been highly variable (Appendix 5). Leavenworth NFH contribution rates to the Chiwawa River, Chickamin, and Rock Creeks combined has averaged 9% (SD = 13%), the Little Wenatchee River has averaged 53% (SD = 41%), Nason Creek has averaged 18% (SD = 10%), White, Napeequa, and Panther Creeks combined has averaged 3% (SD = 6%), and the remaining upper Wenatchee River mainstem has averaged 89% (SD = 18%). As previously noted this is only a brief review of the data from substantially large return years using a suspect method. Additional Wenatchee River basin spawning ground data is available from WDFW and CPUD (Tonseth 2003, Grassell 2003, 2004, Mosey & Murphy 2000, 2002). A potentially better method would add additional return years (2004 & 2005) and utilize scale analysis to apportion the hatchery contribution of which CWT's could be used to evaluate the origin of the hatchery proportion. This method would place an upper limit to the hatchery contribution and potentially provide improved precision for contribution rates by each facility (ie. By CWT expansion the number of Leavenworth NFH adults estimated on the spawning grounds in some years exceeded the estimated spawning escapement). This type of analysis was conducted for the Entiat River basin.

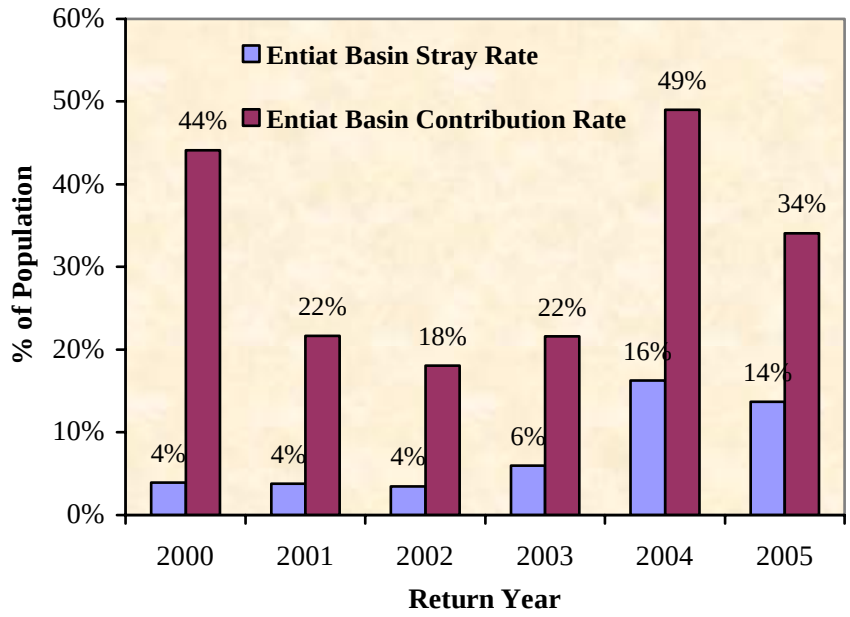


Figure 17. A comparison of the estimated Entiat NFH spring Chinook within basin stray and contribution rates to the Entiat River spawning population.

- The Entiat NFH is the only hatchery actively releasing spring Chinook in the Entiat River. This program returns the majority of spring Chinook to the Entiat Basin. For the period of 1994-2005 this program has contributed on average 80.8% (range = 49.5-95.3%, SD = 11.5%) of the annual adult return to the basin. The Mid-Columbia River FRO has annually conducted spawning ground surveys on the Entiat River Basin since 1994 (Hamstreet 2006). For the period of 1994-1999 an average of only ~5 carcasses a year were recovered (average recovery rate = 7.5%). A few hatchery fish were noted through scale analysis but their origin was unknown. For the period of 2000-2005 an average of 61 carcasses (SD = 35) have been recovered (average recovery rate = 18%). The increased number of carcasses and improved carcass recovery rate has begun to shed light onto the influence of hatchery spawners and their origin.

- Hatchery contribution rates for the Entiat Basin were derived by estimating the spawning escapement from redd counts (Hamstreet 2006, 2005, 2004, 2003, 2002, Carie & Hamstreet 2001). Carcass scale analysis (hatchery vs. wild determination) was utilized to apportion annual escapement into hatchery and wild components. Finally, recovered CWT's were expanded to assign each documented release facility a portion of the estimated hatchery origin spawning escapement. From 2000-2005, the Entiat NFH stray rate to the Entiat Basin spawning grounds has averaged 7.9% (SD = 5.9%) with notable increases in 2004 and 2005 (Figure 17). The contribution of these fish to the estimated spawning escapement has averaged 31.4% (SD = 12.8%). It should be noted, however, that Entiat NFH is not the sole hatchery contributor. Since 2000, the Entiat River spawning escapement has average 45% hatchery spawners of which ENFH contributes 31.4% (~70% of hatchery total). The remaining 13.6% hatchery

origin spawners derive from the Chiwawa Rearing Ponds (5.7%), WNFH (3.6%), Methow State Fish Hatchery (2.1%), LNFH (1.1%), and Oregon Department of Fish & Wildlife Hatcheries (1.1%). However, it should be noted that a recent genetic analysis conducted by Ford et al. (2003) stated "*The similarity between Entiat River wild and Entiat NFH spring Chinook samples, suggests that Entiat NFH salmon have successfully spawned and introgressed into or replaced the natural Entiat River population.*" The sample size in this study was small and over a limited number of years. MCFRO has continued to collect genetics from both the wild and hatchery spring Chinook populations in the case that further investigations are warranted.

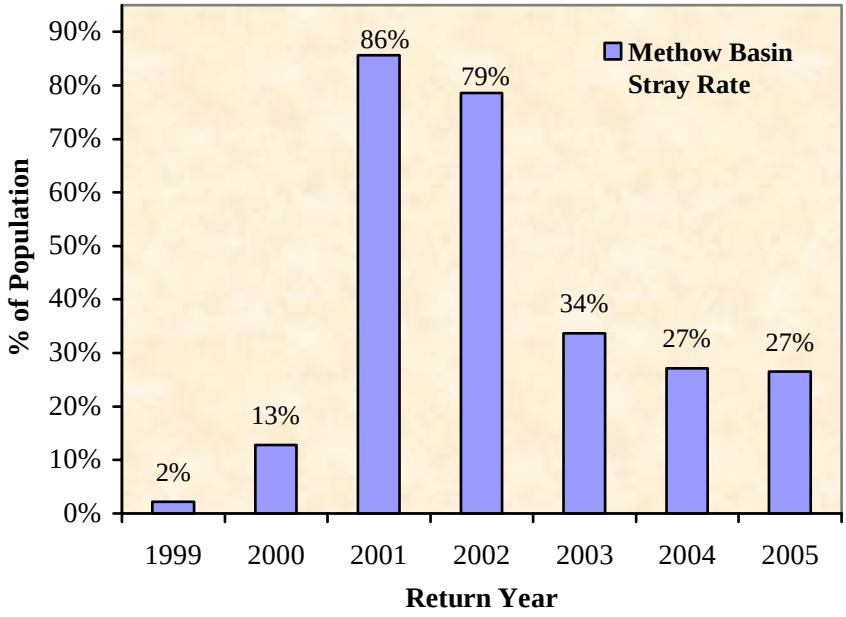


Figure 18. The estimated return proportion of Winthrop NFH origin spring Chinook attempting to spawn in the Methow River Basin.

- As previously mentioned, Winthrop NFH underwent a dramatic program change beginning in the late-1990's and shifted from a segregated harvest augmentation facility to an integrated conservation supplementation facility shifting brood origin from the out of basin Carson stock to the Methow Basin Composite stock. During the brood transition period only select brood (when possible by adipose clip or through age/length criteria) was allowed into the hatchery for spawning. All other non-prioritized stock was blocked from the facility and encouraged to spawn naturally. This programmatic shift is evident (Figure 18) from return year 2000/2001 onward. The vast majority of spring Chinook spawning in the Methow Basin are of hatchery origin and few wild adults are available for incorporation into the Winthrop NFH broodstock. In 2003 it was estimated that 96.2%, 93.1%, and 40.0% of the Methow, Chewuch, and Twisp River spawning populations were composed of hatchery adults (Humling and Snow 2004). From 2001-2005 the average CWT expanded proportion of the Winthrop NFH origin spawners recovered during the Methow Basin spawning ground surveys has

averaged 50.3% (SD = 29.3%). Winthrop NFH origin spawners appear to attempt spawning in their management intended area. The proportion of the hatchery return by tributary for 2001-2005 has varied with the Methow River leading the recovery rate (Ave = 44.2%, SD = 26.9%), followed by the Chewuch River (Ave = 4.2%, SD = 2.5%), WNFH outfall channel (Ave = 1.4%, SD = 1.3%), and the Twisp River (Ave = 0.5%, SD = 0.7%). As previously stated these values were estimated using CWT estimated values provided by WDFW from the spawning grounds and expansions based on the proportion tagged (Table 27 & Appendix 7). Fortunately, the proportion tagged at WNFH has been near 100% CWT per release group for some time which helps in reducing errors of inflated census. Additional data regarding Methow River spring Chinook spawning ground evaluations is available from WDFW (Humling and Snow 2004 & 2005) and the Yakama Nation (Hubble 2003).

Adult Return Survival:

- Table 28 describes spring Chinook brood year survival (%) and recruits per spawned adult (RPS) for each Leavenworth Complex facility by release basin and total return. Additional data is provided in appendices 8-10. For the brood year period of 1990-1999 the total smolt-adult return has averaged 0.404%, 0.302%, and 0.267% for Leavenworth, Entiat, and Winthrop NFH's, respectively. Total recruits per spawned adult (RPS) has averaged 7.2, 5.5, and 4.8 for Leavenworth, Entiat, and Winthrop NFH's, respectively. Often the number of spawners to produce a given brood has been estimated during years of hatchery transfers, extensive disease related culling of gametes or the planting of eggs/fry (see notes under Appendices 8-10). Additionally, smolt-adult return and RPS by release basin has followed a similar pattern by facility with an approximated decrease of 0.04% survival (0.035%-0.056%) and 0.8 RPS (0.6-1.0) from total returns. All facilities have exhibited upward survival trends peaking in brood year 1997 for Entiat/Winthrop NFH's and 1998 for Leavenworth NFH. Brood year 1999 exhibited a drastic decrease over the previous trend. Potentially this drop in survival at all facilities is attributable to the poor outmigration conditions experienced in 2001 when spill at Columbia River hydro-projects was curtailed under a basin wide drought emergency.

Table 28. Leavenworth Complex spring Chinook brood year survival and recruits per spawned adult, brood years 1990-1999.

Brood Year	LEAVENWORTH NFH				ENTIAT NFH				WINTHROP NFH			
	WENATCHEE		TOTAL RETURN		ENTIAT		TOTAL RETURN		METHOW		TOTAL RETURN	
	%	RPS	%	RPS	%	RPS	%	RPS	%	RPS	%	RPS
1990	0.009%	0.1	0.010%	0.1	0.009%	0.2	0.009%	0.2	0.000%	0.0	0.002%	0.0
1991	0.026%	0.3	0.027%	0.3	0.031%	0.6	0.034%	0.6	0.002%	0.0	0.002%	0.0
1992	0.103%	1.6	0.108%	1.7	0.038%	0.7	0.048%	0.9	0.033%	0.6	0.036%	0.7
1993	0.317%	5.3	0.327%	5.5	0.054%	1.0	0.062%	1.1	0.045%	0.8	0.048%	0.9
1994	0.077%	1.4	0.080%	1.5	0.063%	1.1	0.072%	1.3	0.070%	1.3	0.071%	1.3
1995	0.155%	3.5	0.161%	3.6	0.343%	5.9	0.367%	6.3	0.363%	6.5	0.376%	6.8
1996	0.615%	10.4	0.650%	11.0	0.563%	11.6	0.609%	12.5	0.358%	6.4	0.376%	6.8
1997	0.978%	16.7	1.201%	20.5	0.783%	14.1	0.889%	16.0	0.714%	12.9	0.846%	15.2
1998	1.070%	19.9	1.309%	24.3	0.560%	9.6	0.699%	12.0	0.691%	12.4	0.859%	15.5
1999	0.130%	2.4	0.168%	3.1	0.202%	3.6	0.234%	4.2	0.048%	0.9	0.057%	1.0
AVE	0.348%	6.2	0.404%	7.2	0.265%	4.8	0.302%	5.5	0.232%	4.2	0.267%	4.8
MAX	1.070%	19.9	1.309%	24.3	0.783%	14.1	0.889%	16.0	0.714%	12.9	0.859%	15.5
MIN	0.009%	0.1	0.010%	0.1	0.009%	0.2	0.009%	0.2	0.000%	0.0	0.002%	0.0
STDEV	0.398%	7.1	0.486%	8.7	0.281%	5.2	0.323%	5.9	0.282%	5.1	0.339%	6.1

*All adult return information includes all adults age-3 or older recovered throughout the Pacific Northwest (Total Return) and by release basin.

RPS = recruit per spawner ratios.

Adult Return Characteristics

Gender Composition:

- The gender of returning adult spring Chinook to each Leavenworth Complex facility is described by both return year (Table 29) and brood year (Table 30). The majority of Leavenworth Complex adults return as females (~54-62% on average, either by return or brood year). It has been speculated that high growth rates and the large release size of hatchery smolts compared to natural origin cohorts induces precocity potentially skewing the adult return to favor females (Mullan et al. 1992a). Only during years of poor returns (1994-1996) do males seem to increase proportionately. Time series analysis using linear regression on brood years 1989-2000 was conducted in an effort to detect trends by gender for each facility. Trends were only noted if the majority of variability could be explained by time alone ($R^2 \geq 50\%$). Comparisons between facilities and time series analysis within each facility revealed no significant trends or relationships by gender for any Leavenworth Complex spring Chinook program.

Table 29. Leavenworth Complex adult spring Chinook gender percentage by hatchery facility and return year, 1994-2005.

Return	Leavenworth NFH		Entiat NFH		Winthrop NFH	
Year	%Female	%Male	%Female	%Male	%Female	%Male
1994	47.8%	52.2%	44.0%	56.0%	45.0%	55.0%
1995	49.8%	50.2%	49.0%	51.0%	57.0%	43.0%
1996	47.6%	52.4%	60.0%	40.0%	52.0%	48.0%
1997	60.3%	39.7%	55.0%	45.0%	62.0%	38.0%
1998	55.2%	44.8%	61.0%	39.0%	58.0%	42.0%
1999	47.1%	52.9%	68.0%	32.0%	27.0%	73.0%
2000	58.0%	42.0%	51.4%	48.6%	58.4%	41.6%
2001	56.0%	44.0%	61.9%	38.1%	63.9%	36.1%
2002	63.3%	36.7%	65.2%	34.8%	66.6%	33.4%
2003	56.8%	43.2%	57.0%	43.0%	59.1%	40.9%
2004	55.8%	44.2%	57.8%	42.2%	60.1%	39.9%
2005	57.8%	42.2%	56.5%	43.6%	64.1%	35.9%
AVE	54.6%	45.4%	57.2%	42.8%	56.1%	43.9%
MAX	63.3%	52.9%	68.0%	56.0%	66.6%	73.0%
MIN	47.1%	36.7%	44.0%	32.0%	27.0%	33.4%
STDEV	5.3%	5.3%	6.8%	6.8%	10.8%	10.8%

Table 30. Leavenworth Complex adult spring Chinook gender percentage by hatchery facility and brood year, 1989-2000.

Brood	Leavenworth NFH		Entiat NFH		Winthrop NFH	
Year	%Female	%Male	%Female	%Male	%Female	%Male
1989	53.0%	47.0%	59.1%	40.9%	58.7%	41.3%
1990	50.0%	50.0%	NA	NA	NA	NA
1991	54.6%	45.4%	57.3%	42.7%	NA	NA
1992	50.5%	49.5%	63.4%	36.6%	56.9%	43.1%
1993	52.8%	47.2%	52.5%	47.5%	57.3%	42.7%
1994	58.1%	41.9%	62.4%	37.6%	NA	NA
1995	58.2%	41.8%	73.4%	26.6%	NA	NA
1996	56.0%	44.0%	67.7%	32.3%	60.4%	39.6%
1997	56.4%	43.6%	62.4%	37.6%	49.7%	50.3%
1998	60.0%	40.0%	63.7%	36.3%	70.9%	29.1%
1999	51.3%	48.7%	57.4%	42.6%	59.2%	40.8%
2000	57.0%	43.0%	57.9%	42.1%	55.5%	44.5%
AVE	54.8%	45.2%	61.6%	38.4%	58.6%	41.4%
MAX	60.0%	50.0%	73.4%	47.5%	70.9%	50.3%
MIN	50.0%	40.0%	52.5%	26.6%	49.7%	29.1%
STDEV	3.3%	3.3%	5.7%	5.7%	6.0%	6.0%

NA no available data or insufficient data (<30 adults sampled).

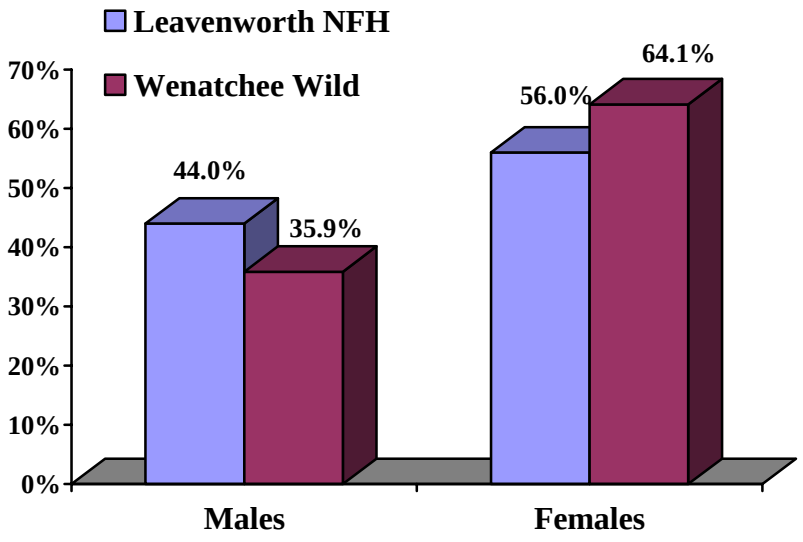


Figure 19. Gender comparison of Leavenworth NFH vs. Wenatchee River wild spring Chinook, 2001.

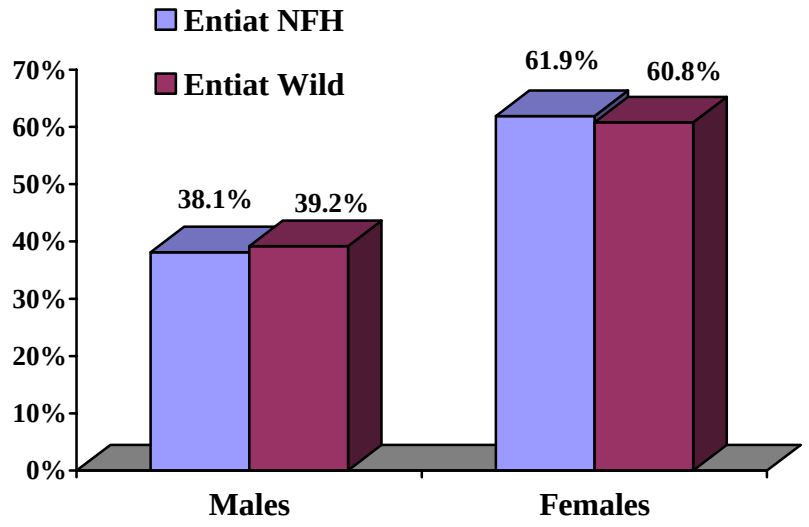


Figure 20. Gender comparison of Entiat NFH vs. Entiat River wild spring Chinook, 2001.

- Few comparisons have been conducted specifically between each Leavenworth Complex hatchery and wild adults in regards to gender. However, a very large spring Chinook return in 2001 provided a substantial number of recovered "wild" carcasses from the spawning grounds in the Wenatchee (Tonseth, 2003) and Entiat River (Hamstreet 2002) to compare against hatchery sampled Leavenworth (Figure 19) and Entiat (Figure 20) NFH returns. From this comparison it appears that very little difference in gender occurs between the Entiat NFH vs. Entiat River wild adults compared to Leavenworth NFH and Wenatchee River wild

adults. It is cautioned that hatchery return and spawning ground recovery data may be biased by collection method. Direct hatchery and wild population comparisons from the spawning grounds are often provided from the agencies conducting these studies in the Wenatchee (Tonseth 2003, Grassell 2003, 2004), Entiat (Hamstreet 2002, 2003, 2004, 2005, 2006, Carie & Hamstreet 2001), and Methow (Humling & Snow 2004, 2005, Hubble 2003) River basins.

Age Class Composition:

- The proportion by age of returning adult spring Chinook to each facility is described by return year (Table 31), and brood year (Table 32). The majority of Leavenworth Complex adults return as age-4 adults (~65-88% on average, either by return or brood year). On average the Entiat NFH brood contained a significantly (students, paired two-tailed t-test, $p \leq 0.05$) higher proportion of age-4 adults than Leavenworth NFH but not Winthrop NFH. Conversely, Leavenworth NFH returns contained a significantly greater proportion of age-5 adults than Entiat NFH but again not Winthrop NFH. Time series analysis using linear regression was conducted in an effort to detect trends by age-class for each facility utilizing brood years 1989-2000. Trends were only noted if the majority of variability could be explained by time alone ($R^2 \geq 50\%$). No trend was noted for Leavenworth or Entiat NFH's. Only age-3 males at Winthrop NFH are exhibiting an increasing trend in proportion ($R^2 = 50\%$).

Table 31. Leavenworth Complex spring Chinook age composition of adults by return year for each facility, 1994-2005.

Return	Leavenworth NFH			Entiat NFH			Winthrop NFH		
Year	Age-3	Age-4	Age-5	Age-3	Age-4	Age-5	Age-3	Age-4	Age-5
1994	2.4%	7.8%	89.6%	6.5%	33.9%	59.7%	3.0%	0.0%	97.0%
1995	13.1%	75.4%	10.9%	2.8%	94.4%	2.8%	14.0%	64.0%	22.0%
1996	9.9%	84.6%	5.5%	5.6%	91.2%	3.2%	9.0%	86.0%	5.0%
1997	0.5%	91.5%	7.9%	1.2%	90.1%	8.7%	0.5%	96.1%	3.4%
1998	0.9%	40.7%	58.4%	7.5%	73.6%	19.0%	0.0%	39.4%	60.6%
1999	14.8%	63.0%	22.2%	5.2%	88.4%	6.4%	53.0%	41.0%	6.0%
2000	3.5%	94.4%	2.1%	3.8%	94.5%	1.6%	7.8%	91.8%	0.4%
2001	1.7%	89.4%	8.9%	4.3%	92.0%	3.7%	4.2%	94.0%	1.8%
2002	0.7%	86.1%	13.2%	0.9%	91.4%	7.7%	0.7%	91.5%	7.8%
2003	3.1%	17.2%	79.7%	5.3%	61.9%	32.6%	12.0%	10.2%	77.8%
2004	9.6%	82.3%	8.1%	2.2%	95.7%	2.0%	11.4%	85.8%	2.8%
2005	2.4%	91.9%	5.6%	6.1%	91.2%	2.8%	14.2%	82.5%	3.3%
AVE	5.2%	68.7%	26.0%	4.3%	83.2%	12.5%	10.8%	65.2%	24.0%
MAX	14.8%	94.4%	89.6%	7.5%	95.7%	59.7%	53.0%	96.1%	97.0%
MIN	0.5%	7.8%	2.1%	0.9%	33.9%	1.6%	0.0%	0.0%	0.4%
STDEV	5.1%	30.3%	31.2%	2.1%	18.4%	17.4%	14.3%	34.2%	34.2%

Data describes the total age composition of yearling releases only and excludes were possible contributions by other hatcheries to the return (ie. MSFH recovered at WNFH). In recent years the age composition displayed for WNFH has been influenced by selective spawning to minimize the "Carson" lineage. Age-6 fish comprised 0.1% - 0.6% of the return in 1994, 1995 and 1997 & one age-7 fish was noted in 2005 @ LNFH. Only one age-6 fish was observed @ ENFH. No age-6 fish or older were observed @ WNFH.

Table 32. Leavenworth Complex spring Chinook age composition of adults by brood year for each facility, 1989-2000.

Brood Year	Leavenworth NFH			Entiat NFH			Winthrop NFH		
	Age-3	Age-4	Age-5	Age-3	Age-4	Age-5	Age-3	Age-4	Age-5
1989	1.7%	43.9%	54.1%	2.2%	88.8%	9.0%	2.0%	87.0%	11.0%
1990	0.0%	45.8%	54.2%	0.0%	91.3%	8.7%	0.0%	0.0%	100.0%
1991	3.0%	80.6%	16.1%	5.3%	89.3%	5.3%	4.8%	42.9%	52.4%
1992	4.9%	87.0%	8.1%	1.5%	87.0%	11.5%	1.1%	94.6%	4.3%
1993	7.1%	64.9%	28.0%	3.6%	79.5%	16.9%	5.2%	63.6%	31.2%
1994	1.1%	58.9%	40.0%	1.1%	73.6%	25.3%	1.3%	89.9%	8.9%
1995	1.1%	93.7%	5.3%	2.0%	95.6%	2.4%	5.7%	90.6%	3.8%
1996	7.7%	83.6%	8.7%	3.8%	91.9%	4.2%	8.2%	85.8%	6.0%
1997	3.0%	84.2%	12.8%	3.2%	90.9%	5.7%	2.2%	93.3%	4.5%
1998	1.1%	57.2%	41.7%	4.9%	78.2%	16.9%	6.2%	78.7%	15.1%
1999	3.6%	70.4%	26.1%	2.2%	94.7%	3.1%	19.0%	61.9%	19.0%
2000	4.3%	89.0%	6.7%	5.1%	92.9%	2.0%	10.7%	86.7%	2.6%
AVE	3.2%	71.6%	25.1%	2.9%	87.8%	9.3%	5.5%	72.9%	21.6%
MAX	7.7%	93.7%	54.2%	5.3%	95.6%	25.3%	19.0%	94.6%	100.0%
MIN	0.0%	43.9%	5.3%	0.0%	73.6%	2.0%	0.0%	0.0%	2.6%
STDEV	2.4%	17.2%	18.4%	1.7%	7.0%	7.2%	5.3%	27.8%	28.6%

Data describes the total age composition by brood year of yearling releases and attempts were possible to exclude contributions by other releases (subyearlings/fry) and hatcheries to the return (ie. MSFH recovered at WNFH). In recent years the age composition displayed for WNFH has been influenced by selective spawning to minimize the "Carson" lineage. Age-6 fish comprised 0.3% of the return in brood years 1989 and 1991 & one age-7 fish was noted in brood year 1998 @ LNFH. Only one age-6 fish from brood year 1997 was observed @ ENFH. No age-6 fish or older were observed @ WNFH.

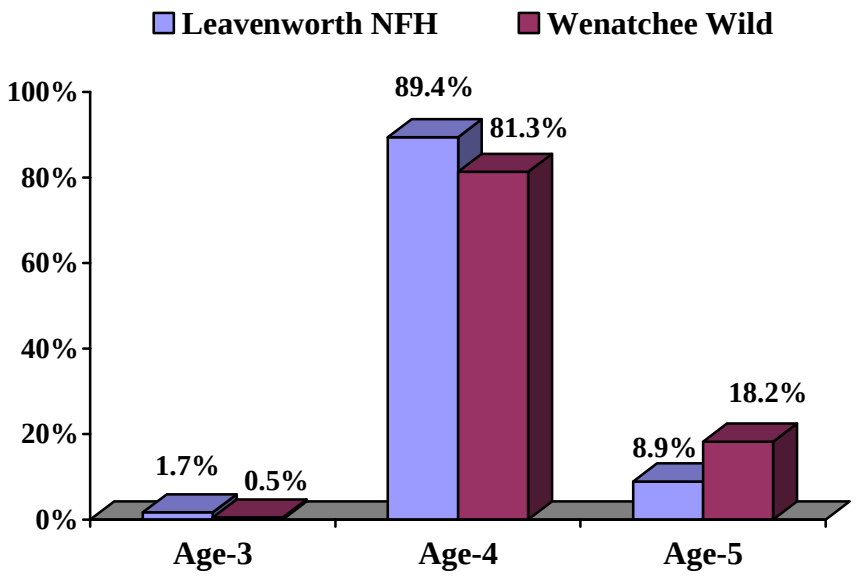


Figure 21. Age comparison of Leavenworth NFH vs. Wenatchee River wild spring Chinook, 2001.

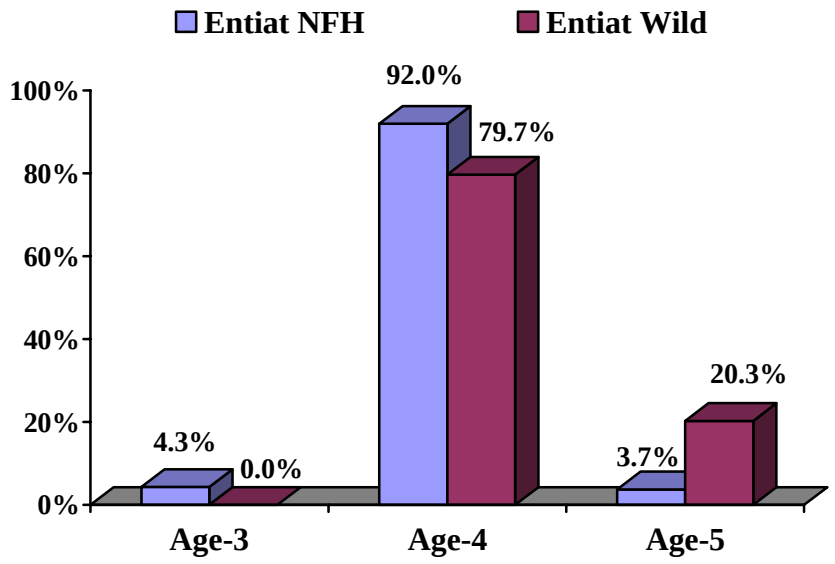


Figure 22. Age comparison of Entiat NFH vs. Entiat River wild spring Chinook, 2001.

- Similar to gender few comparisons between Leavenworth Complex hatchery and wild adults have been conducted for age-class composition. As with the gender comparisons, data was utilized from the 2001 recovered "wild" carcasses collected on the spawning grounds on the Wenatchee (Tonseth 2003) and Entiat River (Hamstreet 2002) to provide age-class proportions from which to compare against the hatchery sampled Leavenworth (Figure 21) and Entiat (Figure 22) NFH returns. For both the Wenatchee and Entiat River wild populations a greater

proportion of age-5 and lower proportions of age-4 and age-3 adults represented the return compared to their respective NFH counter parts. It is cautioned that hatchery return and spawning ground recovery data may be biased by collection method. Direct hatchery and wild population comparisons from the spawning grounds are often provided from the agencies conducting these studies in the Wenatchee (Tonseth 2003, Grassell, 2003, 2004), Entiat (Hamstreet 2002, 2003, 2004, 2005, 2006, Carie & Hamstreet 2001), and Methow (Humling & Snow 2004, 2005, Hubble 2003) River basins.

Adult Length and Growth Rates:

- The average fork length (cm) of returning adult spring Chinook to Leavenworth (Table 33), Entiat (Table 34), and Winthrop (Table 35) NFH's by both return year (left tables) and brood year (right tables) are described by age-class and gender. Comparisons between facilities revealed no difference in age-3 male lengths (ANOVA, $p>0.05$). Leavenworth NFH produced significantly (students, paired two-tailed t-test, $p\leq0.05$) larger age-4/5 males and age-4/5 females compared to Entiat and Winthrop NFH's. Entiat NFH age-4 males and females were significantly larger than Winthrop NFH (students, paired two-tailed t-test, $p\leq0.05$). Temporal analysis using linear regression was conducted in an effort to detect trends in size for each facility for brood years 1991-2000. Trends were only noted if the majority of variability could be explained by the time alone ($R^2\geq50\%$). No trend in length by age or sex was noted for Winthrop NFH. Only age-4 males at Entiat NFH are exhibiting a decreasing trend in length ($R^2=79\%$), while both age-4 males ($R^2=62\%$), and age-4 females ($R^2=56\%$) at Leavenworth NFH are exhibiting decreasing trends in length.

Table 33. Leavenworth NFH spring Chinook average adult fork length (cm) by return year (left table) and brood year (right table).

Sex/Age	Males			Females	
Return Yr.	Age-3	Age-4	Age-5	Age-4	Age-5
1994	52.1	77.8	96.8	75.7	87.9
1995	50.5	83.0	100.0	78.0	90.0
1996	51.4	80.3	96.9	76.8	88.4
1997	52.3	80.8	96.3	77.3	90.7
1998	51.6	78.7	96.5	74.8	87.9
1999	52.0	79.8	97.0	76.4	87.9
2000	52.5	78.3	98.0	75.8	87.0
2001	53.1	80.1	94.5	76.3	89.2
2002	45.7	80.0	96.2	75.3	88.3
2003	52.8	78.0	97.1	75.9	89.6
2004	51.1	75.4	94.4	72.6	87.1
2005	54.6	78.8	92.5	74.8	84.3
AVE	51.6	79.2	96.3	75.8	88.2
MAX	54.6	83.0	100.0	78.0	90.7
MIN	45.7	75.4	92.5	72.6	84.3
STDEV	2.1	1.9	1.9	1.4	1.7

Sex/Age	Males			Females	
Brood Yr.	Age-3	Age-4	Age-5	Age-4	Age-5
1991	52.1	83.0	96.9	78.0	88.4
1992	50.5	80.3	96.3	76.8	90.7
1993	51.4	80.8	96.5	77.3	87.9
1994	52.3	78.7	97.0	74.8	87.9
1995	51.6	79.8	98.0	76.4	87.0
1996	52.0	78.3	94.5	75.8	89.2
1997	52.5	80.1	96.2	76.3	88.3
1998	53.1	80.0	97.1	75.3	89.6
1999	45.7	78.0	94.4	75.9	87.1
2000	52.8	75.4	92.5	72.6	84.3
AVE	51.4	79.4	95.9	75.9	88.0
MAX	53.1	83.0	98.0	78.0	90.7
MIN	45.7	75.4	92.5	72.6	84.3
STDEV	2.1	2.0	1.6	1.5	1.7

Table 34. Entiat NFH spring Chinook average adult fork length (cm) by return year (left table) and brood year (right table).

Sex/Age	Males			Females	
Return Yr.	Age-3	Age-4	Age-5	Age-4	Age-5
1994	51.8	75.0	88.1	70.9	85.1
1995	48.0	80.3	88.0	76.8	90.0
1996	50.3	78.9	92.0	74.0	86.0
1997	48.5	78.5	91.8	76.1	88.4
1998	52.0	78.7	90.9	73.8	83.5
1999	54.7	78.2	95.3	75.1	87.6
2000	53.6	76.7	94.2	75.4	82.7
2001	55.1	77.8	91.6	74.8	87.6
2002	52.0	77.3	90.4	74.0	83.8
2003	53.7	76.5	93.7	74.9	86.8
2004	52.8	77.0	88.2	72.9	81.6
2005	53.2	76.5	93.5	73.1	83.8
AVE	52.1	77.6	91.5	74.3	85.6
MAX	55.1	80.3	95.3	76.8	90.0
MIN	48.0	75.0	88.0	70.9	81.6
STDEV	2.2	1.4	2.5	1.6	2.6

Sex/Age	Males			Females	
Brood Yr.	Age-3	Age-4	Age-5	Age-4	Age-5
1991	51.8	80.3	92.0	76.8	86.0
1992	48.0	78.9	91.8	74.0	88.4
1993	50.3	78.5	90.9	76.1	83.5
1994	48.5	78.7	95.3	73.8	87.6
1995	52.0	78.2	94.2	75.1	82.7
1996	54.7	76.7	91.6	75.4	87.6
1997	53.6	77.8	90.4	74.8	83.8
1998	55.1	77.3	93.7	74.0	86.8
1999	52.0	76.5	88.2	74.9	81.6
2000	53.7	77.0	93.5	72.9	83.8
AVE	52.0	78.0	92.2	74.8	85.2
MAX	55.1	80.3	95.3	76.8	88.4
MIN	48.0	76.5	88.2	72.9	81.6
STDEV	2.4	1.2	2.1	1.2	2.4

Table 35. Winthrop NFH spring Chinook average adult fork length (cm) by return year (left table) and brood year (right table).

Sex/Age	Males			Females	
Return Yr.	Age-3	Age-4	Age-5	Age-4	Age-5
1994	55.0		90.5		87.0
1995	54.0	70.0	93.0	77.7	
1996	52.1	75.3	91.7	73.5	90.0
1997	45.0	78.2	91.5	74.7	85.7
1998		74.1	92.0	73.0	86.7
1999					
2000	49.6	76.3	101.0	73.1	84.0
2001	51.6	79..2		74.8	85.0
2002		76.4	90.5	73.0	84.3
2003	47.4	74.0	87.0	74.3	86.1
2004	47.8	72.8		72.1	77.0
2005	50.4	72.1	93.5	72.3	83.8
AVE	50.3	74.4	92.3	73.9	85.0
MAX	55.0	78.2	101.0	77.7	90.0
MIN	45.0	70.0	87.0	72.1	77.0
STDEV	3.2	2.5	3.8	1.6	3.3

Sex/Age	Males			Females	
Brood Yr.	Age-3	Age-4	Age-5	Age-4	Age-5
1991	55.0	70.0	91.7	77.7	90.0
1992	54.0	75.3	91.5	73.5	85.7
1993	52.1	78.2	92.0	74.7	86.7
1994	45.0	74.1		73.0	
1995			101.0		84.0
1996		76.3		73.1	85.0
1997	49.6	79..2	90.5	74.8	84.3
1998	51.6	76.4	87.0	73.0	86.1
1999		74.0		74.3	77.0
2000	47.4	72.8	93.5	72.1	83.8
AVE	50.7	74.6	92.5	74.0	84.7
MAX	55.0	78.2	101.0	77.7	90.0
MIN	45.0	70.0	87.0	72.1	77.0
STDEV	3.6	2.5	4.3	1.6	3.5

- Brood growth (average differences in fork length) by age for males and females for each Leavenworth Complex facility is shown in Table 36. Brood growth was calculated as the difference in average fork length between age-classes of each brood to possibly assess the quality of the marine environment. (note: decrease in brood year 2000 age 3-4 males and 1999 4-5 male/female growth rates, corresponding to a transition from previously high survival rates). Comparisons

were conducted among and between Leavenworth Complex facilities. Among facilities only Leavenworth NFH age-4/5 males and females grew significantly (students, paired two-tailed t-test, $p \leq 0.05$) faster compared to Entiat NFH (Winthrop NFH had too few comparative data points). An analysis was conducted using linear regression on observed within program growth rates over time for brood years 1991-2000. Trends were only noted if the majority of variability could be explained by the time alone ($R^2 \geq 50\%$). Only Entiat NFH growth rates between age-3 to age-4 males exhibited a decreasing trend ($R^2 = 65\%$). No other trend in growth rate was noted at any facility or gender based age-class.

Table 36. Leavenworth Complex spring Chinook growth (cm) by gender/age-class for each facility by brood year, 1991-2000.

	Leavenworth NFH			Entiat NFH			Winthrop NFH		
Sex/Age	Male Growth		Female Growth	Male Growth		Female Growth	Male Growth		Female Growth
Brood Yr.	Age3-4	Age4-5	Age4-5	Age3-4	Age4-5	Age4-5	Age3-4	Age4-5	Age4-5
1991	30.9	13.9	10.4	28.5	11.7	9.2	15.0	21.7	12.3
1992	29.8	16.0	13.9	30.9	12.9	14.4	21.3	16.2	12.2
1993	29.4	15.7	10.6	28.2	12.4	7.4	26.1	13.8	12.0
1994	26.4	18.3	13.1	30.2	16.6	13.8	29.1	NA	NA
1995	28.2	18.2	10.6	26.2	16.0	7.6	NA	NA	NA
1996	26.3	16.2	13.4	22.0	14.9	12.2	NA	NA	11.9
1997	27.6	16.1	12.0	24.2	12.6	9.0	NA	NA	9.5
1998	26.9	17.1	14.3	22.2	16.4	12.8	24.8	10.6	13.1
1999	32.3	16.4	11.2	24.5	11.7	6.7	NA	NA	2.7
2000	22.6	17.1	11.7	23.3	16.5	10.9	25.4	20.7	11.7
AVE	28.0	16.5	12.1	26.0	14.2	10.4	23.6	16.6	10.7
MAX	32.3	18.3	14.3	30.9	16.6	14.4	29.1	21.7	13.1
MIN	22.6	13.9	10.4	22.0	11.7	6.7	15.0	10.6	2.7
STDEV	2.7	1.3	1.5	3.3	2.1	2.8	4.9	4.7	3.4

Spawn Timing:

- Spawn timing of Leavenworth Complex facilities was compared using hatchery records to approximate the ~50% cumulative spawn date each year assuming linear ripening between spawn dates (ie. 25% spawned on Aug-14, and 75% on Aug-21 = 7.143% per day, ~ 50% spawn date of Aug-18th). For the period of 1994-2005 the average 50% spawn date has averaged August 17th (SD = 2.4 days), August 21st (SD = 3.4 days), and August 26th (SD = 3.4 days) for Leavenworth, Winthrop, and Entiat NFH's, respectively (Table 37). An analysis was conducted using linear regression on observed within program 50% spawn dates for return years 1994-2005. Trends were only noted if the majority of variability could be explained by the time alone ($R^2 \geq 50\%$). This analysis revealed no apparent trends or shift in annual spawn timing (Figure 23).

Table 37. Leavenworth Complex approximate 50% spawn data by facility by year, 1994-2005.

Return Year	Leavenworth NFH	Entiat NFH	Winthrop NFH
1994	13-Aug	27-Aug	20-Aug
1995	21-Aug	27-Aug	14-Aug
1996	21-Aug	25-Aug	25-Aug
1997	17-Aug	26-Aug	25-Aug
1998	19-Aug	29-Aug	19-Aug
1999	18-Aug	29-Aug	NA
2000	17-Aug	28-Aug	25-Aug
2001	17-Aug	27-Aug	22-Aug
2002	16-Aug	25-Aug	24-Aug
2003	14-Aug	23-Aug	19-Aug
2004	19-Aug	25-Aug	20-Aug
2005	17-Aug	23-Aug	24-Aug
AVE	17-Aug	26-Aug	21-Aug
MAX	21-Aug	29-Aug	25-Aug
MIN	13-Aug	23-Aug	14-Aug
STDEV	2.4 days	1.8 days	3.4 days

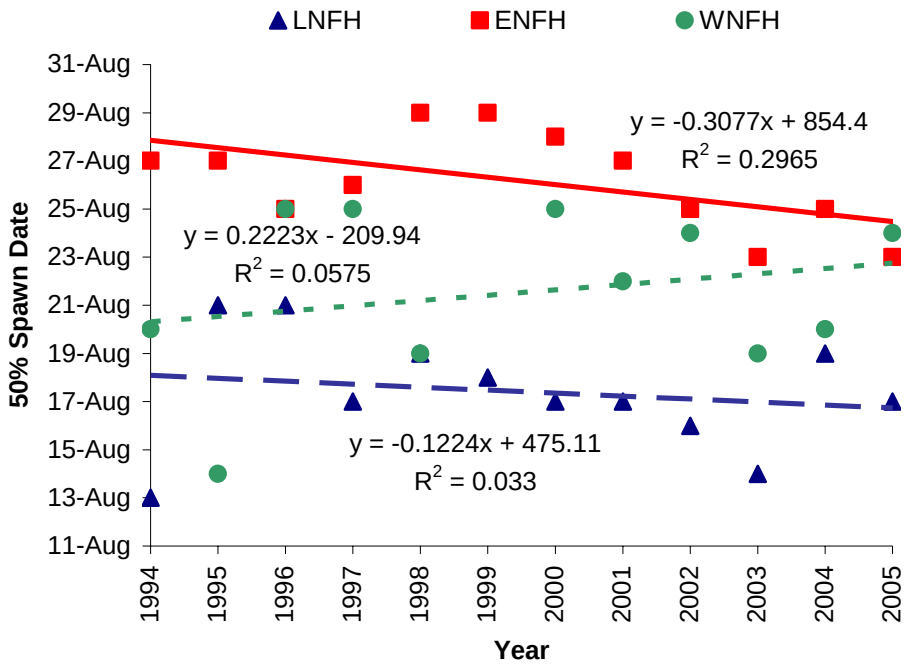


Figure 23. Scatter plot with linear comparisons of 50% spawn date of spring Chinook by Leavenworth Complex hatcheries, 1994-2005.

Bacterial Kidney Disease:

- Annual bacterial kidney disease (BKD) risk profiles are conducted for all female spring Chinook brood stock. Categorical assignment of BKD risk provides a metric to prioritize egg culling. The removal of high risk gametes is believed to reduce the risk of BKD via vertical transmission to offspring. The distribution in the average annual BKD risk profile for Leavenworth Complex hatcheries is shown (Figure 24). For the period of 1995-2005, Leavenworth NFH has averaged 11.0% moderate to very high BKD risk (Table 38) Entiat NFH has averaged 4.0% moderate to very high BKD risk (Table 39), and Winthrop NFH has averaged 22.2% moderate to very high BKD risk (Table 40).

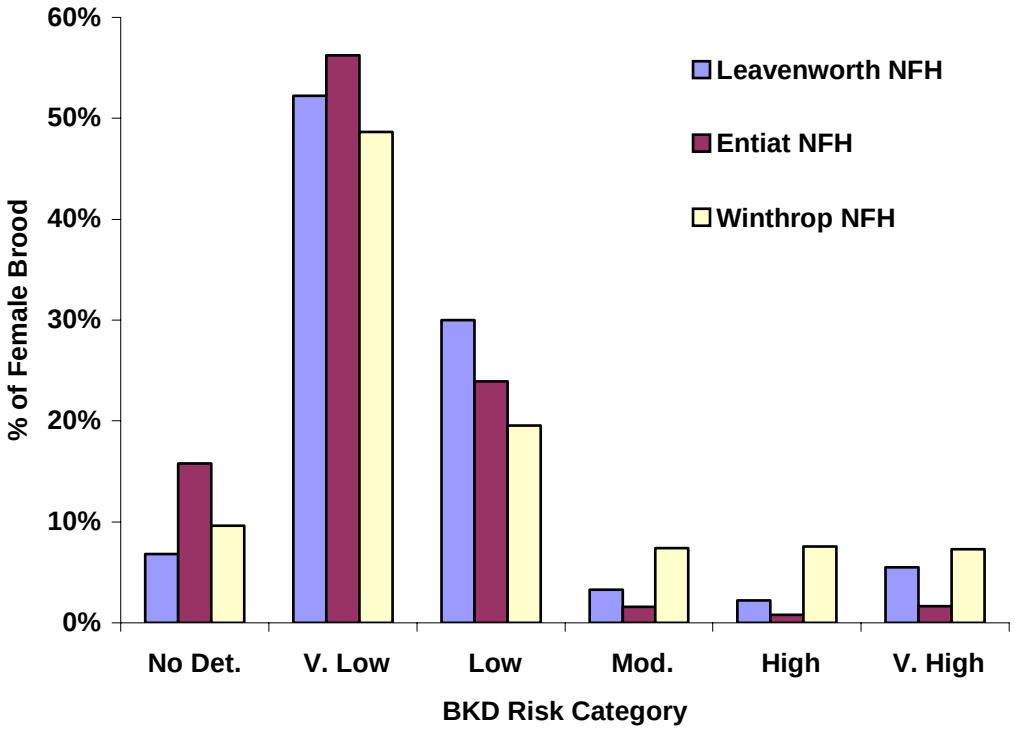


Figure 24. Leavenworth Complex spring Chinook female brood bacterial kidney disease (BKD) average annual risk profile by hatchery, 1995-2005.

Table 38. Leavenworth NFH spring Chinook females BKD risk profiles, 1995-2005.

Rank / Year	No Detection	Very Low	Low	Moderate	High	Very High
1995	0.0%	31.4%	52.7%	6.8%	3.2%	5.9%
1996	0.0%	59.2%	25.6%	3.4%	5.3%	6.5%
1997	0.6%	23.0%	63.2%	8.3%	1.6%	3.2%
1998	14.7%	59.0%	14.7%	1.8%	2.6%	7.3%
1999	2.4%	43.2%	41.9%	4.9%	1.9%	5.8%
2000	15.1%	50.8%	28.4%	2.1%	0.8%	2.7%
2001	1.0%	65.4%	28.1%	1.0%	1.6%	2.9%
2002	0.2%	44.0%	45.9%	3.1%	1.4%	5.4%
2003	25.3%	46.8%	7.8%	3.1%	3.4%	13.6%
2004	15.2%	74.1%	4.3%	0.4%	1.2%	4.9%
2005	0.3%	77.7%	17.2%	1.2%	1.2%	2.4%
AVE	6.8%	52.2%	30.0%	3.3%	2.2%	5.5%
MAX	25.3%	77.7%	63.2%	8.3%	5.3%	13.6%
MIN	0.0%	23.0%	4.3%	0.4%	0.8%	2.4%
STDEV	9.0%	16.9%	19.0%	2.5%	1.3%	3.2%

Table 39. Entiat NFH spring Chinook females BKD risk profiles, 1995- 2005.

Rank / Year	No Detection	Very Low	Low	Moderate	High	Very High
1995	0.0%	20.7%	67.2%	8.6%	1.7%	1.7%
1996	0.0%	65.7%	29.4%	1.0%	1.0%	2.9%
1997	0.0%	60.1%	38.5%	0.0%	1.4%	0.0%
1998	0.0%	0.0%	95.2%	1.6%	2.4%	0.8%
1999	9.6%	75.8%	11.4%	0.4%	1.1%	1.8%
2000	30.5%	63.3%	4.8%	0.5%	0.0%	1.0%
2001	4.4%	81.5%	7.4%	3.7%	0.0%	3.0%
2002	25.2%	65.2%	5.2%	1.5%	0.0%	3.0%
2003	62.0%	34.0%	1.3%	0.0%	0.7%	2.0%
2004	36.0%	61.3%	0.7%	0.0%	0.7%	1.3%
2005	6.1%	91.2%	2.0%	0.0%	0.0%	0.7%
AVE	15.8%	56.3%	23.9%	1.6%	0.8%	1.6%
MAX	62.0%	91.2%	95.2%	8.6%	2.4%	3.0%
MIN	0.0%	0.0%	0.7%	0.0%	0.0%	0.0%
STDEV	20.3%	27.2%	31.4%	2.6%	0.8%	1.0%

Table 40. Winthrop NFH Chinook females BKD risk profiles, 1995- 2005.

Rank / Year	No Detection	Very Low	Low	Moderate	High	Very High
1995	0.0%	11.1%	33.3%	22.2%	33.3%	0.0%
1996	16.0%	59.4%	9.4%	5.7%	5.7%	3.8%
1997	0.0%	12.3%	48.6%	26.8%	10.1%	2.2%
1998	15.2%	56.5%	17.4%	2.2%	2.2%	6.5%
1999	All Broodstock collected by WDFW					
2000	20.6%	53.1%	24.1%	1.3%	0.4%	0.4%
2001	1.5%	30.3%	14.9%	8.5%	13.9%	30.8%
2002	0.0%	73.2%	18.7%	2.4%	5.7%	0.0%
2003	2.9%	56.4%	22.6%	2.9%	1.2%	14.0%
2004	38.4%	41.6%	2.3%	0.9%	2.7%	14.2%
2005	1.3%	92.4%	4.0%	0.9%	0.4%	0.9%
AVE	9.6%	48.6%	19.5%	7.4%	7.6%	7.3%
MAX	38.4%	92.4%	48.6%	26.8%	33.3%	30.8%
MIN	0.0%	11.1%	2.3%	0.9%	0.4%	0.0%
STDEV	12.8%	25.6%	13.9%	9.4%	10.1%	9.9%

Coded Wire Tag Returns:

- Each year coded-wire tags are applied to various release groups of spring Chinook from Leavenworth Complex facilities. Tags are distributed in a manner to represent the entire brood year. In addition specific tag groups are often utilized to represent unique aspects within each brood year such as rearing unit, water re-use, BKD risk, stock, or specific study. Tags are recovered at each Leavenworth Complex from returning adults and decoded. Information regarding each CWT adult is then submitted to the Regional Mark Information System. This system provides online queries from which data representing a particular hatchery or tag code can be gathered from throughout the Pacific Northwest.

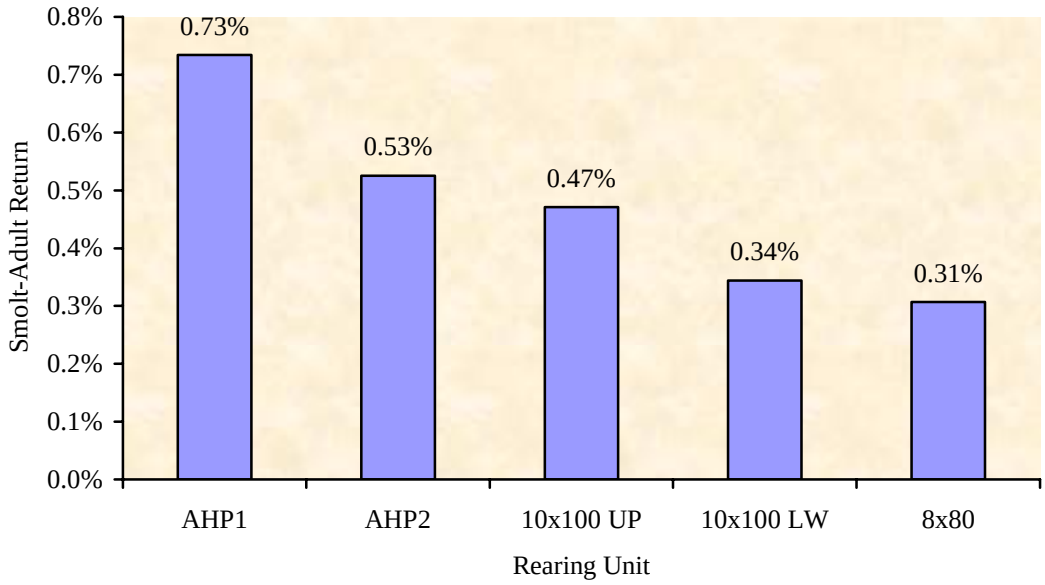


Figure 25. Leavenworth NFH CWT recovery and subsequent average smolt-adult survival rates by rearing unit for brood years 1997-2000.

- Appendix 11 provides a current summary of CWT returns for Leavenworth NFH for brood years 1994-2000. Recent, (1997-2000) CWT groups at this facility have been applied in a manner to represent the rearing units present at this facility (ie. adult holding ponds 1 & 2, upper & lower 10'x100' raceways, and 8'x80' lower raceways). Although the 1997-2000 brood year average return survival (Figure 25) appears different by rearing unit no significant difference between rearing units is currently observed (ANOVA, $p = 0.441$).

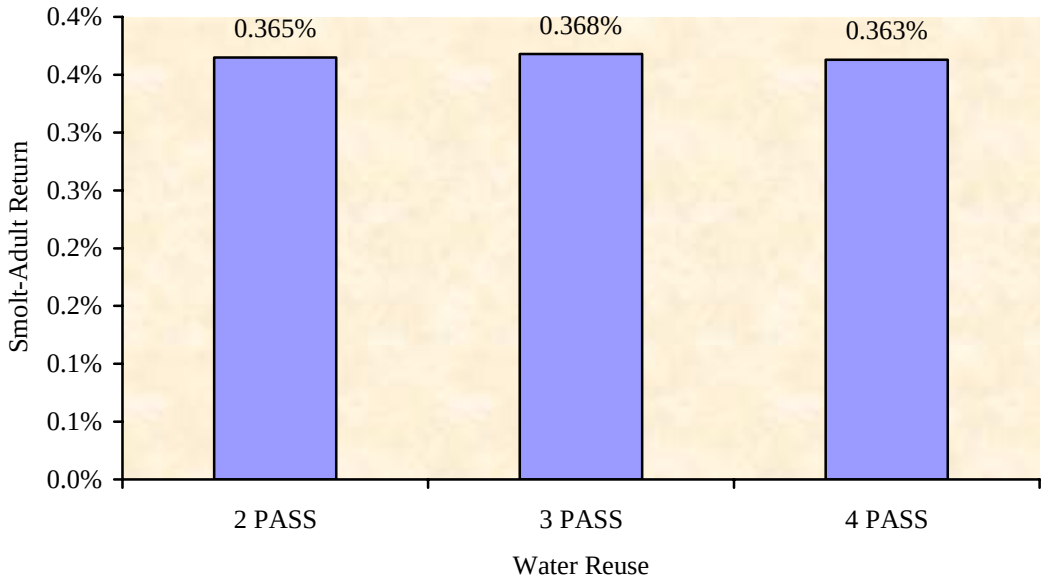


Figure 26. Entiat NFH average spring Chinook smolt-adult survival rates by water reuse for brood years 1997-2000.

- Appendix 12 provides a current summary of CWT returns for Entiat NFH for brood years 1994-2000. Recent, (1997-2000) CWT groups at this facility have primarily been applied in a manner to represent the re-use of water at this facility (ie. 2nd – 4th pass). In general juveniles are ponded to first pass water on the upper bank raceways until the time of marking in June. At this time juveniles are split to either second pass water on middle bank raceways or third pass water on lower bank raceways. Fish placed on second or third pass water remain until released the following April. Fish remaining on first pass water in the upper bank are moved to fourth pass water after the adult holding ponds are empty. Generally this had occurred in October; however, more recently this has been delayed until December to accommodate the holding and spawning of adult coho for the Yakama Nation. The average 1997-2000 brood year survival by water reuse is surprisingly similar at this facility (Figure 26) with no significant difference in smolt-adult survival observed (ANOVA, $p = 0.9998$).

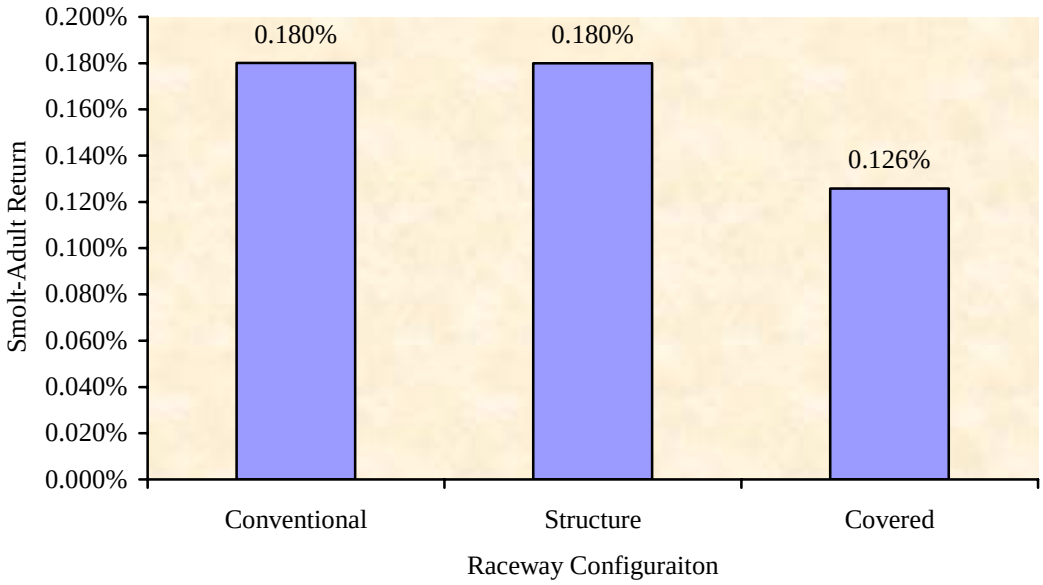


Figure 27. Winthrop NFH average spring Chinook smolt-adult survival rates by conventional production vs. "natures rearing" incorporating the use of within raceway structure or cover.

- Appendix 13 provides a current summary of CWT returns for Winthrop NFH for brood years 1994-2000. Winthrop NFH has had a variety of different tag codes applied by various rearing units, stocks, and fish health profiles to name a few. A study was conducted in which "natures" rearing was investigated by treating raceways with automatic feeders, structure and/or covers compared to standard or conventional rearing practices. A complete evaluation of this study has not been conducted; however, a brief review of the recent 2000 brood year return averages by treatment group is displayed in Figure 27.

Additional Studies

Carcass nutrient supplementation:

Salmon provide a crucial link in the flow of marine derived nutrients to the freshwater environments in which they spawn (Cederholm et al. 1999). A growing body of evidence suggests that this annual pulse of nutrients released from decaying post-spawn adults provide substantial benefits in both aquatic and terrestrial ecosystems through a variety of pathways (Bilby et al. 2001). In recognition of these benefits, a nutrient enhancement program was established in 2000 to outplant post-spawn spring Chinook carcasses from Leavenworth Complex hatcheries in the Wenatchee, Entiat and Methow River basins. Carcasses were sanitized through freezing and the tail was removed prior to outplanting to distinguish outplants from naturally spawned carcasses. Carcass distribution targeted known spring Chinook spawning areas in each basin. During the course of the project, decisions were made to eliminate female broodstock because they are injected with erythromycin prior to spawning to combat bacterial kidney disease. Additionally, any MS-222 treatment (fish sedative) of adults required a one month (living) withdrawal period or the subsequent carcass was not useable for outplant. In 2003, spawning practices changed to the extent that few suitable carcasses were available for outplant (use of MS-222 at both ENFH and LNFH). In an effort to continue nutrient supplementation, an alternative method was employed. In 2003, carcass analogs were purchased from the fish feed manufacturer Bio-Oregon based on favorable findings about the ability of this product to mimic natural salmon carcass nutrient contribution. The carcass analog is composed primarily of post-spawn hatchery Chinook salmon and binder that is pasteurized through heating and desiccation into a pellet for distribution. Carcass analogs were outplanted under guidelines from Bio-Oregon that suggested three pounds of dried analog provides the nutrient equivalent to one fifteen pound Chinook carcass (pers com. D. Roley, Bio-Oregon). A summary of the carcass outplanting program is shown (Table 41). Due to the limited availability of useable carcasses for outplanting, complications with other in basin studies, and the costs associated with the use of analogs, the Leavenworth Complex nutrient enhancement program was discontinued in 2004.

Table 41. Summary of Leavenworth Complex nutrient enhancement program, 2000-2004.

Year	Leavenworth NFH	Entiat NFH	Winthrop NFH	Comments
2000	580	282	272	All broodstock outplanted
2001	0	161	126	Only males carcasses used
2002	370	116	123	Includes 4 coho in Methow
2003	40	400	155	LNFH & ENFH used analogs. Numbers are in carcass equivalents
2004	Carcass nutrient program was discontinued.			

Leavenworth NFH – density rearing study:

Spring Chinook salmon at Leavenworth NFH were reared at three different loading densities during brood years 1994 – 1996. Each year, following differential coded wire tagging, fingerlings were loaded in triplicate at targeting release densities of 10,000, 20,000 or 30,000 (density indexes of 0.07, 0.14, and 0.21 (#/lb/length*ft^3) or 5, 10, and 15 kg/m^3) per 8'x80'raceway. During rearing, growth and size at release were maintained between all treatment groups. No significant differences for survival or the number of adults returned were observed from the pooled 1994-1996 data set (ANOVA, p>0.05) (Figure 28).

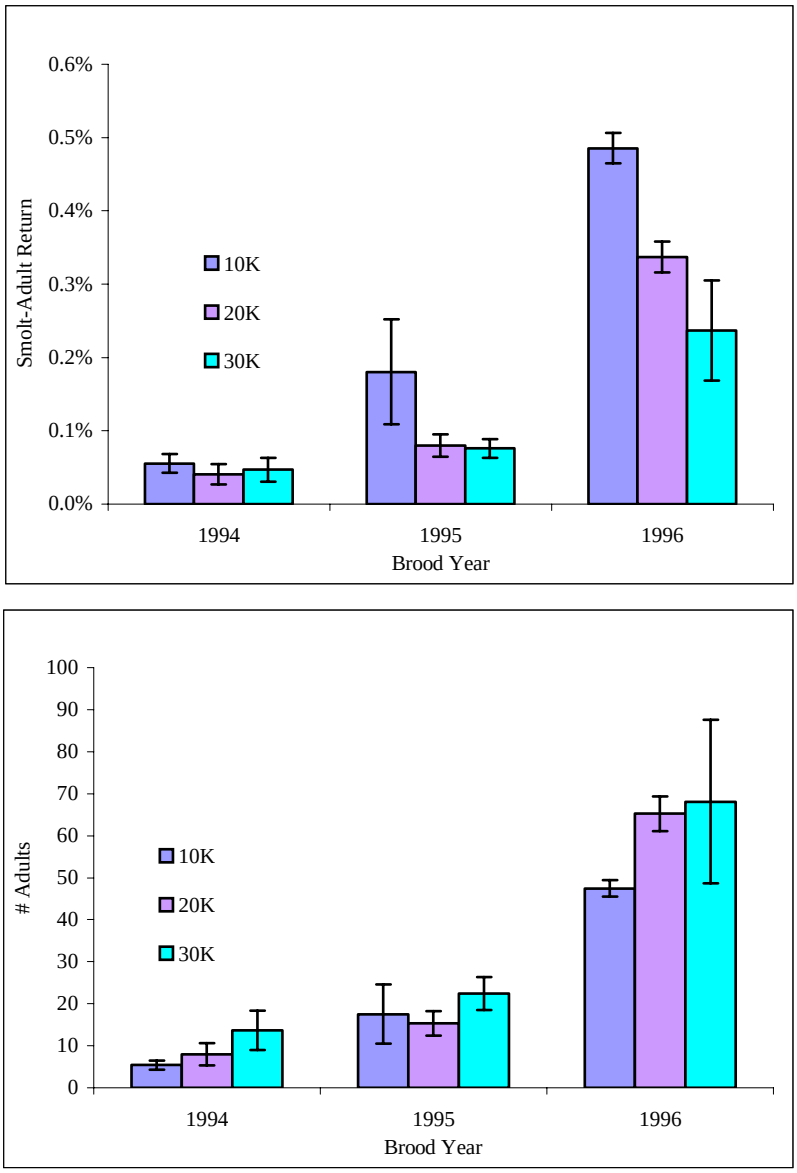


Figure 28. Leavenworth NFH spring Chinook raceway rearing density study results for brood years 1994-1996 by average survival (top) and number of adults returned (bottom) per raceway per year. Standard error bars shown.

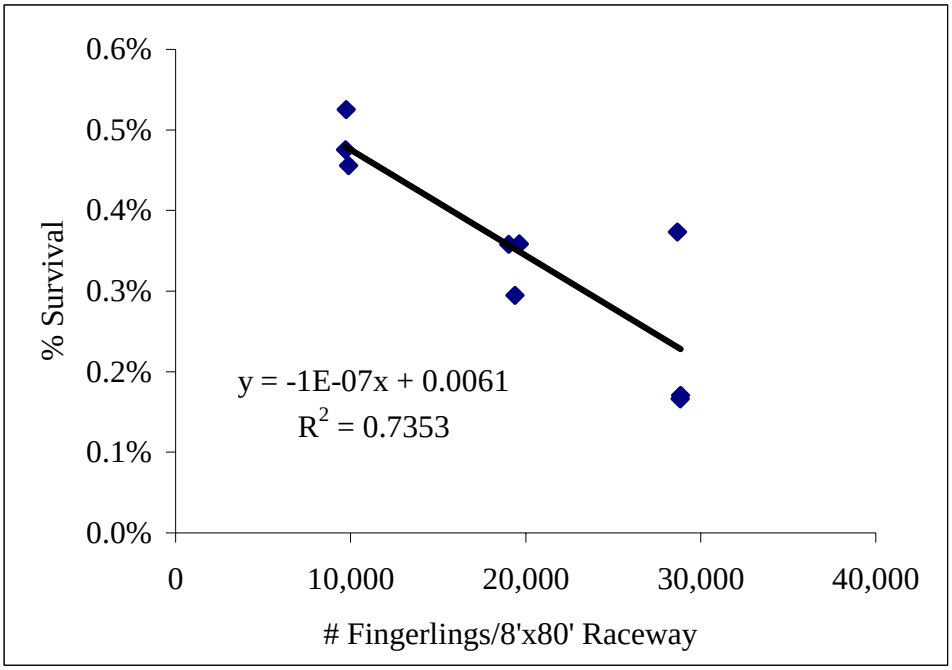


Figure 29. A comparison of juvenile spring Chinook raceway density vs. smolt-to-adult survival rates for the 1996 brood year.

Comparing results within each year revealed only the 1996 brood provided sufficient return rates for an observable significant difference to occur between the survival of treatment groups (ANOVA, $p = 0.0242$) but not in the number of adults returned (non-parametric Kruskal-Wallis, $p = 0.15$). Utilizing linear regression, the 1996 brood year data revealed an inverse relationship between rearing density and survival ($R = -0.73$, $p \leq 0.05$) with the 10,000 groups exhibiting an almost two-fold increase in survival over the 30,000 groups (Figure 29). However, the linear model predicted that densities of 23,000 to 27,000 fingerlings per raceway (density index of 0.15-0.17 (#/lb/length*ft^3), or 10.7-12.2 kg/m^3) maximized the adult yield per raceway (Figure 30).

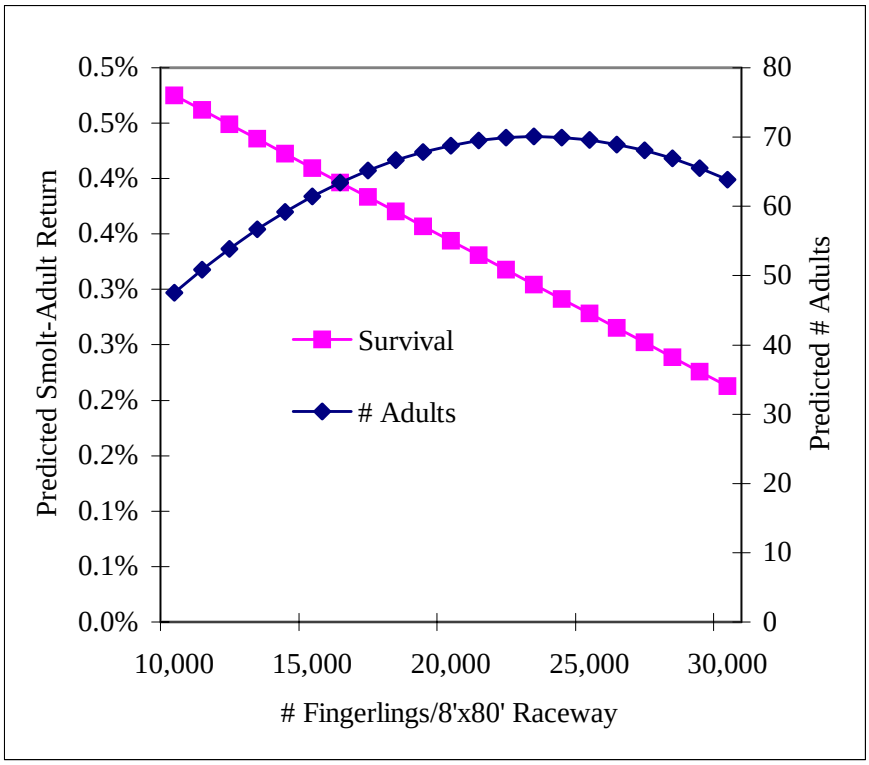


Figure 30. Linear model predictions using brood year 1996 Leavenworth NFH spring Chinook rearing density study data of smolt-to-adult survival and subsequent number of adults returned.

Entiat NFH – wild vs. hatchery comparisons:

- The Mid-Columbia River FRO currently operates a five foot diameter rotary screw trap on the Entiat River. Consistent operation of the Entiat River juvenile trap began in July of 2003 and has continued on an annual March-November seasonal basis since that time. The trap is located at river kilometer 10 just below the Entiat NFH (Figure 31) and is focused on capturing spring Chinook juveniles emigrating from the spawning grounds located upstream of the trap site. The following figures describe current knowledge about Entiat River wild spring Chinook juveniles with comparisons to the Entiat NFH as appropriate.

Figure 31. Picture of Entiat River rotary screwtrap located just downstream of Entiat NFH.

- Figure 32 is a pictorial depiction comparing Entiat NFH smolts against Entiat River wild spring Chinook yearlings. By size hatchery smolts are 2-3 times larger than wild smolts due to a continual growth rate (Figure 33).

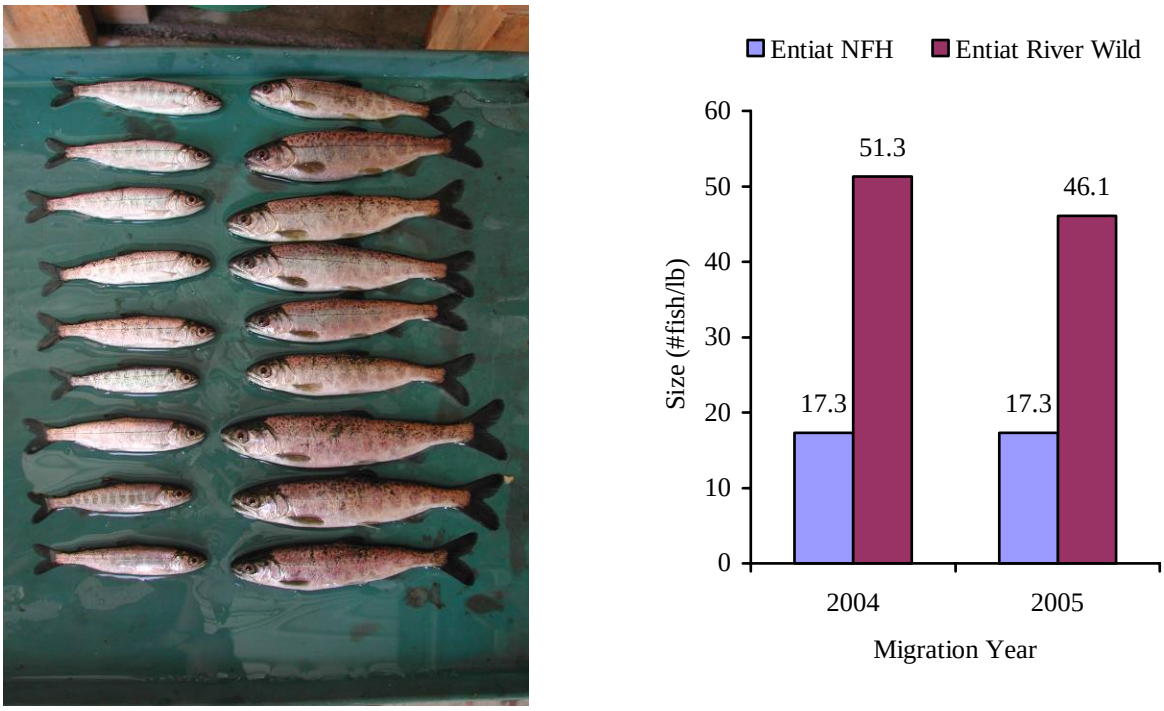


Figure 32. Picture and graph comparing Entiat River wild (left) vs. Entiat NFH (right) yearling spring Chinook smolts.

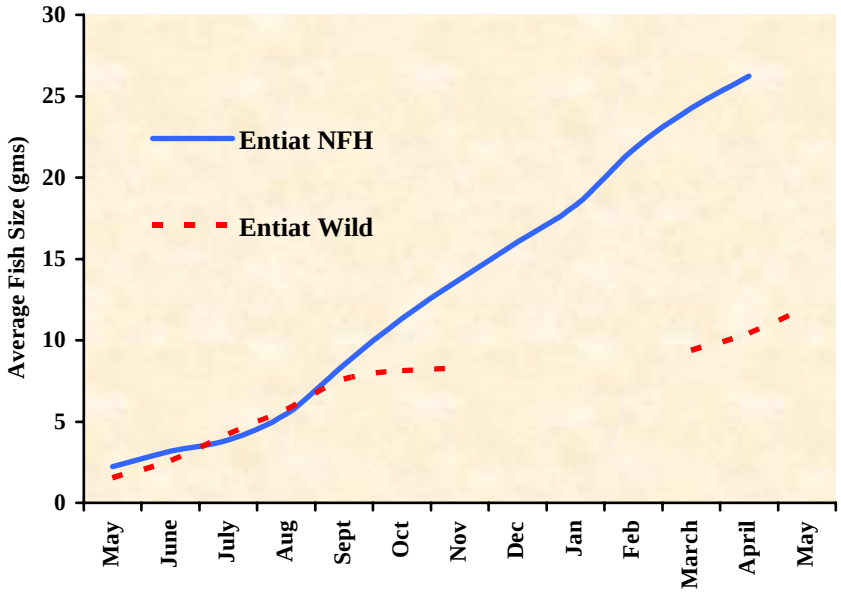


Figure 33**.** A comparison of spring Chinook growth rates for brood year 2003 from Entiat NFH vs. Entiat River wild migrants.

- Entiat River Chinook juveniles exhibit different migration times by run and age classification (Figure 34). Peak catch at the Entiat River migrant trap in 2005 was

April 12th for yearling spring Chinook, June 16th for summer Chinook, and October 1st for subyearling spring Chinook juveniles.

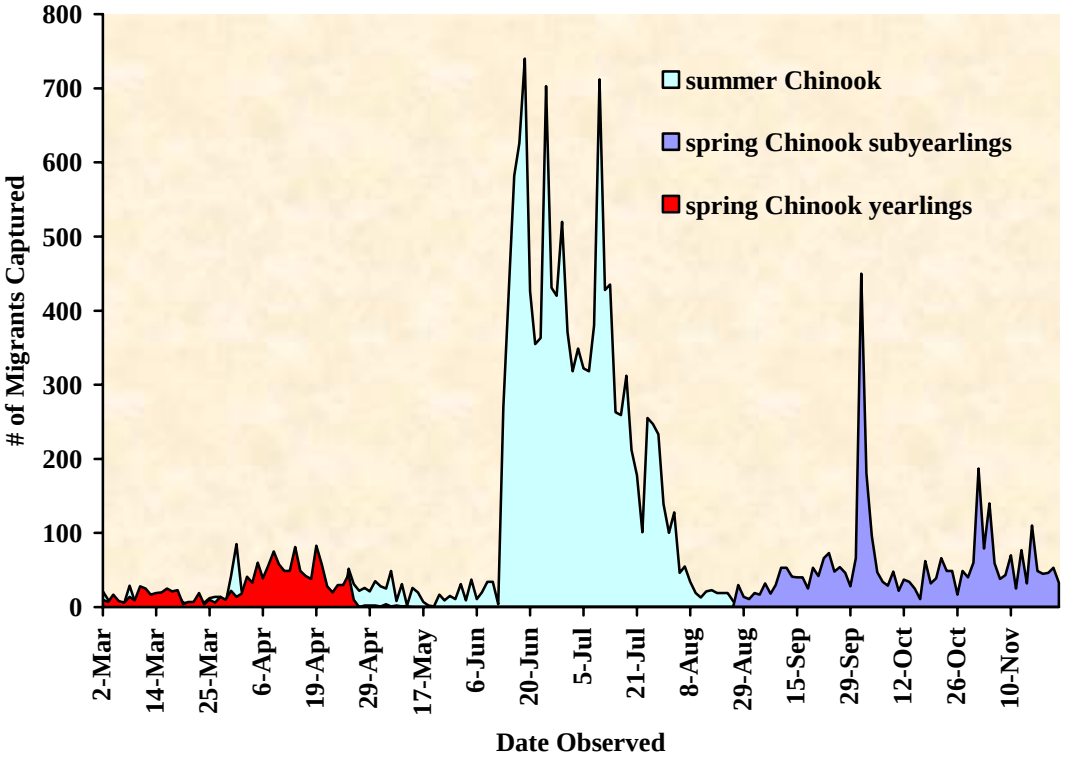


Figure 34. Entiat River juvenile trap catch by day for spring and summer Chinook, 2005.

- Entiat River wild spring Chinook production has averaged (average of ~3 BY's) 64% subyearlings, and 36% (SD = 7.1%) yearling life histories. The average estimated survival from egg-to-emigrant, and production by emigrant-to-redd has averaged 3.8% (SD = 1.0%) and 173 (SD = 45), respectively. This survival rate closely approximates the range estimated by Mullan (1992b) for this basin.

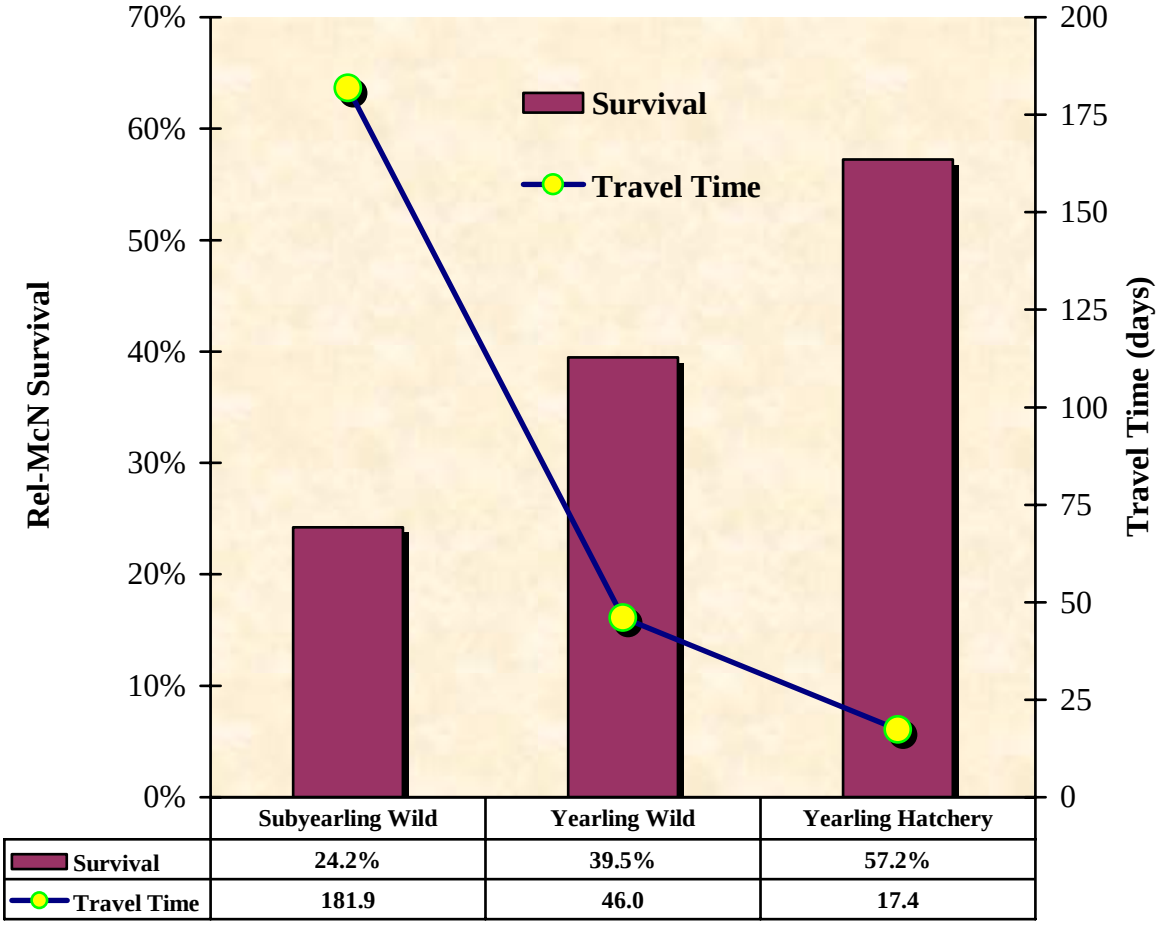


Figure 35. A comparison of PIT-tagged spring Chinook 2004 migration year survival from release point to McNary Dam for brood year 2002 wild and Entiat NFH smolts.

- Figure 35 compares the 2004 migration year survival from release at the Entiat migrant trap or from the Entiat NFH to McNary Dam for PIT-tagged Entiat NFH yearling, Entiat River wild subyearling (captured, tagged, and released in fall 2003), and Entiat River wild yearling spring Chinook. Data provided courtesy of Columbia River DART.

Leavenworth NFH – hatchery adult outplant program – Peshasin/Ingalls Creeks:

- The USFWS in conjunction with the Yakama Nation conducted a Leavenworth NFH adult spring Chinook outplant program. Beginning in 2001 and continuing each year through 2004 a portion of the adult hatchery spring Chinook salmon that returned to the hatchery were live outplanted in early-July each year to Peshastin and Ingalls Creeks within the Wenatchee River watershed (Figure 36). These adults were successful in producing redds (Figure 37) at an average annual rate of 4.6 fish/redd (SD = 1.8 fish/redd). In 2005 no adults were outplanted and surveys indicated only three redds were observed (A. Grassell, pers. comm., Chelan County PUD).

Figure 36. Pictures of the Leavenworth NFH adult spring Chinook outplant program to Peshastin Creek.

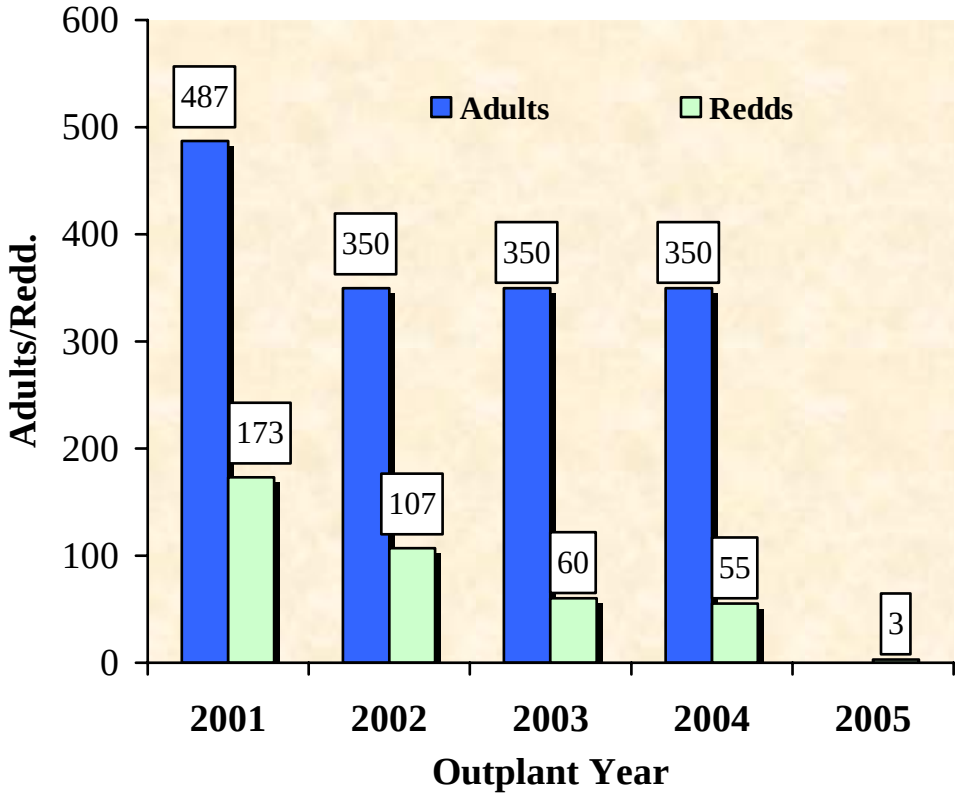


Figure 37. A comparison of the number of Leavenworth NFH adult spring Chinook outplants vs. observed redds, 2001-2005.

- In 2004 and 2005, smolt production monitoring began in Peshastin Creek by the Mid-Columbia River FRO. An instream rotary screw trap was placed in Peshastin Creek at river mile 6.3 and operated March-November in 2004 and March – July, September-November, 2005 (Figure 38),

- During 2004 and 2005 spring Chinook juveniles were captured and exhibited primarily a subyearing life history emigration pattern (Figure 39) with very few yearlings observed in the Spring of 2004 or 2005. Trapping in 2004 estimated 61,566 (95%CI = +/- 20,136) emergent fry, 1,423 (95%CI = +/- 626) non-migratory parr, and 3,406 (95%CI = +/- 164) migrant subyearlings. The 2004 estimated green egg (60 redds * 5,268 fecundity LNFH records = 316,080 green eggs) to subyearling migrant survival was ~1.1% or ~57 migrants/redd.

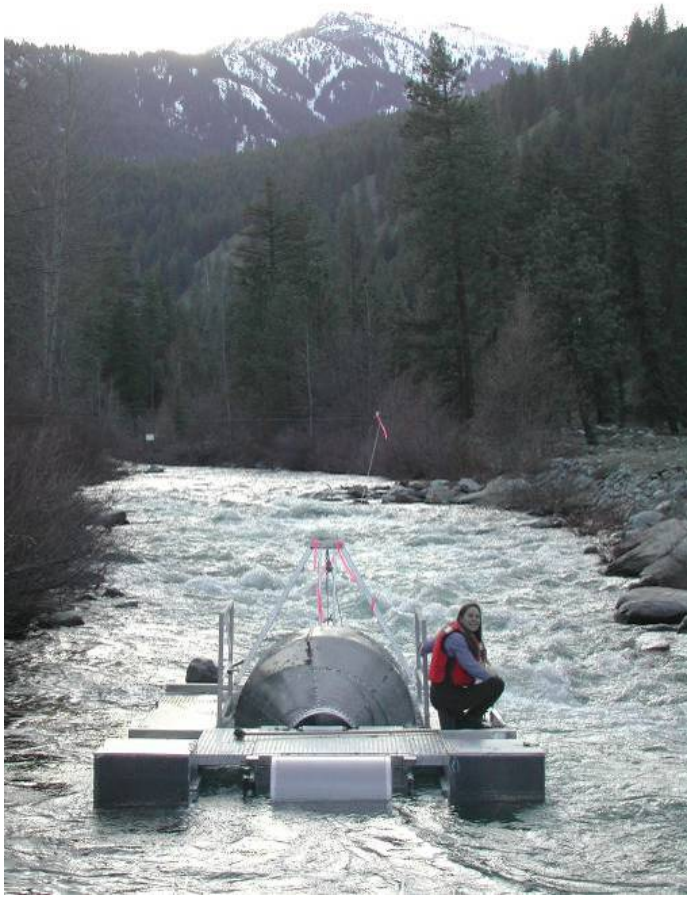


Figure 38. Picture of the Peshastin Creek rotary screw trap.

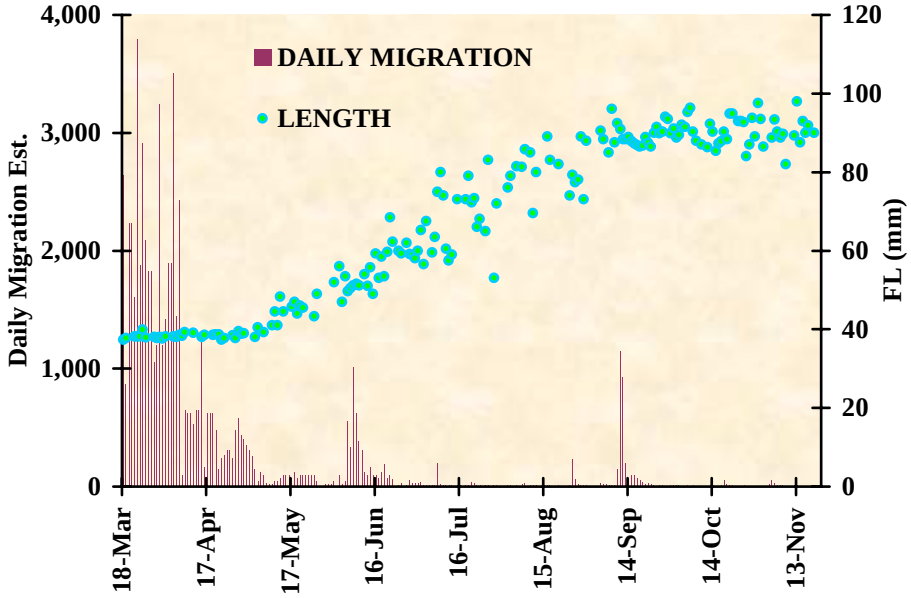


Figure 39. Peshastin Creek juvenile spring Chinook daily population migration estimate and average daily fork length, 2004.

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APPENDICES

Appendix 1. Applegate Final Draft Confirmed Methow/Upper Columbia Agreement, May 11, 2001.

APPLEGATE FINAL DRAFT
CONFIRMIRMED METHOW/UPPER COULMBIA AGREEMENT
5/11/01

This document reflects the agreement of representatives of the National Marine Fisheries Service, US Fish and Wildlife Service, Yakama Nation and Washington Department of Fish and Wildlife at the May 11, 2001 policy meeting on abundant hatchery returns. The agreement will be circulated to these parties and to the Colville Tribes who were unable to attend the May 11 discussion, but participated in the precious deliberations-for concurrence. The concurrence letter will come from the Washington Department of Fish and Wildlife and should be available for signature early next week. At the May 11 policy discussion, only two amendments were approved. Section 4 of Methow Production Issues was amended to make clear that adult fish would generally not have access to the channel below the Winthrop hatchery. In addition, language was added to the Leavenworth Issues section to provide for potential outplanting of fish in Icicle Creek above the hatchery. See the agreement for the specific language on these two points.

METHOW RIVER PRODICTION ISSUES: THIS YEAR'S OPERATIONS

All parties commit to the 1.15 million smolt program for this year and agree that it is the production program planned for outyears, subject to further discussion as noted in the longer-term issue list below. For this year, broodstock collection efforts will endeavor to collect a target of 1,000 adult fish using the priorities specified in 3(A)-(D) below. If 1,000 fish are obtained, collection at Winthrop as specified in 3(E) below will not be applicable. It is acknowledged that, given expected water conditions, the number collected could be less that 1,000. All smolt releases from these collections would be marked with an internal tag.
The collection of broodstck would be conducted with the following priorities:

a: As a first priority, collect adults at Chewuch. Collect as many as practicable, not to exceed 60% of the run. The fist 250,000 smolts would be released in the Chewuch River. Remaining smolts would be released in the mainstem Methow as part of the Methow Composite program. Also as first priority, at Twisp, design broodstock protocols combination with expected production from the existing captive broodstock program.
b: Collect adult swim-ins at the Methow Hatchery. Cross the 1997 brood-year return with Chewuch males (utilizing live spawning for wild males) and release progeny as smolts in the mainstem Methow. Except as noted below, smolt releases would not be adipose fin clipped, but would be internally tagged at a 100% rate as noted in 2 above.
c: WDFW staff will, in consultation with the co-managers, develop protocols that identify the number of adult fish needed to contributed to the attainment of the 1.15 million smolt program given the anticipated adult collection at the Methow, Twisp, and Chewuch facilities.
d: If needed to attain the 1.15 million smolt release goal, Carson stock fish will be outcrossed with Chewuch males and the resultant progeny reared at Winthrop National Fish Hatchery and released in the mainstem Methow as smolts. These fish would be marked at the 100% rate with a coded wire tag and adipose fin clip. When these marked fish return in the future in they are not needed for hatchery broodstock, they will be used in a beneficial manner, with fist consideration being given to natural spawning in the system.
e: The parties believe it will be unnecessary to trap at Winthrop. If collection under (A) and (B) above are insufficient, broodstock collection at Winthrop Nation Fish Hatchery will occur at a level sufficient to meet the overall production program. If it turns out the collected fish are not needed, they will be outplanted to Lost River and Early Winters Creek.

f: Efforts will be made to minimize the collection of excess gametes. Any production excess to that needed for the 1.15 million smolt program would be outplanted to Lost River and Early Winters Creek.

Uncollected adults will be allowed to spawn naturally. The Winthrop channel will be closed at the mouth of the channel. Some adult fish will be allowed to use the channel, as determined in-season.
The 300,000 Carson fish currently being held on-site at Winthrop National Fish Hatchery will be raised to smolts and made available for outplanting in the Okanogan Basin
Parties should be notified immediately before there is divergence from the above protocol.

LONGER-TEM METHOW RIVER ISSUES TO BE ADDRESSED

The following issues will need to be discussed further prior to next year's program.

Further discussion of the 1.15 million production goal needs to occur. In a low abundance year, would out-of –basin Carson stock be brought back into the basin?
What is the most appropriate stock for use in the Okanogan? There are several options currently being considered. If, for example, listed fish are to be used, NMFS would need to determine if the population could be designated as an experimental population. If hatchery fish were to be used, the issue would not arise.
When is it appropriate to outplant Methow Composite sock in the Chewuch given the levels of Carson influence in the existing Composite stock?
The Twisp production program needs to be discussed. How can the program meet the full production levels? How significant ate the impact of the weir on the natural spawning population?

Appendix 2. Leavenworth NFH spring Chinook releases into Icicle Creek, brood years 1984-2003*.

Brood Year	Release Year	Yearlings	Sub-Yearlings	Fry	TOTAL	# CWT Tagged	% Coded-wire Tagged	% Adipose Clipped	# PIT Tagged
1984	1985		52,798		52,798	52,798	100%	100.0%	
1984	1986	1,969,668			1,969,668		0%	0.0%	
1985	1986		477,974		477,974		0%	0.0%	
1985	1987	2,336,868			2,336,868	22,895	1%	1.0%	
1986	1987		523,531	842,000	1,365,531		0%	0.0%	
1986	1988	2,207,292			2,207,292	323,740	15%	14.7%	
1987	1988		333,896	605,530	939,426	236,200	25%	25.1%	
1987	1989	2,239,677			2,239,677	318,765	14%	14.2%	
1988	1988			1,044,000	1,044,000		0%	0.0%	
1988	1989		376,984		376,984	298,462	79%	79.2%	
1988	1990	2,304,237			2,304,237	183,989	8%	8.0%	2,040
1989	1989			1,793,336	1,793,336		0%	0.0%	
1989	1990		534,000		534,000	121,038	23%	22.7%	
1989	1991	2,258,034			2,258,034	188,062	8%	8.3%	
1990	1990-91			768,808	768,808		0%	0.0%	
1990	1992	2,286,828			2,286,828	292,237	13%	12.8%	
1991	1992		530,700		530,700		0%	0.0%	
1991	1993	1,757,931			1,757,931	276,521	16%	15.7%	1,192
1992	1994	1,522,846			1,522,846	235,412	15%	15.5%	1,177
1993	1995	1,712,648			1,712,648	254,138	15%	14.8%	1,198
1994	1996	1,706,060			1,706,060	287,288	17%	16.8%	1,196
1995	1997	919,025			919,025	299,190	33%	32.6%	1,198
1996	1998	1,701,753			1,701,753	301,044	18%	17.7%	7,468
1997	1999	1,636,402			1,636,402	187,841	11%	11.5%	7,404
1998	2000	1,680,904			1,680,904	193,411	12%	11.5%	7,387
1999	2001	1,630,089			1,630,089	242,732	15%	14.9%	7,592
2000	2002	1,554,362			1,554,362	444,493	29%	100%	317,278
2001	2003	1,288,893			1,288,893	771,756	60%	100%	240,558
2002	2004	1,422,100			1,422,100	822,002	58%	100%	216,698
2003	2005	1,476,046			1,476,046	782,602	53%	100%	14,825
2004	2005		486,185		486,185	204,017	42%	100%	

*2004 brood was not complete with the release of yearlings at the time of this report.

Appendix 3. Entiat NFH spring Chinook releases into the Entiat River, brood years 1988 - 2003.

Brood Year	Release Year	Yearlings	Sub-Yearlings	Fry	TOTAL	CWT # Tagged	% Coded -Wire Tagged	% Adipose Clipped	# PIT Tagged
1989	1989			116,145	116,145		0%	0%	
1988	1990	585,800			585,800	91,822	16%	16%	
1989	1990		34,426	43,951	78,377		0%	0%	
1989	1991	818,707			818,707	111,207	14%	14%	
1990	1991		377,946		377,946		0%		
1990	1992	343,150			343,150	95,682	28%	28%	
1991	1992		361,590		361,590	194,451	54%	54%	
1991	1993	376,462			376,462	115,117	31%	31%	1,189
1992	1993		332,178		332,178	130,345	39%	39%	
1992	1994	378,729			378,729	115,838	31%	31%	1,178
1993	1994		399,429		399,429	195,487	49%	49%	
1993	1995	391,211			391,211	103,052	26%	26%	1,194
1994	1995		186,817		186,817	186,817	100%	100%	
1994	1996	335,593			335,593	100,448	30%	30%	1,200
1995	1997	200,486			200,486	197,071	98%	98%	1,199
1996	1998	350,784			350,784	124,536	36%	36%	
1997	1998		154,053		154,053	154,053	100%	100%	
1997	1999	354,238			354,238	118,058	33%	33%	
1998	2000	359,667			359,667	109,394	30%	30%	
1999	2000		421,126		421,126	99,963	24%	24%	
1999	2001	397,855			397,855	394,411	99%	99%	
2000	2002	533,720			533,720	159,363	30%	100%	59,401
2001	2003	395,689			395,689	199,248	50%	100%	59,879
2002	2004	386,833			386,833	193,630	50%	100%	58,625
2003	2005	401,240			401,240	199,127	50%	100%	3,732

Appendix 4. Winthrop NFH spring Chinook releases into the Methow River, brood years 1989-2003.

Brood Year	Release Year	Yearlings	Sub-Yearlings (SY)	Fry	TOTAL	CWT # Tagged	% Adipose Clipped	# PIT Tagged
1989	1990		203,471		203,471			
1989	1991	1,055,056			1,055,056	107,670	10%	
1990	1991		417,864	164,900	582,764			
1990	1992	624,771			624,771	90,620	15%	
1991	1993	950,624			950,624	189,187	20%	1,489
1992	1994	556,313			556,313	140,873	25%	1,398
1993	1995	770,847			770,847	164,456	21%	1,496
1994	1996	112,395			112,395	110,878	99%	1,493
1995	1997	14,620			14,620	14,620	100%	
1996	1998	324,851			324,851	324,851	100%	9,542
1997	1999	545,062			545,062	513,724	94%	7,490
1998	2000	377,696			377,696	364,632	97%	7,490
1999	2001	175,869			175,869	171,496	98%	7,422
2000	2002	201,604			201,604	201,604	0%	27,459
2001	2002		64,683		64,683	59,474	0%	
2001	2003	461,678			461,678	439,785	57%	19,962
2002	2004	578,307			578,307	513,687	7%	19,887
2003	2005	550,214			550,214	527,836	18%	3,600

Appendix 5. Leavenworth NFH adult spring Chinook deposition by fishery and location using currently available data for return years 1999-2005.

Type of recovery and specific location		Estimated # of Adults/Run Year							Estimated % of Adults/Run Year						
Fishery	SITE NAME	1999	2000	2001	2002	2003	2004	2005	1999	2000	2001	2002	2003	2004	2005
Ocean Troll	AK M 1 NW 113-41		26						0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
(non-treaty)	AK M 1 SW 104-40						5		0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
	MARINE AREA 4				20				0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
	NTR 02W-000				101				0.0%	0.0%	0.0%	0.6%	0.0%	0.0%	0.0%
Ocean Troll Total		**0**	**26**	**0**	**121**	**0**	**5**	**0**	**0.0%**	**0.3%**	**0.0%**	**0.8%**	**0.0%**	**0.1%**	**0.0%**
Columbia River	MCNARY-PRIEST RAP		1						0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Gillnet	BLIND SL (LWR COL R)				18				0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
	BONNEVILLE POOL NET			203	707	217	30		0.0%	0.0%	1.1%	4.5%	2.2%	0.5%	0.0%
	COL R TONGUE POINT			21					0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
	COL R ZONE 1 NET		1	9	273	106	279		0.0%	0.0%	0.0%	1.7%	1.1%	4.7%	0.0%
	COL R ZONE 2 NET		16	146	519	231	1,057		0.0%	0.2%	0.8%	3.3%	2.4%	17.9%	0.0%
	COL R ZONE 3 NET		7	74	247	52	46		0.0%	0.1%	0.4%	1.6%	0.5%	0.8%	0.0%
	JOHN DAY POOL NET			466	234	117	13		0.0%	0.0%	2.4%	1.5%	1.2%	0.2%	0.0%
	THE DALLES POOL NET			133	248	27	8		0.0%	0.0%	0.7%	1.6%	0.3%	0.1%	0.0%
	YOUNGS BAY				18	84			0.0%	0.0%	0.0%	0.1%	0.9%	0.0%	0.0%
Columbia River Gill Net Total		**0**	**25**	**1,052**	**2,263**	**834**	**1,434**	**0**	**0.0%**	**0.3%**	**5.5%**	**14.4%**	**8.5%**	**24.3%**	**0.0%**
Columbia River	COL R OR SPORT SEC 1			1,037	103	51	97		0.0%	0.0%	5.4%	0.7%	0.5%	1.6%	0.0%
Sport	COL R OR SPORT SEC 2			169	61	214	17		0.0%	0.0%	0.9%	0.4%	2.2%	0.3%	0.0%
	COL R OR SPORT SEC 4			151		38	50		0.0%	0.0%	0.8%	0.0%	0.4%	0.8%	0.0%
	COL R OR SPORT SEC 5				61				0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%
	COL R OR SPORT SEC 7						17		0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%
	COL R OR SPORT SEC 8			150					0.0%	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%
	COL R OR SPORT SEC 9			75		101	47		0.0%	0.0%	0.4%	0.0%	1.0%	0.8%	0.0%
	COL R OR SPT SEC 10			88	94		180		0.0%	0.0%	0.5%	0.6%	0.0%	3.0%	0.0%
	COL R WA SEC 10				45		91		0.0%	0.0%	0.0%	0.3%	0.0%	1.5%	0.0%
	COL R WA SEC 4				50	82	52		0.0%	0.0%	0.0%	0.3%	0.8%	0.9%	0.0%
	COL R WA SEC 6			78		39	47		0.0%	0.0%	0.4%	0.0%	0.4%	0.8%	0.0%
	COL R WA SEC 7						50		0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	0.0%
	COL R WA SPORT SEC 2			88					0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%
	COL R WA SPORT SEC 5						14		0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	0.0%
	COL R WA SPORT SEC 8				114		20		0.0%	0.0%	0.0%	0.7%	0.0%	0.3%	0.0%
	COL R WN SPORT SEC 1			530	164	101	23		0.0%	0.0%	2.8%	1.0%	1.0%	0.4%	0.0%
Columbia River Sport Total		**0**	**0**	**2,367**	**693**	**626**	**705**	**0**	**0.0%**	**0.0%**	**12.3%**	**4.4%**	**6.4%**	**12.0%**	**0.0%**
Freshwater	ICICLE CR 45.0474	108	1,606	2,260	1,201	935	347	103	5.1%	16.4%	11.8%	7.6%	9.5%	5.9%	2.7%
Sport	JOHN DAY POOL UPR				8	9	5		0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%
	MCNARY -CHIEF JOSEPH				24				0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%
	THE DALLES POOL UPR					10	8		0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%
	UMPQUA R SPORT		9						0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	WILLAMETTE R LWR BTS			69					0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%
	WIND R 29.0023		23						0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Freshwater Sport Total		**108**	**1,638**	**2,329**	**1,233**	**954**	**360**	**103**	**5.1%**	**16.7%**	**12.1%**	**7.9%**	**9.7%**	**6.1%**	**2.7%**
Hatchery	COWLITZ SALMON HATCH					1			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	DRYD DAM+TUM FCF+CHI					14			0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
	ENTIAT NFH	11			9	6		4	0.5%	0.0%	0.0%	0.1%	0.1%	0.0%	0.1%
	LEAVENWORTH HATCHERY	1,745	4,457	6,259	6,459	4,825	2,308	2,560	82.2%	45.5%	32.6%	41.1%	49.0%	39.1%	67.4%
	LTL WHITE SALMON NFH		1						0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	ROUND BUTTE TRAP						8		0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%
	WELLS W LADDE+METHOW		29						0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
	WELLS W LADDER TRAP	2							0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	WINTHROP NFH		9						0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Hatchery Total		**1,758**	**4,496**	**6,259**	**6,468**	**4,847**	**2,316**	**2,564**	**82.8%**	**45.9%**	**32.6%**	**41.2%**	**49.2%**	**39.3%**	**67.5%**
Spawning	CHIWAWA +CHICKAMIN			55					0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%
Ground[1]	CHIWAWA R 45.0759					64			0.0%	0.0%	0.0%	0.0%	0.6%	0.0%	0.0%
	DRYDEN DAM FCF			8					0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	ICICLE CR 45.0474	45	163	1,488	828	549	214	67	2.1%	1.7%	7.7%	5.3%	5.6%	3.6%	1.8%
	INGALLS CR 45.0232								0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	LTL WENATCHEE 450985			38	23				0.0%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%
	NASON CR 45.0888		3	177	88	20			0.0%	0.0%	0.9%	0.6%	0.2%	0.0%	0.0%
	PESHASTIN CR 45.0232								0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	WENATCHEE R 45.0030			234	175	79			0.0%	0.0%	1.2%	1.1%	0.8%	0.0%	0.0%
	WHITE+NAPEEQUA+PANTH			16					0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
Spawning Ground Total		**45**	**166**	**2,016**	**1,114**	**712**	**214**	**67**	**2.1%**	**1.7%**	**10.5%**	**7.1%**	**7.2%**	**3.6%**	**1.8%**
Treaty	BONNEVILLE POOL CERE		109			18			0.0%	1.1%	0.0%	0.0%	0.2%	0.0%	0.0%
Ceremonial	BVILLE POOL UM TRIBE	36	89	96	18				1.7%	0.9%	0.5%	0.1%	0.0%	0.0%	0.0%
	BVILLE POOL WS TRIBE			17					0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
	DALLES POOL		10						0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	ICICLE CR 45.0474	175	3,238	5,075	3,793	1,852	863	1,063	8.2%	33.0%	26.4%	24.2%	18.8%	14.6%	28.0%
Treaty Ceremonial Total		**211**	**3,446**	**5,188**	**3,811**	**1,870**	**863**	**1,063**	**9.9%**	**35.2%**	**27.0%**	**24.3%**	**19.0%**	**14.6%**	**28.0%**
Ocean Trawl	NEWPORT TRAWL BYCATCH			9					0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ocean Trawl Total		**0**	**0**	**9**	**0**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Grand Total		**2,122**	**9,798**	**19,220**	**15,703**	**9,843**	**5,898**	**3,797**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
ABOVE ROCK ISLAND TOTAL		**2,086**	**9,506**	**15,610**	**12,576**	**8,344**	**3,732**	**3,797**	**98.3%**	**97.0%**	**81.2%**	**80.1%**	**84.8%**	**63.3%**	**100%**

[1] in 2001 487 and in 2002-2004, 350 SCS outplanted to Peshastin and Ingalls Creeks, These fish included in LNFH total. CWT data acquired from RMIS.
Population census by tag group created by dividing estimated_number by the % tagged in each CWT group. Total returns of LNFH origin fish are indicated.
Estimates by both CWT expansion and actual LNFH hatchery rack return, Icicle Creel census and Icicle tribal harvest estimates have been substituted in place of sole CWT expanded data based on assumed improved validity.

Appendix 6. Entiat NFH adult spring Chinook deposition by fishery and location using currently available information for return years 1999-2005.

Type of recovery and specific location		RETURN YEAR #'s							RETURN YEAR %'s						
FISHERY	**SITE NAME**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
OCEAN TROLL	AK M 1 NW 113-31				13				0.0%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%
(NON-TREATY)	NEWPORT TROLL 4			3					0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
	SWTR 023-059		3						0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
OCEAN TROLL (NON-TREATY)		**0**	**3**	**3**	**13**	**0**	**0**	**0**	**0.0%**	**0.2%**	**0.1%**	**0.5%**	**0.0%**	**0.0%**	**0.0%**
COLUMBIA	1I MCNARY-PRIEST RAP		3						0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
RIVER	1J PRIEST RA-WANAPUM		3						0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
GILL NET	BONNEVILLE POOL NET			64	41	13	8		0.0%	0.0%	2.0%	1.7%	1.3%	0.9%	0.0%
	COL R ZONE 1 NET			6	45	23	11		0.0%	0.0%	0.2%	1.8%	2.2%	1.2%	0.0%
	COL R ZONE 2 NET			10	101	8	38		0.0%	0.0%	0.3%	4.2%	0.8%	4.3%	0.0%
	COL R ZONE 3 NET				25	12	3		0.0%	0.0%	0.0%	1.0%	1.1%	0.3%	0.0%
	COL R ZONE 5 NET			3					0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
	JOHN DAY POOL NET			30	21		11		0.0%	0.0%	1.0%	0.9%	0.0%	1.3%	0.0%
	THE DALLES POOL NET				99		3		0.0%	0.0%	0.0%	4.1%	0.0%	0.3%	0.0%
	YOUNGS BAY					3			0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%
COLUMBIA RIVER GILL NET		**0**	**7**	**113**	**332**	**60**	**74**	**0**	**0.0%**	**0.3%**	**3.6%**	**13.7%**	**5.6%**	**8.4%**	**0.0%**
FRESHWATER NET	VERNITA BAR (36)				2				0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
FRESHWATER NET TOTAL		**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0.0%**	**0.1%**	**0.0%**	**0.0%**	**0.0%**
COMMERCIAL SEINE	AK M 1 SW 104-40	4							0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
COMMERCIAL SEINE TOTAL		**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0.5%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
COLUMBIA	COL R OR SPORT SEC 1			50					0.0%	0.0%	1.6%	0.0%	0.0%	0.0%	0.0%
RIVER	COL R OR SPORT SEC 2			48					0.0%	0.0%	1.5%	0.0%	0.0%	0.0%	0.0%
SPORT	COL R OR SPORT SEC 5					12			0.0%	0.0%	0.0%	0.0%	1.1%	0.0%	0.0%
	COL R OR SPORT SEC 7					5			0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%
	COL R OR SPORT SEC 8			27		10			0.0%	0.0%	0.9%	0.0%	1.0%	0.0%	0.0%
	COL R OR SPT SEC 10						17		0.0%	0.0%	0.0%	0.0%	0.0%	1.9%	0.0%
	COL R WA SEC 10			34	25				0.0%	0.0%	1.1%	1.0%	0.0%	0.0%	0.0%
	COL R WA SEC 4		1	27	14	21	9		0.0%	0.0%	0.9%	0.6%	2.0%	1.0%	0.0%
	COL R WA SEC 6			14	48				0.0%	0.0%	0.4%	2.0%	0.0%	0.0%	0.0%
	COL R WA SPORT SEC 5					5			0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%
	COL R WA SPORT SEC 8						17		0.0%	0.0%	0.0%	0.0%	0.0%	1.9%	0.0%
	COL R WN SPORT SEC 1			34	95				0.0%	0.0%	1.1%	3.9%	0.0%	0.0%	0.0%
COLUMBIA RIVER SPORT TOTAL		**0**	**1**	**232**	**182**	**53**	**43**	**0**	**0.0%**	**0.0%**	**7.4%**	**7.5%**	**5.0%**	**4.9%**	**0.0%**
ESTUARY SPORT	SLIP POINT	1							0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
ESTUARY SPORT TOTAL		**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0.1%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
FRESHWATER	JOHN DAY POOL UPR					1			0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
SPORT	MCNARY -CHIEF JOSEPH		8						0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%
FRESHWATER SPORT TOTAL		**0**	**8**	**0**	**0**	**1**	**0**	**0**	**0.0%**	**0.4%**	**0.0%**	**0.0%**	**0.1%**	**0.0%**	**0.0%**
HATCHERY	COWLITZ SALMON HATCH	7							0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	ENTIAT NFH	724	1,919	2,666	1,834	884	759	763	91.4%	89.2%	85.2%	75.4%	83.4%	85.9%	86.3%
	LEAVENWORTH HATCHERY	1				4			0.1%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%
	METHOW HATCHERY					1			0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
	WELLS W LADDE+METHOW		49						0.0%	2.3%	0.0%	0.0%	0.0%	0.0%	0.0%
	WELLS W LADDER TRAP	43							5.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	WINTHROP NFH		15						0.0%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%
HATCHERY TOTAL		**775**	**1,983**	**2,666**	**1,834**	**889**	**759**	**763**	**97.8%**	**92.1%**	**85.2%**	**75.4%**	**83.9%**	**85.9%**	**86.3%**
SPAWNING	CHEWUCH R 48.0728		9						0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%
GROUND	ENTIAT R 46.0042		77	105	67	56	148	121	0.0%	3.6%	3.4%	2.8%	5.3%	16.7%	13.7%
	NASON CR 45.0888		10						0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%
SPAWNING GROUND TOTAL		**0**	**96**	**105**	**67**	**56**	**148**	**121**	**0.0%**	**4.5%**	**3.4%**	**2.8%**	**5.3%**	**16.7%**	**13.7%**
TREATY	BONNEVILLE POOL CERE		26						0.0%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%
CEREMONIAL	BVILLE POOL UM TRIBE	12	29	11					1.6%	1.4%	0.3%	0.0%	0.0%	0.0%	0.0%
TREATY CEREMONIAL TOTAL		**12**	**55**	**11**	**0**	**0**	**0**	**0**	**1.6%**	**2.6%**	**0.3%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Grand Total		**792**	**2,152**	**3,130**	**2,431**	**1,059**	**1,024**	**884**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
ABOVE ROCK ISLAND Total		**768**	**2,079**	**2,771**	**1,901**	**945**	**907**	**884**	**97.0%**	**96.6%**	**88.5%**	**78.2%**	**89.2%**	**88.6%**	**100%**

CWT data acquired from RMIS. Population census by tag group created by dividing estimated_number by the % tagged in each CWT group.
Total returns of ENFH origin fish are indicated. Estimates by both CWT expansion, actual ENFH hatchery rack return, & Entiat River spawning ground estimates have been combined in place of sole CWT expanded data based on assumed improved validity.

Appendix 7. Winthrop NFH adult spring Chinook deposition by fishery and location using currently available data for 1999-2005.

Type of recovery and specific location		RETURN YEAR #'s							RETURN YEAR %'s						
FISHERY	**SITE NAME**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
OCEAN	AK M 1 NW 113-45		3						0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
TROLL	COOS BAY TROLL 5			1					0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
(NON-	GARIBALDI TROLL 3			2					0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
TREATY)	MARINE AREA 2					6			0.0%	0.0%	0.0%	0.0%	1.0%	0.0%	0.0%
	SWTR 023-056					5			0.0%	0.0%	0.0%	0.0%	0.9%	0.0%	0.0%
OCEAN TROLL (NON-TREATY)		**0**	**3**	**3**	**0**	**11**	**0**	**0**	**0.0%**	**0.3%**	**0.1%**	**0.0%**	**1.8%**	**0.0%**	**0.0%**
COLUMBIA	1I MCNARY-PRIEST RAP		3						0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
RIVER	1J PRIEST RA-WANAPUM		2						0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
GILL NET	BLIND SL (LWR COL R)			4					0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
	BONNEVILLE POOL NET			70	78	12	9		0.0%	0.0%	1.5%	2.8%	2.0%	1.5%	0.0%
	COL R TONGUE POINT				2				0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
	COL R ZONE 1 NET			4	38	4			0.0%	0.0%	0.1%	1.3%	0.7%	0.0%	0.0%
	COL R ZONE 2 NET			9	97	21			0.0%	0.0%	0.2%	3.5%	3.4%	0.0%	0.0%
	COL R ZONE 3 NET			2	14	2			0.0%	0.0%	0.0%	0.5%	0.3%	0.0%	0.0%
	COL R ZONE 5 NET			3					0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%
	JOHN DAY POOL NET			136	30	3	2		0.0%	0.0%	3.0%	1.1%	0.5%	0.3%	0.0%
	THE DALLES POOL NET			34	66	6			0.0%	0.0%	0.7%	2.4%	1.0%	0.0%	0.0%
	YOUNGS BAY			3	2	3	3		0.0%	0.0%	0.1%	0.1%	0.5%	0.5%	0.0%
COLUMBIA RIVER GILL NET		**0**	**5**	**267**	**327**	**52**	**14**	**0**	**0.0%**	**0.5%**	**5.8%**	**11.7%**	**8.4%**	**2.3%**	**0.0%**
FRESHWATER	PRIEST RAPIDS -E LAD				1				0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
NET	VERNITA BAR (36)				3				0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
FRESHWATER NET TOTAL		**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0.0%**	**0.1%**	**0.0%**	**0.0%**	**0.0%**
COLUMBIA	COL R OR SPORT SEC 1			83	12	5			0.0%	0.0%	1.8%	0.4%	0.8%	0.0%	0.0%
RIVER	COL R OR SPORT SEC 2			64	19	10			0.0%	0.0%	1.4%	0.7%	1.7%	0.0%	0.0%
SPORT	COL R OR SPORT SEC 3						6		0.0%	0.0%	0.0%	0.0%	0.0%	1.0%	0.0%
	COL R OR SPORT SEC 4				30				0.0%	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%
	COL R OR SPORT SEC 5			19	6	10			0.0%	0.0%	0.4%	0.2%	1.7%	0.0%	0.0%
	COL R OR SPORT SEC 7				7				0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%
	COL R OR SPORT SEC 8			9	11				0.0%	0.0%	0.2%	0.4%	0.0%	0.0%	0.0%
	COL R OR SPORT SEC 9				6				0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%
	COL R OR SPT SEC 10			28			6		0.0%	0.0%	0.6%	0.0%	0.0%	1.0%	0.0%
	COL R WA SEC 10			37	23				0.0%	0.0%	0.8%	0.8%	0.0%	0.0%	0.0%
	COL R WA SEC 4			19	13	5			0.0%	0.0%	0.4%	0.4%	0.8%	0.0%	0.0%
	COL R WA SEC 6			17	12	5			0.0%	0.0%	0.4%	0.4%	0.8%	0.0%	0.0%
	COL R WA SEC 7			10	6				0.0%	0.0%	0.2%	0.2%	0.0%	0.0%	0.0%
	COL R WA SPORT SEC 2			10	6				0.0%	0.0%	0.2%	0.2%	0.0%	0.0%	0.0%
	COL R WA SPORT SEC 5				11				0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%
	COL R WA SPORT SEC 8			19	19				0.0%	0.0%	0.4%	0.7%	0.0%	0.0%	0.0%
	COL R WN SPORT SEC 1			96	25	5			0.0%	0.0%	2.1%	0.9%	0.8%	0.0%	0.0%
COLUMBIA RIVER SPORT TOTAL		**0**	**0**	**411**	**207**	**42**	**12**	**0**	**0.0%**	**0.0%**	**9.0%**	**7.4%**	**6.7%**	**2.0%**	**0.0%**
FRESHWATER	BONNEVILLE POOL UPR				1				0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
SPORT	COLUMBIA NEAR WELLS			2	1				0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	LEWIS R 27.0168	2							1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	MCNARY -CHIEF JOSEPH			4	6				0.0%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%
	THE DALLES POOL UPR				1	1			0.0%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%
FRESHWATER SPORT TOTAL		**2**	**0**	**6**	**9**	**1**	**0**	**0**	**1.1%**	**0.0%**	**0.1%**	**0.3%**	**0.2%**	**0.0%**	**0.0%**
HATCHERY	COWLITZ SALMON HATCH		2						0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
	DRYDEN DAM FCF	1							0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	ENTIAT NFH	1							0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	LTL WHITE SALMON NFH	2	1						1.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	METHOW HATCHERY			377	293	57	103	4	0.0%	0.0%	8.2%	10.5%	9.2%	17.1%	0.9%
	WARM SPRINGS NFH		1						0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
	WELLS HATCHERY	3							1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	WELLS W LADDE+METHOW		155						0.0%	13.6%	0.0%	0.0%	0.0%	0.0%	0.0%
	WELLS W LADDER TRAP	173							92.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	WINTHROP NFH		792	176	185	279	317	337	0.0%	69.8%	3.9%	6.6%	45.2%	52.6%	72.6%
HATCHERY TOTAL		**180**	**951**	**553**	**478**	**336**	**420**	**341**	**96.7%**	**83.8%**	**12.1%**	**17.1%**	**54.4%**	**69.7%**	**73.5%**
SPAWNING	CHEWUCH R 48.0728		4	268	153	11	10	14	0.0%	0.4%	5.9%	5.5%	1.8%	1.7%	3.0%
GROUND	METHOW R 48.0002	4	130	2,999	1,543	151	122	109	2.2%	11.4%	65.5%	55.1%	24.4%	20.3%	23.5%
	WINTHROP NFH OUTFALL			37	26	8	20		0.0%	0.0%	0.8%	0.9%	1.3%	3.3%	0.0%
	TWISP R 48.0374		5	6	34		4	0	0.0%	0.5%	0.1%	1.2%	0.0%	0.7%	0.0%
	SIMILKAMEEN R 490325				10				0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%
	ENTIAT R 46.0042		12	15		6			0.0%	1.1%	0.3%	0.0%	1.0%	0.0%	0.0%
	WHITE R 45.1116				3				0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
SPAWNING GROUND TOTAL		**4**	**151**	**3,325**	**1,769**	**176**	**156**	**123**	**2.2%**	**13.3%**	**72.6%**	**63.2%**	**28.6%**	**25.9%**	**26.5%**
TREATY	BONNEVILLE POOL CERE		6						0.0%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%
CEREMONIAL	BVILLE POOL UM TRIBE		17	9	4				0.0%	1.5%	0.2%	0.1%	0.0%	0.0%	0.0%
	BVILLE POOL WS TRIBE			2					0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	DALLES POOL		1						0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
TREATY CEREMONIAL TOTAL		**0**	**24**	**12**	**4**	**0**	**0**	**0**	**0.0%**	**2.1%**	**0.3%**	**0.1%**	**0.0%**	**0.0%**	**0.0%**
TEST FISHERY NET	COL R (WOODY IS TEST)				1				0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
TEST FISHERY NET TOTAL		**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
Grand Total		**186**	**1,134**	**4,578**	**2,800**	**618**	**602**	**464**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
ABOVE ROCK ISLAND Total		**182**	**1,098**	**3,881**	**2,248**	**512**	**576**	**464**	**97.7%**	**96.8%**	**84.8%**	**80.3%**	**82.9%**	**95.6%**	**100%**

CWT data acquired from RMIS. Population census by tag group created by dividing estimated_number by the % tagged in each CWT group.
Total returns of WNFH origin fish are indicated. Estimates by both CWT expansion and actual WNFH/MSFH hatchery rack return,
have been combined in place of sole CWT expanded data based on assumed improved validity.

Appendix 8. Leavenworth NFH spring Chinook adult return and survival both within and outside the Wenatchee River Basin, brood years 1979-1999.

Brood Year	Adults Spawned	Yearlings Released	Wenatchee Basin Return	% to Basin	Wenatchee Basin Return/Spawner	Out of Basin Recoveries	Total Return	% Total Return	Total Return/Spawner
1979	*1323*	2,380,787	3,343	0.140%	*2.5*	NA	NA	NA	NA
1980	*1043*	1,878,286	5,408	0.288%	*5.2*	NA	NA	NA	NA
1981	*1287*	2,316,488	8,638	0.373%	*6.7*	NA	NA	NA	NA
1982	*1287*	2,316,480	10,850	0.468%	*8.4*	NA	NA	NA	NA
1983	*1217*	2,190,000	6,734	0.307%	*5.5*	6	6,740	0.308%	*5.5*
1984	*1094*	1,969,668	3,877	0.197%	*3.5*	NA	NA	NA	NA
1985	*1298*	2,336,868	5,879	0.252%	*4.5*	NA	NA	NA	NA
1986	*1226*	2,207,294	3,787	0.172%	*3.1*	204	3,991	0.181%	*3.3*
1987	*1244*	2,239,677	6,231	0.278%	*5.0*	1,183	7,414	0.331%	*6.0*
1988	*1280*	2,304,237	14,870	0.645%	*11.6*	2,427	17,297	0.751%	*13.5*
1989	*1254*	2,258,034	7,403	0.328%	*5.9*	789	8,192	0.363%	*6.5*
1990	2,020	2,286,828	201	0.009%	0.1	35	236	0.010%	0.1
1991	1,527	1,757,931	464	0.026%	0.3	14	478	0.027%	0.3
1992	986	1,522,846	1,574	0.103%	1.6	72	1,646	0.108%	1.7
1993	1,020	1,712,648	5,426	0.317%	5.3	174	5,600	0.327%	5.5
1994	932	1,706,060	1,311	0.077%	1.4	46	1,357	0.080%	1.5
1995	408	919,025	1,427	0.155%	3.5	53	1,480	0.161%	3.6
1996	1,010	1,701,753	10,461	0.615%	10.4	608	11,069	0.650%	11.0
1997	959	1,636,402	16,002	0.978%	16.7	3,654	19,656	1.201%	20.5
1998	904	1,680,904	17,978	1.070%	19.9	4,026	22,004	1.309%	24.3
1999	892	1,630,089	2,122	0.130%	2.4	612	2,734	0.168%	3.1

Italicized values are dervied using spawner estimates based on a back calculation from the number of yearlings released using 90% survival to yearling from green egg, a fecundity of 4,000 and a spawn ratio of 1:1. NA - Not Available, spring Chinook were not tagged these years. Therefore, total contribution was probably higher than stated. Fry and/or fingerlings were also released in years (broood year) 1983 to 1991. They probably contributed little, if any, therefore are not included in the return rate. Wenatchee Basin recoveries include hatchery, sport/tribal harvests, as well as, spawning ground recoveries. Non-CWT data is apportioned by hatchery brood age composition. Out of Basin recoveries are derived annually through CWT data in the the regional mark information system (RMIS) database. # of adults are estimated by expanding expected CWT recoveries by the % marked for each tag code group.

Appendix 9. Entiat NFH spring Chinook adult return and survival both within and outside the Entiat River Basin, brood years 1979-1999.

Brood Year	Adults Spawned	Yearlings Released	Entiat Basin Return	% to Basin	Entiat Basin Return/Spawner	Out of Basin Recoveries	Total Return	% Total Return	Total Return/Spawner
1979	*346*	623,373	436	0.070%	1.3	NA	NA	NA	NA
1980	*554*	997,841	758	0.076%	1.4	NA	NA	NA	NA
1981	*531*	955,970	1,160	0.121%	2.2	NA	NA	NA	NA
1982	*359*	645,458	831	0.129%	2.3	NA	NA	NA	NA
1983	*497*	894,631	1,155	0.129%	2.3	NA	NA	NA	NA
1984	*464*	835,090	216	0.026%	0.5	NA	NA	NA	NA
1985	*514*	925,000	929	0.100%	1.8	NA	NA	NA	NA
1986	*466*	838,940	449	0.054%	1.0	NA	NA	NA	NA
1987	*440*	791,263	490	0.062%	1.1	NA	NA	NA	NA
1988	*325*	585,800	678	0.116%	2.1	64	742	0.127%	2.3
1989	*455*	818,707	442	0.054%	1.0	8	450	0.055%	1.0
1990	*191*	343,150	30	0.009%	0.2	0	30	0.009%	0.2
1991	*209*	376,462	118	0.031%	0.6	9	127	0.034%	0.6
1992	*210*	378,729	145	0.038%	0.7	37	182	0.048%	0.9
1993	*217*	391,211	212	0.054%	1.0	32	244	0.062%	1.1
1994	*186*	335,593	212	0.063%	1.1	28	240	0.072%	1.3
1995	116	200,486	688	0.343%	5.9	47	735	0.367%	6.3
1996	171	350,784	1,976	0.563%	11.6	160	2,136	0.609%	12.5
1997	*197*	354,238	2,775	0.783%	14.1	374	3,149	0.889%	16.0
1998	209	359,667	2,015	0.560%	9.6	499	2,514	0.699%	12.0
1999	*221*	397,855	803	0.202%	3.6	128	931	0.234%	4.2

Italicized values are dervied using spawner estimates based on a back calculation from the number of yearlings released using 90% survival to yearling from green egg, a fecundity of 4,000 and a spawn ratio of 1:1. NA - Not Available, spring Chinook were not tagged these years. Therefore, total contribution was probably higher than stated. Fry and/or subyearlings were also released in brood years 1982-1983, 1987 - 1994, 1997 and 1999. Most probably contributed little, if any, therefore are not included in the return rate. CWT tagged subyearlings did not contribute in most years, however, the 1997 brood year was influenced by a strong return of subyearlings and may have effected the stated return rates. Attempts have been made to separate the yearling from subyearling program during these years (note italicized adult spawned #'s). Entiat Basin recoveries include hatchery returns and spawing ground recoveries following the implementation of CWT's in brood year 1988. Non-CWT data is apportioned by hatchery brood age composition. Out of Basin recoveries are derived annually through CWT data in the the regional mark information system (RMIS) database. # of adults are estimated by expanding expected CWT recoveries by the % marked for each tag code group.

Appendix 10. Winthrop NFH spring Chinook adult return and survival both within and outside the Entiat River Basin, brood years 1979-1999.

Brood Year	Adults Spawned	Yearlings Released	Methow Basin Return	% to Basin	Methow Basin Return/Spawner	Out of Basin Recoveries	Total Return	% Total Return	Total Return/Spawner
1979	*537*	966,300	402	0.042%	0.7	NA	NA	NA	NA
1980	*396*	712,700	1,175	0.165%	3.0	NA	NA	NA	NA
1981	*530*	953,508	1,028	0.108%	1.9	NA	NA	NA	NA
1982	*547*	985,081	877	0.089%	1.6	NA	NA	NA	NA
1983	*649*	1,167,625	1,031	0.088%	1.6	NA	NA	NA	NA
1984	*590*	1,062,794	736	0.069%	1.2	NA	NA	NA	NA
1985	*594*	1,069,293	163	0.015%	0.3	NA	NA	NA	NA
1986	*606*	1,090,200	90	0.008%	0.1	NA	NA	NA	NA
1987	*481*	865,734	117	0.014%	0.2	NA	NA	NA	NA
1988	*623*	1,121,395	703	0.063%	1.1	NA	NA	NA	NA
1989	*586*	1,055,056	254	0.024%	0.4	34	288	0.027%	0.5
1990	*347*	624,771	3	0.000%	0.0	8	11	0.002%	0.0
1991	*528*	950,624	21	0.002%	0.0	0	21	0.002%	0.0
1992	*309*	556,313	186	0.033%	0.6	16	202	0.036%	0.7
1993	*428*	770,847	349	0.045%	0.8	21	370	0.048%	0.9
1994	*62*	112,395	79	0.070%	1.3	1	80	0.071%	1.3
1995*	8	14,620	53	0.363%	6.5	2	55	0.376%	6.8
1996	180	324,851	1,162	0.358%	6.4	61	1,223	0.376%	6.8
1997	*303*	545,062	3,892	0.714%	12.9	719	4,611	0.846%	15.2
1998	210	377,696	2,609	0.691%	12.4	634	3,243	0.859%	15.5
1999	*98*	175,869	84	0.048%	0.9	16	100	0.057%	1.0

Italicized values are dervied using spawner estimates based on a back calculation from the number of yearlings released using 90% survival to yearling from green egg, a fecundity of 4,000 and a spawn ratio of 1:1. NA - Not Available, spring Chinook were not tagged these years. Therefore, total contribution was probably higher than stated. Fry and/or subyearlings were also released in brood years 1983, 1988 - 1990, and 2001. Most probably contributed little, if any, therefore are not included in the return rate. *BY 95 release included an approximate 50% split of identically marked release groups from both Methow State Fish Hatchery and Winthrop NFH. Therefore, similar survival between the two facilities was assumed and tag recoveries were split to approximate brood year returns by facility. Non-CWT data is apportioned by hatchery brood age composition. Out of Basin recoveries are derived annually through CWT data in the regional mark information system (RMIS) database. # of adults are estimated by expanding expected CWT recoveries by the % marked for each tag code group.

Appendix 11. Leavenworth NFH spring Chinook Coded-Wire Tag Returns, brood years, 1994-2000.

Brood Year	CWT #	Release Date	# Released	# per pound	Marked Release	Pond	Group or Comment	% Marked	Best Estimates of Available Return Data Age 3	Age 4	Age 5	Total Return	% Return
00	054307	4/22/02	137,392	23.80	48,412	M	LWRWY	35.2%	6	100	15	121	0.2499%
00	054414	4/22/02	191,346	20.49	24,272	A02	AHP	12.7%	11	165	6	182	0.7498%
00	054415	4/22/02	184,658	20.49	22,200	A01	AHP	12.0%	7	203	12	222	1.0000%
00	054436	4/22/02	196,015	23.11	68,654	M	10x100UP	35.0%	3	78	3	84	0.1224%
00	054437	4/22/02	259,442	23.11	66,779	M	10x100UP	25.7%	1	95	12	108	0.1617%
00	054438	4/22/02	175,946	22.71	71,057	M	10x100LW	40.4%	5	90	18	113	0.1590%
00	054439	4/22/02	238,944	22.71	70,164	M	10x100LW	29.4%	2	97	3	102	0.1454%
00	054440	4/22/02	170,619	23.80	72,955	M	LWRWY	42.8%	5	93	6	104	0.1426%
99	054912	4/17/01	183,792	17.00	26,680	A01	A01	14.5%	7	6	32	45	0.1687%
99	054911	4/17/01	184,047	17.00	30,344	A02	A02	16.5%	3	21	2	26	0.0857%
99	054429	4/17/01	414,838	17.23	53,915	M	10X100LW	13.0%	1	39	7	47	0.0872%
99	054428	4/17/01	459,566	16.51	67,258	M	10X100UP	14.6%	1	17	10	28	0.0416%
99	054427	4/17/01	387,846	16.50	64,535	M	LWRWY	16.6%	1	35	35	71	0.1100%
98*	054259	4/18/00	486,550	17.80	48,115	M	10X100UP	9.9%	9	217	197	423	0.8791%
98	054258	4/18/00	435,036	18.70	49,058	M	10X100LW	11.3%	1	186	111	298	0.6074%
98	054257	4/18/00	375,324	19.53	49,648	M	LWRWY	13.2%	6	146	93	245	0.4935%
98	054246	4/18/00	192,299	17.00	22,861	A01	AHP1	11.9%	1	127	57	185	0.8092%
98	054245	4/18/00	191,695	17.00	23,729	A02	AHP2	12.4%		115	73	188	0.7923%
97	054255	4/19/99	431,094	17.00	47,698	M	10X100LW	11.1%	3	221	29	253	0.5304%
97	053928	4/19/99	431,147	16.24	44,059	M	10X100UP	10.2%	7	298	56	361	0.8194%
97	053853	4/19/99	191,956	17.90	22,236	A02	AHP2	11.6%	1	84	20	105	0.4722%
97	053852	4/19/99	199,247	17.20	23,844	A01	AHP1	12.0%	5	183	40	228	0.9562%
97	053734	4/19/99	382,958	18.32	49,176	M	LWRWY	12.8%	7	189	40	236	0.4799%
96	055015	4/20/98	19,951	16.58	19,392	R48	Density2	97.2%	2	44	13	59	0.3042%
96	055014	4/20/98	20,004	16.58	19,044	R45	Density2	95.2%	2	68	2	72	0.3781%
96	053925	4/20/98	379,506	17.58	28,805	M	production	7.6%	3	88	15	106	0.3680%
96	053924	4/20/98	170,239	15.18	29,706	M	production	17.4%	2	99	8	109	0.3669%
96	053919	4/20/98	553,169	16.83	28,523	M	production	5.2%	5	93	25	123	0.4312%
96	053918	4/20/98	29,733	16.08	28,837	R50	Denstiy3	97.0%	2	38	11	51	0.1769%
96	053917	4/20/98	29,364	16.08	28,845	R47	Density3	98.2%	2	39	8	49	0.1699%
96	053916	4/20/98	29,969	16.08	28,681	R44	Density3	95.7%	5	92	15	112	0.3905%
96	053850	4/20/98	20,025	16.58	19,635	R51	Density2	98.1%	3	59	10	72	0.3667%
96	053848	4/20/98	209,480	15.28	23,561	A02	Dry	11.2%	3	64	3	70	0.2971%
96	053847	4/20/98	210,297	17.18	24,192	A01	Moist	11.5%	5	70	6	81	0.3348%
96	053712	4/20/98	9,998	15.08	9,879	R52	Denstiy1	98.8%	1	41	5	47	0.4758%
96	052831	4/20/98	10,008	15.08	9,712	R49	Density1	97.0%	1	39	8	48	0.4942%
96	052623	4/20/98	10,010	15.08	9,753	R46	Denstiy1	97.4%	4	44	5	53	0.5434%
95	053922	4/17/97	29,480	23.32	28,963	R46	30k study	98.2%		14	3	17	0.0587%
95	053921	4/17/97	104,341	19.88	29,799	M	30k study	28.6%		29	1	30	0.1007%
95	053920	4/17/97	67,334	18.92	29,669	M	30k study	44.1%		19	1	20	0.0674%
95	053842	4/17/97	80,462	16.92	22,939	M	1st FL row	28.5%		56	1	57	0.2485%
95	053841	4/17/97	117,885	16.67	21,573	M	2nd FL row	18.3%		13	6	19	0.0881%
95	053810	4/17/97	163,458	14.94	24,890	A01	AP #1	15.2%		22	6	28	0.1125%
95	053809	4/17/97	161,147	14.94	24,815	A02	AP #2	15.4%		24	2	26	0.1048%
95	053653	4/17/97	9,841	18.42	9,765	R52	10k study	99.2%	1	10		11	0.1126%
95	053652	4/17/97	9,590	17.98	9,533	R51	10k study	99.4%		10		10	0.1049%
95	053651	4/17/97	9,798	17.92	9,760	R50	10k study	99.6%	1	27	4	32	0.3279%
95	053644	4/17/97	19,450	20.45	19,147	R49	20ksty/inx	98.4%		14		14	0.0731%
95	053643	4/17/97	19,398	18.92	19,286	R48	20ksty/inx	99.4%		19	2	21	0.1089%
95	053642	4/17/97	19,424	20.25	19,196	R47	20ksty/inx	98.8%		11		11	0.0573%
95	052852	4/17/97	107,417	16.42	29,855	M	3rd FL row	27.8%		54	4	58	0.1943%
94	053844	4/15/96	180,206	17.51	25,070	M	FL27-31	13.9%	1	15	5	21	0.0838%
94	053843	4/15/96	180,444	17.52	25,255	M	FL01-05	14.0%	1	12	5	18	0.0713%
94	053840	4/15/96	219,245	15.25	28,696	M	30k	13.1%		11	10	21	0.0732%
94	053839	4/15/96	213,348	15.05	29,881	M	30k	14.0%		8	5	13	0.0435%
94	053838	4/15/96	224,354	15.00	29,412	M	30k	13.1%		1	4	5	0.0170%
94	053650	4/15/96	10,087	14.80	10,006	R50	10k	99.2%		2	2	4	0.0400%
94	053649	4/15/96	9,590	15.70	9,494	R51	10k	99.0%		5	3	8	0.0843%
94	053648	4/15/96	9,881	15.20	9,861	R52	10k	99.8%		3	2	5	0.0507%
94	053641	4/15/96	20,208	16.48	20,006	R47	20k	99.0%		5	4	9	0.0450%
94	053640	4/15/96	20,067	17.08	19,906	R48	20k	99.2%		1	1	2	0.0100%
94	053639	4/15/96	19,462	15.90	19,228	R49	20k	98.8%		8	4	12	0.0624%
94	053512	4/15/96	176,436	17.52	20,100	M	FL16-20	11.4%		8	3	11	0.0547%
94	053511	4/15/96	212,054	16.40	20,135	A02	A02	9.5%		12	4	16	0.0795%
94	053510	4/15/96	210,678	16.40	20,238	A01	A01	9.6%		8	2	10	0.0494%

* one age-7 male, 106 cm recovered at LNFH in 2005, not included in total for CWT #054259

Appendix 12. Entiat NFH spring Chinook Coded-Wire Tag Returns, brood years, 1994-2000.

Brood Year	CWT #	Release Date	Number Released	# per pound	Marked Release	Pond	Group or Comment	% Marked	Best Estimates of Available Return Data			Total Return	% Return
									Age 3	Age 4	Age 5		
00	054434	4/8/02	102,525	15.79	67,466	M	2PAS-B	65.8%	8	33		41	0.0608%
00	054435	4/8/02	184,090	17.44	65,261	HP1HP2	4PAS-HPS	35.5%	1	13		14	0.0215%
00	054914	4/8/02	65,446	16.13	26,636	M	3PAS-C	40.7%	5	4		9	0.0338%
00	-	4/8/02	50,504	32.69		R27R26	Chilled	0.0%				0	NE
00	-	4/7/02	2,400	16.00		R23	3PAS-C	0.0%				0	NE
00	054913	4/7/02	131,155	22.29	33,962	R23PAP	PAP	25.9%		10		10	0.0294%
99	054951	4/3/01	101,285	12.56	100,317	M	2PASBKB	99.0%	1	117	30	148	0.1475%
99	054950	4/3/01	100,122	12.79	99,172	M	3PASBKC	99.1%	14	128		142	0.1432%
99	054528	4/3/01	196,448	12.89	194,922	HP1&2	4PASHP1	99.2%	2	104	7	113	0.0580%
99	054517	5/14/00	421,126	43.80	99,963	M	Zeros	23.7%	45	88		133	0.1330%
98	054839	4/4/00	123,962	11.96	27,179	HP1	4PASHP1	21.9%	9	114	10	133	0.4893%
98	053927	4/4/00	123,273	11.96	26,749	HP2	4PASHP2	21.7%	7	117	15	139	0.5196%
98	053926	4/4/00	43,192	11.95	26,791	M	3PASBKC	62.0%	12	120	27	159	0.5935%
98	053923	4/4/00	69,240	11.89	28,675	M	2PASBKB	41.4%	4	177	17	198	0.6905%
97	054354	5/28/98	80,744	41.25	74,736	M	Zeros	92.6%	2	1		3	0.0040%
97	054353	5/28/98	84,255	41.25	79,317	M	Zeros	94.1%		3		3	0.0038%
97	053913	4/7/99	45,184	11.19	29,654	M	3PASBKC	65.6%	12	189	7	208	0.7014%
97	053912	4/7/99	84,957	11.22	28,722	M	2PASBKB	33.8%	7	149	5	161	0.5605%
97	050531	4/7/99	224,097	11.35	59,391	M	4PASHP12	26.5%	19	451	46	516	0.8688%
96	blank	4/1/98	16,364	10.05	16,053	M	Highs	98.1%	6	69	2	77	0.4797%
96	053763	4/1/98	177,563	11.35	53,529	M	HPonds	30.1%	5	247	13	265	0.4951%
96	053708	4/1/98	76,901	10.25	19,155	M	C-Bank	24.9%	1	127	15	143	0.7465%
96	053707	4/1/98	39,972	10.15	18,006	M	B-Bank	45.0%	6	127	4	137	0.7609%
96	053706	4/1/98	39,984	10.15	17,793	M	B-Bank	44.5%	4	131	6	141	0.7924%
95	621955	4/1/97	61,510	9.64	60,546	M	B-bank	98.4%	2	224	4	230	0.3799%
95	621952	4/1/97	59,971	9.61	59,059	M	C-bank	98.5%	8	175	3	186	0.3149%
95	621649	4/1/97	53,834	9.79	52,258	HP1&2	Lows-HP1&2	97.1%	2	148	5	155	0.2966%
95	053805	4/1/97	7,585	9.14	7,393	R21	Highs	97.5%	1	19		20	0.2705%
95	053646	4/1/97	17,586	9.79	17,215	HP1	Mod/HP1	97.9%		51	2	53	0.3079%
94	053828	5/15/95	186,817	50.85	186,817	M	Zeros	100.0%	2	4		6	0.0032%
94	053814	4/1/96	161,060	13.50	25,223	HP1&2	BY'94	15.7%		8	4	12	0.0476%
94	053813	4/1/96	84,651	13.20	37,903	R12-19	BY'94	44.8%		21	1	22	0.0580%
94	053812	4/1/96	89,882	13.20	37,322	R21-29	BY'94	41.5%		24	9	33	0.0884%

Appendix 13. Winthrop NFH spring Chinook Coded-Wire Tag Returns, brood years, 1994-2000.

Brood Year	CWT #	Release Date	# Released	# per pound	Marked Release	Pond	Group or Comment	% Marked	Best Estimates of Available Return Data			Total Return	% Return
									Age 3	Age 4	Age 5		
00	054441	4/15/02	68,286	17.81	68,286	M	MetLowD	100.0%	27	123	5	155	0.2270%
00	054617	4/15/02	13,516	18.66	13,516	D01	MetLowD	100.0%	3	15		18	0.1332%
00	054618	4/15/02	13,515	17.32	13,515	D03	MetCovD	100.0%		12	2	14	0.1036%
00	054619	4/15/02	13,652	17.35	13,652	D06	MetCovD	100.0%	1	13	1	15	0.1099%
00	054620	4/15/02	13,441	16.71	13,441	D10	MetCovD	100.0%	3	17	1	21	0.1562%
00	054621	4/15/02	13,464	16.71	13,464	D13	MetCovD	100.0%	4	14		18	0.1337%
00	054622	4/15/02	13,561	16.88	13,561	D05	MetStruD	100.0%	1	9	1	11	0.0811%
00	054623	4/15/02	13,484	16.88	13,484	D07	MetStruD	100.0%	8	19		27	0.2002%
00	054624	4/15/02	13,476	18.71	13,476	D09	MetStruD	100.0%	9	19		28	0.2078%
00	054625	4/15/02	13,452	18.71	13,452	D11	MetStruD	100.0%	12	19		31	0.2304%
00	054626	4/15/02	11,757	17.06	11,757	D15	MetModD	100.0%	2	11	2	15	0.1276%
99	054656	4/17/01	21,041	15.27	20,878	M	LowDBank	99.2%	2	8		10	0.0479%
99	054542	4/17/01	7,990	15.26	7,784	M	LowDBank	97.4%		3		3	0.0385%
99	054541	4/17/01	9,947	13.93	9,908	M	LowEBank	99.6%		2	1	3	0.0303%
99	054540	4/17/01	9,992	14.59	9,913	M	HighEBnk	99.2%		4		4	0.0404%
99	054539	4/17/01	9,948	13.93	6,757	E06E05	LowEBank	67.9%		4		4	0.0592%
99	054538	4/17/01	9,982	14.59	9,884	D11	TestDBnk	99.0%		1		1	0.0101%
99	054537	4/17/01	9,989	12.36	9,950	D09	TestDBnk	99.6%		4	6	10	0.1005%
99	054408	4/17/01	67,050	13.18	66,550	D07	TestDBnk	99.3%		30	2	32	0.0481%
99	053711	4/17/01	9,986	14.23	9,966	D05	TestDBnk	99.8%	1	1		2	0.0201%
99	053658	4/17/01	9,943	12.33	9,924	M	MSFHEBnk	99.8%	1	1		2	0.0202%
99	053654	4/17/01	10,001	14.23	9,982	M	LowDBank	99.8%		2		2	0.0200%
98	054949	4/10/00	119,601	14.51	115,928	M	LowDBank	96.9%	5	262	164	431	0.3718%
98	054931	4/10/00	47,444	13.80	45,554	M	LowEBank	96.0%	2	99	82	183	0.4017%
98	054841	4/10/00	22,333	14.47	21,469	M	HighEBnk	96.1%	2	48	23	73	0.3400%
98	054840	4/10/00	15,176	11.95	14,364	E06E05	LowEBank	94.6%		51	8	59	0.4107%
98	054616	4/10/00	12,590	14.18	12,566	D11	TestDBnk	99.8%		18	16	34	0.2706%
98	054615	4/10/00	14,813	14.21	14,462	D09	TestDBnk	97.6%		33	12	45	0.3112%
98	054614	4/10/00	14,999	14.21	14,254	D07	TestDBnk	95.0%		22	16	38	0.2666%
98	054613	4/10/00	14,904	13.50	14,472	D05	TestDBnk	97.1%		10	8	18	0.1244%
98	054406	4/10/00	71,265	13.28	68,529	M	MSFHEBnk	96.2%	53	186	75	314	0.4582%
98	053632	4/10/00	44,571	14.00	43,034	M	LowDBank	96.6%		115	51	166	0.3857%
97	054948	4/15/99	97,250	12.81	94,073	M	LowEBank	96.7%	12	191	21	224	0.2381%
97	054907	4/15/99	38,059	13.03	36,088	M	MSFHEBnk	94.8%	9	105	13	127	0.3519%
97	054906	4/15/99	43,018	12.61	40,292	M	MSFHEBnk	93.7%	4	128	8	140	0.3475%
97	054526	4/15/99	236,020	13.12	217,327	M	LowDBank	92.1%	34	485	91	610	0.2807%
97	054359	4/15/99	70,740	13.71	68,592	M	ModMedC	97.0%	6	71	28	105	0.1531%
97	054358	4/15/99	59,975	13.75	57,352	M	ModCBank	95.6%	5	132	21	158	0.2755%
96	053048	4/14/98	10,440	13.80	10,194	E11	BY 96	97.6%	3	35	1	39	0.3826%
96	054612	4/14/98	12,383	15.75	12,116	E15	HIGH WOE	97.8%	2	38		40	0.3301%
96	054611	4/14/98	10,268	14.58	10,045	E12	MOD W/E	97.8%	3	23	1	27	0.2688%
96	054453	4/14/98	110,290	13.90	106,197	M	BY 96	96.3%	21	375	18	414	0.3898%
96	053856	4/14/98	110,506	13.65	102,644	M	BY 96	92.9%	22	319	2	343	0.3342%
96	053710	4/14/98	7,893	11.69	7,472	E13	MOD W/OE	94.7%	2	27	18	47	0.6290%
96	053709	4/14/98	9,415	14.20	8,993	E14	HIGH W/E	95.5%	6	16		22	0.2446%
96	053631	4/14/98	53,656	13.34	51,231	M	BY 96	95.5%	5	157	8	170	0.3318%
95	636043	4/9/97	1,971	12.60	1,952	E15	BY '95	99.0%		22	1	23	1.1783%
95	636042	4/9/97	1,625	12.70	1,622	M	BY '95	99.8%	2	10	1	13	0.8015%
95	636041	4/9/97	1,894	12.90	1,890	M	BY '95	99.8%		6		6	0.3175%
95	636040	4/9/97	2,112	12.60	2,091	M	BY '95	99.0%	1	25		26	1.2434%
95	636039	4/9/97	2,037	13.00	2,033	E15	BY '95	99.8%	2	21	2	25	1.2297%
95	636038	4/9/97	2,363	12.67	2,358	M	BY '95	99.8%	1	16		17	0.7209%
95	636037	4/9/97	2,618	13.12	2,613	M	BY '95	99.8%	4	7		11	0.4210%
94	053846	4/11/96	2,056	11.68	2,044	D12	BY '94	99.4%				0	0.0000%
94	053845	4/11/96	2,006	11.68	2,006	D11	BY '94	100.0%		2	1	3	0.1496%
94	053811	4/11/96	100,263	13.07	98,758	M	BY '94	98.5%		42	7	49	0.0496%
94	051725	4/11/96	2,001	11.68	2,001	D10	BY '94	100.0%		1		1	0.0500%
94	051724	4/11/96	2,018	11.47	2,018	D09	BY '94	100.0%		2		2	0.0991%
94	051723	4/11/96	2,012	11.47	2,012	D08	BY '94	100.0%		2		2	0.0994%
94	051722	4/11/96	2,039	11.47	2,039	D07	BY '94	100.0%		2	1	3	0.1471%

U. S. Fish and Wildlife Service
Mid-Columbia River Fishery Resource Office
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Leavenworth, WA

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