



**LOWER SNAKE RIVER COMPENSATION PLAN
CHINOOK SALMON FISH HATCHERY
EVALUATIONS—IDAHO**

Project Progress Report

October 1, 2003 to September 30, 2004



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**Lower Snake River Compensation Plan
Chinook Salmon Fish Hatchery Evaluations—Idaho
Part 1: Chinook Salmon**

**2004 Annual Report
October 1, 2003 to September 30, 2004**

Lower Snake River Compensation Plan

By

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ABSTRACT

This annual report summarizes brood year 2002 juvenile survival and 2004 adult return data for Chinook salmon at Lower Snake River Compensation Plan (LSRCP) hatcheries operated by Idaho Department of Fish and Game (IDFG).

Idaho-LSRCP hatcheries (McCall, Clearwater, and Sawtooth) released a combined 4,514,870 brood year 2002 Chinook salmon in 2003 and 2004 including 3,551,436 yearling smolts and 963,434 subyearling parr and presmolts.

Representative groups of brood year 2002 hatchery-origin Chinook salmon juveniles were tagged with passive integrated transponders (PIT) to estimate survival to Lower Granite Dam (LGD). Estimated survival rates ranged from 0.8% for presmolts released from Crooked River pond to 89.6% for smolts released from the Dworshak Fish Hatchery.

In 2004, 86,501 adult and jack spring and summer Chinook salmon were counted at LGD, which was less than the 2003 return of 99,463 but 1.6 times higher than the previous 10 year average (1994-2003). Of the total 2004 return, 58,542 were estimated to be hatchery origin.

Contribution of adult Chinook salmon from individual LSRCP fish hatcheries operated by IDFG include 10,926 for McCall stock released at Knox Bridge, 1,617 for Sawtooth stock released at Sawtooth Fish Hatchery, and 4,666 for the Clearwater Fish Hatchery satellite facilities (2,496 at Powell, 2,170 at Red and Crooked rivers). These numbers include the estimated number of fish harvested in the Pacific Ocean and the Columbia and Snake River basins, and those trapped at the hatchery weirs.

Smolt-to-adult return (SAR) rates for brood year 1999 LSRCP spring and summer Chinook salmon released as yearling smolts (including the estimated harvest) ranged from 0.3% for Sawtooth Fish Hatchery and South Fork Clearwater to 0.7% for fish released from McCall Fish Hatchery.

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INTRODUCTION

The U.S. Army Corps of Engineers (USACE) constructed four hydroelectric dams (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite) on the lower Snake River between 1961 and 1975. Fishery managers and biologists expected the survival of downstream migrating smolts and upstream migrating adults to be reduced by dam construction and operation and the alteration of the river ecosystem. A joint Coordination Act Report (CAR) written by the US Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) in 1972 was submitted to the USACE describing the impacts of the four Lower Snake River dams on both fish and wildlife. Based on that report, the USACE submitted a Special Report to Congress which was used to authorize the Lower Snake River Compensation Plan (LSRCP) through the Water Resources Development Act of 1976 (90 Stat. 2917). Intent of the LSRCP was to mitigate for the reduced survival of anadromous fish resulting from dam construction and operation. The primary compensation tool specified in the LSRCP was a hatchery mitigation program. In 1977, the USFWS was given budgeting and administrative responsibility for operation and maintenance funding of LSRCP fish hatchery programs through an interagency agreement among the USACE, NMFS, and the USFWS.

The LSRCP hatchery program specified the use of fish hatcheries to produce and release enough juvenile anadromous salmonids to meet adult return goals that were established to offset the estimated mortality caused by the four lower Snake River dams. Original mortality estimates for spring and summer run Chinook salmon *Oncorhynchus tshawytscha* attributable to the four lower Snake River dams were derived by applying a 15% smolt mortality rate at each of the four projects (a total estimated loss of 48%). That expected loss was multiplied by the estimated return of spring/summer Chinook salmon adults (122,200) to the Snake River in 1957 (pre dam construction) resulting in a mitigation goal of 58,677 (50,677 spring run and 8,000 summer run) spring and summer run Chinook salmon above Lower Granite Dam (LGD) (LSRCP 1991, Table 1). Additionally, a return goal of 18,300 fall run Chinook salmon above LGD was established using similar criteria.

To achieve the established mitigation goals, LSRCP funded hatcheries were constructed in Idaho, Oregon, and Washington. Hatcheries located in Idaho include three operated by Idaho Department of Fish and Game (IDFG) and one operated by the USFWS. Facilities operated by IDFG include Clearwater, McCall, and Sawtooth fish hatcheries (with four associated satellite facilities) (Figure 1; Table 2). Facilities operated by USFWS include Dworshak National Fish Hatchery (DNFH) and the associated Kooskia satellite facility (Figure 1). Adult return goals for LSRCP hatcheries operated by IDFG account for 39,360 of the 58,677 return goal above LGD (Table 2). Hatchery capacity specifications for LSRCP facilities operated by IDFG were based on adult escapement goals (Table 2) and an average smolt-to-adult return (SAR) rate of 0.87%.

In addition to the LSRCP funded hatcheries located in Idaho, Idaho Power Company (IPC) owns and maintains three additional Chinook salmon hatcheries that are operated by IDFG (Rapid River, Oxbow, and Pahsimeroi fish hatcheries) (Figure 1). Specific information pertaining to the DNFH and IPC hatcheries are summarized in separate reports.

Table 1. Adult spring and summer run Chinook salmon return goals for the LSRCP program.

Agency / River System	Run Type	Adult Return Goal
IDFG		
S.F. Salmon River	Summer	8,000
Upper Salmon River	Spring	19,445
Clearwater River	Spring	11,915
USFWS		
Clearwater River	Spring	9,135
ODFW		
Grande Ronde River	Spring	5,820
Imnaha River	Spring	3,210
WDFW		
Tucannon River	Spring	1,152
TOTAL		58,677

Table 2. Adult spring and summer run Chinook salmon return goals for LSRCP funded hatcheries located in Idaho and operated by IDFG. Return goals listed for satellite facilities are a subset of the overall hatchery return goal (in bold font).

Hatchery and Satellite	First Year of Operation	Run Type	Adult Return Goal
McCall	1979	Summer	8,000
Sawtooth	1985	Spring	19,445
E.F. Salmon	1984	Spring	6,090
Clearwater	1990	Spring	11,915
Powell	1989	Spring	2,553
Red River	1986	Spring	2,553
Crooked River	1990	Spring	6,809
TOTAL			39,360

LSRCP Hatcheries operated by IDFG

McCall Fish Hatchery

McCall Fish Hatchery was built in 1979 and is located on the North Fork of the Payette River in the city of McCall, Idaho (Figure 1). It is the incubation and rearing facility for the South

Fork Salmon River (SFSR) Chinook salmon program. An adult trapping and spawning facility is located on the upper SFSR near Warm Lake (Figure 1). The adult escapement goal for the SFSR is 8,000 adults above LGD. Original broodstock for the SFSR program was composed of summer run adults collected at Little Goose Dam from 1974 to 1978, from Lower Granite Dam (LGD) in 1979, and from LGD and the SFSR trap in 1980 (Kiefer et al. 1992). Adults collected during these years (1974-1980) were spawned at Rapid River or Dworshak National fish hatcheries. Juveniles produced from these adults were released into the upper SFSR near the current location of the adult trap. Beginning in 1981, broodstock collection has come exclusively from adults captured at the adult trap site on the SFSR. From the inception of the SFSR program through brood year 1990, not all of the juvenile Chinook salmon released have been marked with a fin clip. Because of this, an unknown proportion of the unmarked returning adults through 1995 were hatchery-origin. Beginning with brood year 1991, all juvenile Chinook salmon released into the upper SFSR were marked or tagged, and the origin of adults returning from these releases could be distinguished from naturally produced adults either from a fin clip or from the presence of a coded wire tag (CWT) or visual implant.

Sawtooth Fish Hatchery

Sawtooth Fish Hatchery was constructed in 1985 and is located on the main stem Salmon River approximately 10 km upstream from the town of Stanley, Idaho (Figure 1). The hatchery consists of an adult weir, adult trap, spawning and incubation facilities, and rearing space for 2.3 million Chinook salmon smolts at 15 fish per pound. The original escapement goal for Sawtooth Fish Hatchery was 19,445 adult Chinook salmon above LGD from juvenile releases at Sawtooth Fish Hatchery, the East Fork Salmon River, and Valley Creek.

A rearing pond was constructed in 1966 at the current Sawtooth Fish Hatchery site and received fry releases from Hayden Creek, Rapid River, and Marion Forks Fish Hatchery in Oregon in the late 1960s (Bowles and Leitzinger 1991). During the 1970s, several releases were made into the rearing pond from Rapid River stock. Bowles and Leitzinger (1991) note that adult returns from these releases were negligible. The original brood source for the Sawtooth Fish Hatchery program came from adults captured at a temporary weir operated from 1981-1984 at the site of the current hatchery location. It was estimated that at least 50% of the adults trapped in 1981 resulted from a hatchery smolt release (914,000) in 1979 that was Rapid River stock raised at the Mullen Fish Hatchery (Moore 1981). Also, an unknown proportion of adults trapped in 1982 consisted of age-five adults from the same Rapid River smolt release. Beginning in 1983, all returning hatchery adults at the trap were Sawtooth Fish Hatchery stock. Eggs collected from adults trapped at the temporary weir were incubated and reared at the McCall Fish Hatchery from 1981-1983 and at Pahsimeroi Fish Hatchery in 1984. Smolts reared at McCall and Pahsimeroi fish hatcheries for brood years 1981-1984 were released in the Upper Salmon in 1983-1986 at the current hatchery location. Brood year 1985 was the first year that all adult trapping, incubation, and rearing occurred at the Sawtooth Fish Hatchery. Through brood year 1990, not all of the juvenile Chinook salmon released were marked with a fin clip. Because of this, an unknown proportion of the unmarked returning adults through 1995 were hatchery-origin. Beginning with brood year 1991, all juvenile Chinook salmon released at or above the Sawtooth Fish Hatchery weir were marked or tagged, and the origin of adults returning from those releases could be distinguished from naturally produced adults either from a fin clip or from the presence of a CWT.

The East Fork Salmon River adult trap is a satellite facility of Sawtooth Fish Hatchery that began operation in 1984. It is located approximately 29 km upstream of the mouth of the

East Fork Salmon River (Figure 1). The escapement goal for the East Fork weir is 6,090 above LGD (Table 2). Eggs from adults that are trapped and spawned at the East Fork satellite are transferred to the Sawtooth Fish Hatchery for incubation and rearing. Adult collection and spawning occurred at the East Fork satellite from 1985-1993 (Brent Snider, Idaho Department of Fish and Game, personal communication). From 1994-1997, the trap was operated but due to low numbers of returning adults, all adults captured were released above the weir to spawn naturally. Trapping operations for Chinook salmon were discontinued from 1998-2003 due to low numbers of returning adults. Trapping resumed in 2004 but all Chinook trapped were released above the barrier to spawn naturally.

While Valley Creek was initially slated to receive releases of up to 300,000 smolts annually, due to lack of adult returns to Sawtooth Fish Hatchery, no juvenile releases have occurred in Valley Creek.

Clearwater Fish Hatchery

Clearwater Fish Hatchery was constructed in 1992 and is located on the North Fork Clearwater River approximately one km above the mouth near the town of Orofino, Idaho. The original adult escapement goal for Clearwater Fish Hatchery was set at 11,915 Chinook salmon above LGD. Clearwater Fish Hatchery contains adult holding, spawning, incubating facilities, and rearing space for 1,500,000 Chinook smolts and 1,700,000 steelhead smolts. Three satellite facilities (Red River, Crooked River, and Powell) associated with Clearwater Fish Hatchery were constructed prior to Clearwater Fish Hatchery (Table 2; Figure 1). Incubation and initial rearing of all Chinook salmon juveniles released at the three satellite facilities occurs at Clearwater Fish Hatchery.

Red River Satellite—In 1976, a rearing pond and temporary weir were constructed at the site of the current satellite facility as part of the Columbia River Fisheries Development Program (Kiefer et al. 1992). In 1986, the satellite facility was updated and a permanent weir was installed near the rearing pond as part of the LSRCP program. Both fall presmolt and spring smolt releases have occurred at Red River. The Red River satellite facility is located approximately 21 km upstream from the mouth of Red River and approximately 183 km upstream from Clearwater Fish Hatchery.

Crooked River Satellite—An adult trap and juvenile rearing ponds were constructed on Crooked River in 1989. The adult trap is located on Crooked River approximately 1 km upstream from the mouth. The juvenile rearing ponds are located approximately 16 km upstream of the adult trap. The Crooked River satellite facility is located approximately 150 km upstream from the Clearwater Fish Hatchery. Both fall presmolt and spring smolt releases have occurred at Crooked River. There are no adult holding facilities at Crooked River so all adults retained for broodstock are transported to the Red River satellite facility. Initially, Red River and Crooked River adults were kept separate and treated as two different stocks. However, in 1997 it was decided to treat the Red River and Crooked River adults as a single stock and adults trapped from each of the facilities are combined in the same holding ponds and are referred to as the “South Fork” stock (McGhee and Patterson 1999). For this report, harvest and escapement estimates for the South Fork stock will represent the combined juvenile release and adult recovery data from Red River and Crooked River satellite facilities.

Powell Satellite—Construction of an adult trap, weir, holding ponds, and a juvenile rearing pond was completed in 1989 but adult trapping began in 1988. The Powell facility is

located on the upper Lochsa River approximately 200 km upstream from the Clearwater Fish Hatchery (Figure 1). Originally, a floating weir that spanned the Lochsa River was used to guide fish into Walton Creek where another weir guided them into the trap box. The floating weir was operated from 1988 to 1992. High water events in 1992 caused extensive damage to weir panels and the floating weir has not been operated since. Since 1992, fish have no longer been guided to Walton Creek by a mechanical structure, but rather by attraction flow from Walton Creek, the water source for the Powell satellite facility. It should be noted that Walton Creek is a small tributary with no natural run of Chinook salmon. Adults retained for broodstock are spawned at the Powell facility and eggs are transferred to Clearwater Fish Hatchery for incubation and rearing. Both fall presmolt and spring smolt releases occur at the Powell facility.

Hatchery Evaluation Component of LSRCP

The LSRCP includes a Hatchery Evaluation Study (HES) component to monitor and evaluate the hatchery mitigation program. The primary goal of the HES is to work with individual hatcheries to help determine the best hatchery management practices that allow the hatcheries to meet LSRCP and IDFG anadromous fisheries goals. Objectives to address the goal are: 1) to monitor and document the extent to which hatcheries meet their mitigation goals, and 2) to conduct small-scale manipulative studies involving modified or alternative hatchery practices that show potential for increasing adult returns and achieving LSRCP and IDFG goals. These small-scale studies may be printed and bound as independent reports.

In addition to monitoring production and productivity of the LSRCP hatcheries, some production and productivity data collected from natural populations that are adjacent to the LSRCP hatchery programs are also reported. These data are typically collected by ongoing IDFG research programs (e.g., Idaho Supplementation Studies and Idaho Natural Production Monitoring programs).

The primary purpose of this report is to summarize activities at each of the LSRCP funded hatcheries operated by IDFG and to estimate at what level each facility contributed to fisheries in the Pacific Ocean and Columbia River as well as to the adult return above LGD and back to the respective hatchery trapping facilities. This includes reporting adult returns to hatchery facilities and juvenile rearing and release information on a yearly basis. Additionally, life stage-specific survival during periods when fish are not directly associated with the hatcheries is reported to address overall survival from release to return. In each annual report, a brood year is summarized or "closed out" by consolidating the juvenile rearing and release information and the adult returns from a given brood year. Because of the five-year generation length of Chinook salmon, there is a five-year lag associated with summarizing the productivity of a brood year. Hence, brood year 1999 is summarized in the current 2004 report. To avoid unnecessary duplication of data reporting, only the major components of data collected by hatchery staff are reported. Specific hatchery broodstock collection, spawning, incubation, and rearing summaries can be found in hatchery specific Brood Year reports available from IDFG.

This report is organized into three major sections: 1) juvenile release and survival information for brood year 2002 juveniles including parr or presmolts released in 2003 and yearling smolts released in 2004; 2) adult return information, by age class, collected in 2004 including the estimated number of spring and summer Chinook salmon harvested in the Pacific Ocean, Columbia and Snake River fisheries, the number that passed over LGD, and the number of adults that returned to each hatchery; and 3) productivity estimates of the adults that

returned to each hatchery facility from brood year 1999 (e.g., brood year reconstruction and parent:progeny relationships).

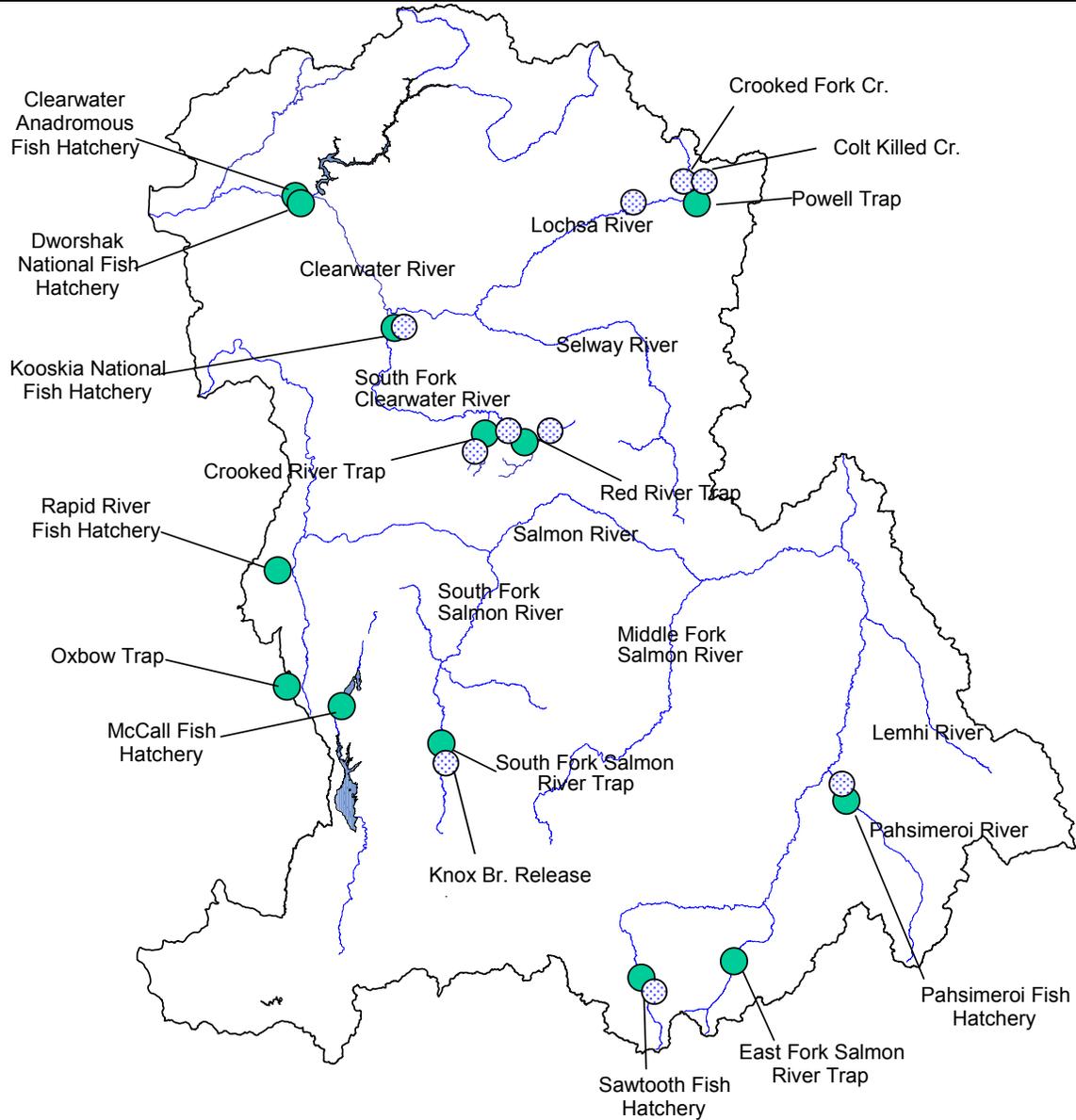


Figure 1. Locations of Chinook salmon hatcheries and trapping facilities in Idaho. Solid circles represent adult trapping or hatchery locations. Circles with dot matrix represent locations where natural-origin Chinook salmon are PIT tagged in order to estimate survival to Lower Granite Dam.

METHODS

Smolt Survival From Release To LGD

Survival estimates of hatchery-origin juvenile Chinook salmon from release to arrival at LGD are generated using PIT tag release groups from the various hatchery facilities. Specifically, the Survival Under Proportional Hazards (SURPH) computer program (Lady et al. 2001) is used to generate a point estimate of survival and 95% confidence intervals. The program uses the Cormack-Jolly-Seber model (Cormack 1964, Jolly 1965, Seber 1965) for single release and multiple recapture events. This method accounts for differences in collection efficiency at the dams, so comparisons between release groups from different facilities and releases from different time periods are appropriate. PIT tag groups are generally made up of 300-700 fish from LSRCP facilities released every year to evaluate migration timing and survival of hatchery-reared juveniles to LGD. In addition to reporting survival rates of hatchery-origin fish, survival rates for several groups of natural-origin Chinook that are tagged from other ongoing research projects in Idaho located adjacent to hatchery release sites are also reported for comparison. All PIT tagged natural-origin fish were captured using rotary screw traps as they volitionally emigrated from the rearing areas. In order to make comparisons with the hatchery-origin releases, natural-origin fish were classified as parr, presmolts, or smolts based on the date they were captured and tagged. Subyearlings trapped prior to September 1 are considered parr, and those captured on or after September 1 are considered presmolts. Yearling smolts are captured between February and June of the following year.

To compare arrival timing at LGD from different release groups, the “arrival window” in which the middle 80% of PIT tag detections occurred is also reported. This interval provides a measure of when fish arrive at LGD and how “spread out” the major component of each release group of juveniles were as they passed LGD.

Estimating Downstream Harvest (Ocean and Columbia River)

In order to estimate the total production of the LSRCP hatchery facilities in Idaho, estimates of harvest from fisheries in the Pacific Ocean and Columbia River are also reported. Estimates are generated by utilizing CWT harvest data retrieved from the Regional Mark Information System (RMIS) database that is maintained by the Pacific States Marine Fisheries Commission (PSMFC). Coded-wire tag recoveries are expanded based on two criteria: 1) the estimated sample rate of the fishery, and 2) the proportion of the release group that was tagged with CWTs. These expanded values represent the total estimated harvest of each release group.

Adult Returns to LGD

Adult returns to LGD are comprised of both spring and summer run components. Adult counting facilities operated by the Fish Passage Center (FPC) at Lower Snake and Columbia River hydroelectric projects categorize spring and summer runs based on the arrival timing at individual projects. For example, Chinook salmon arriving at LGD between March 1 and June 17 are classified as spring run while Chinook salmon arriving between June 18 and August 17 are classified as summer run. The FPC does not discriminate Chinook salmon return numbers by their respective origins (wild or hatchery). Some hatchery-origin Chinook salmon have no external mark, and a visual determination of origin is not possible.

The U.S. v. Oregon Technical Advisory Committee (TAC) further breaks down the adult escapement crossing LGD into hatchery- or wild-origin by using data collected at hatcheries and from fisheries. It should be noted that the TAC estimate does not include jacks. Adult Chinook salmon return data presented in this report are from both methods (FPC and TAC).

Estimating Harvest from Fisheries in Idaho

The occurrence of Chinook salmon sport fisheries in Idaho is variable and from 1979 through 1996 only occurred on the Little Salmon River (a terminal fishery for the Rapid River Fish Hatchery). From 1996 to 2004, some limited sport fisheries occurred in the Salmon and Clearwater rivers. Estimates of harvest from these fisheries are determined from IDFG regional staff and from IDFG staff funded through the LSRCP Harvest Monitoring Program (HMP). Methods include a combination of angler check stations, roving creel, and voluntary drop-off check station boxes.

Adult Age Classification

Depending on the availability of known age information (e.g., CWTs, PIT tags, or other age-specific marks) recovered from returning adults, age composition of adults returning to individual LSRCP hatchery facilities is determined from either visual examination of length frequency histograms, or in cases where some known age information is available, the computer program Rmix is used. Rmix was developed by Du (2002) as an add-on program to the R (R-Development Core Team 2004) computing environment that utilized the original MIX program developed by Macdonald and Pitcher (1979). Rmix was designed to estimate the parameters of a mixture distribution with overlapping components, such as the overlapping length distributions associated with adult salmon returns composed of multiple age classes. Rmix utilizes the maximum likelihood estimation method.

The age notations used throughout this report for returning adults refer to the total age of the fish (fresh- and saltwater) and assume all juveniles migrate to the ocean as age 1+ smolts. Therefore, fish that spend one, two, or three years in the ocean are classified as three-, four-, and five-year-olds, respectively.

Determination of Origin

Chinook salmon bearing an external mark, typically an adipose or ventral fin clip, are classified as hatchery-origin. However, some hatchery-origin fish have no external mark but do have a coded-wire tag (CWT) inserted in their snout. All externally unmarked fish with a CWT were also classified as hatchery-origin. Some hatchery-origin fish are referred to as reserve or production fish. The terms reserve and production are used in reference to a hatchery-origin Chinook salmon with an adipose fin clip (AD) that can be legally harvested in a mark selective fishery. Other hatchery-origin fish are referred to as supplementation fish. Supplementation fish refer to Chinook salmon that are part of the Idaho Supplementation Study (ISS) or the Nez Perce Tribal (NPT) hatchery program and are not intended to contribute to selective sport fisheries. Supplementation fish are typically marked with a right ventral (RV) or left ventral (LV) fin clip or with a CWT and no external mark. For a more detailed explanation of the ISS program, refer to Bowles and Leitzinger (1991).

Brood Year Reconstruction, SARs, and Progeny-to-Parent Ratios

In order to reconstruct a brood year for hatchery-origin Chinook salmon, adults that return from a given brood year over three return years are summarized. For example, the 1999 brood year includes age-3 fish that return in 2002, age-4 fish that return in 2003, and age-5 fish that return in 2004. These returns include fish recovered at hatchery weirs, those recovered in fisheries, and those that were recovered as strays, at trap sites, or during spawning ground surveys. For those recovered in mixed-stock fisheries (ocean, Columbia and Snake rivers), the total number of fish harvested from each age class is estimated based on the number of CWTs recovered from each age class expanded by the sample rate of the fishery and the tagging rate. For those recovered in terminal fisheries, the number of fish harvested in each age class is estimated based on the number of CWTs recovered from each age class expanded by tagging rate. Then the proportion of the expanded recoveries from each age class is applied to the total estimated harvest in the terminal fishery. If insufficient numbers of CWTs are recovered in the terminal fishery, length frequency data from fish sampled during the fishery will be used to estimate age-composition of the harvest.

Smolt-to-adult survival rates (SARs) are estimated by summing up the total returns from a given brood year (brood year reconstruction as described above) divided by the number of smolts released from the brood in question.

Female-progeny to female-parent ratios are estimated by dividing the number of female returns from a brood year by the number of females that were spawned to create the brood in question. For example, brood year 1999 female-progeny to female-parent ratio is calculated by dividing the age-4 and age-5 females that returned in 2003 and 2004, respectively, by the number of females that were spawned in 1999. A ratio of one signifies the brood was at replacement or, simply stated, that each female spawned in 1999 produced one returning female adult. Two different female-progeny to female-parent ratios are provided in this report: one includes only the number of female-progeny that returned to the hatchery weir, and the second includes the estimated number of females harvested in addition to those returning to the weir. Harvest information includes ocean, Columbia and Snake River, and terminal fisheries. The number of females harvested is estimated by applying the sex ratio of adults recovered at the hatchery weir to the estimated number of fish harvested in each fishery with the assumption that there is no gender bias in the fisheries.

RESULTS

Brood Year 2002 Juvenile Releases

From July 14, 2003 through April 21, 2004, a total of 4,514,870 brood year 2002 juvenile Chinook salmon were released from three LSRCP hatcheries (Table 3). An additional 6,393,578 brood year 2002 juvenile Chinook salmon were released from two IPC and two USFWS fish hatcheries in Idaho (Table 3).

Smolt releases occurred from March 15 through April 21, 2004, and subyearling parr and presmolts were released from July 14 through September 26, 2003 (Table 3).

Table 3. Brood Year 2002 juvenile Chinook salmon released in 2003 (subyearling parr and presmolts) and 2004 (yearling smolts) from hatcheries located in Idaho.

Rearing Hatchery	Life Stage	Release Date	Release Location	Marks	Purpose ^a	Number Released	
Clearwater	Parr	7/28-7/30	Colt Killed Cr*	RV	ISS	122,152	
	Parr	7/28	Pete King Cr*	CWT	ISS	16,293	
	Parr	7/28	Squaw Cr*	CWT	ISS	16,534	
	Presmolt	9/16	Walton Cr	AD	LSRCP	385,431	
	Presmolt	9/17	Crooked R.	LV	ISS	234,361	
	Presmolt	9/26	Red R.	RV	ISS	108,323	
	Smolt	4/7	Crooked R.	AD	LSRCP	750,317	
	Smolt	4/8	Papoose Cr*	CWT	ISS	56,174	
	Smolt	4/9	Red R.	AD	LSRCP	354,868	
	Smolt	3/30-4/2	Walton Cr	AD	LSRCP	376,797	
	Total						2,421,250
	McCall	Parr	7/14	Stolle Pond	CWT	ISS	80,340
		Smolt	3/21	Johnson Cr	CWT	NPT	112,870
Smolt		3/22-3/25	Knox Bridge	AD	LSRCP	914,060	
Smolt		3/22-3/25	Knox Bridge	CWT	ISS	174,150	
Total						1,281,420	
Sawtooth	Smolt	4/13	Sawtooth Weir	CWT	ISS	187,461	
	Smolt	4/13	Sawtooth Weir	AD	LSRCP	624,739	
	Total						812,200
Pahsimeroi	Smolt	4/11-4/21	Pahsimeroi R.	CWT	ISS	124,489	
	Smolt	4/11-4/21	Pahsimeroi R.	AD/CWT	IPC	984,509	
	Total						1,108,998
Rapid River	Smolt	3/15	Little Salmon R*	AD	IPC	300,140	
	Smolt	3/15	Rapid R.	AD/CWT	IPC	2,762,058	
	Smolt	3/18	Hells Canyon Dam	AD	IPC	499,956	
	Total						3,562,154
Dworshak^b	Smolt	3/31-4/1	N.F. Clearwater R.	AD	LSRCP	1,078,923	
Kooskia^b	Smolt	3/30	Clearwater R.	AD	USFWS	643,503	
Grand Total						10,908,448	

* This is an offsite release and no adult trapping facilities exists to evaluate adult returns.

^a ISS = Idaho Supplementation Study, LSRCP = Lower Snake River Compensation Program, NPT = Nez Perce Tribal release, IPC = Idaho Power mitigation program, USFWS = US Fish and Wildlife Service program.

^b Data is from Burge et al. 2007.

Migration Timing and Survival of Brood Year 2002 Juvenile Chinook Salmon

Representative groups from all hatchery facilities were PIT tagged to evaluate migration timing and survival to LGD. These evaluation groups include fish released as subyearling parr and presmolts as well as yearling smolts.

Hatchery-origin Yearling Smolts

The majority of PIT-tagged juvenile Chinook salmon released as yearling smolts from Idaho fish hatcheries arrived at LGD from late April to mid-May (Table 4). The “80% arrival window” for yearling smolt releases averaged 14.3 days and ranged from 7 to 26 days (Table 4).

Survival estimates for yearling smolts from release to LGD averaged 64.1% and ranged from 48.0% for the Crooked River Pond release to 89.6% for the N. Fork Clearwater release group (Table 4, Figure 2). Survival of hatchery-origin yearling smolts released in 2004 is inversely related ($r^2 = 0.75$) with distance from the release sites to Lower Granite Dam (Figure 3). This relationship is typical of previous years (Leth et al. 2004; Leth 2007).

Hatchery-origin Subyearling Parr and Presmolts

Generally, arrival timing to LGD of hatchery-origin juvenile Chinook salmon released as subyearling parr and presmolts was more protracted than for those released as yearling smolts (Table 4). The majority of individuals released as parr and presmolts arrived at LGD from late May through June. The “80% arrival window” for parr and presmolt releases averaged 39.3 days (range: 19-59 days) compared to 14 days for the yearling smolt releases (Table 4).

Averaged over all release sites, the estimated survival to LGD of hatchery-origin juveniles released as subyearling parr and presmolts was 3.7% (range: 0.8-6.6%), a substantial decrease from the hatchery-origin smolt survival likely due to the overwinter mortality associated with fish released as subyearlings. Differential survival of subyearling and yearling hatchery-origin juveniles observed in 2004 is typical of previous years (Leth et al. 2004; Leth 2007; Leth and Lindley 2007).

Table 4. Estimated survival, migration, and arrival timing of brood year 2002 juvenile Chinook salmon released from fish hatcheries located in Idaho and from natural-origin juveniles PIT tagged in populations adjacent to the hatchery release sites. Probability of detection is based on output from the SURPH computer program and represents collection efficiency of the juvenile detection system at Lower Granite Dam. Survival data for natural-origin fish is from Dave Venditti (IDFG, personal communication). Interrogation data is from the PTAGIS database (www.ptagis.org).

Rearing Hatchery	Life Stage	Release Site	Program*	Distance to LGD (Km)	Number PIT Tagged	Number of Unique Detections at LGD	Estimated Survival (%) to LGD (95% CI)	Probability of Detection	Median Arrival Date	80% Arrival Window (# of Days)
Clearwater	Presmolt	Crooked R. Pond	LSRCP	280	499	4	.8 (0-1.6)	1.00	6/24	5/24 - 7/02 (40)
	Presmolt	Red R. Pond	ISS	299	496	28	6.6 (4.31-8.79)	.86	5/21	4/13 - 6/10 (59)
	Smolt	Crooked R. Pond	LSRCP	280	299	95	48.0 (42.0 - 54.1)	.66	5/11	5/4 - 5/24 (21)
	Smolt	Powell Pond	LSRCP	321	292	154	77.5 (71.3-83.8)	.68	5/4	4/28 - 5/7 (10)
	Smolt	Red R. Pond	LSRCP	299	295	151	72.1 (66.4-77.9)	.71	5/5	5/1 - 5/21 (21)
	Smolt	American R.	Natural	272	1047	420	52.0 (48.0-56.0)	.77	6/21	5/25 - 7/4 (40)
	Smolt	Colt Killed Ck.	Natural	341	88	29	37.0 (27.0-47.0)	.90	6/11	5/13 - 6/27 (36)
	Smolt	Crooked R.	Natural	280	927	266	42.0 (38.0-46.0)	.69	6/15	5/27 - 7/3 (38)
	Smolt	Crooked Fork Ck.	Natural	323	263	66	32.0 (26.0-38.0)	.79	5/23	5/4 - 6/14 (42)
	Smolt	Red R.	Natural	299	1326	429	44.0 (42.0-46.0)	.73	6/12	5/23 - 7/2 (41)
McCall	Parr	Stolle Pond	ISS	470	589	17	3.8 (2.2-5.4)	.76	5/9	5/3 - 5/21 (19)
	Smolt	S. Fork Salmon R.	CSS	457	51,574	21,659	55.9 (55.5-56.5)	.75	5/4	4/28 - 5/10 (13)
	Smolt	S. Fork Salmon R.	ISS	457	600	274	62.8 (58.4-67.1)	.73	5/5	4/28 - 5/10 (13)
Sawtooth	Smolt	S. Fork Salmon	Natural	457	1375	-	38.0 (36.0-40.0)	-	-	-
	Smolt	Sawtooth Weir	LSRCP	747	498	239	59.2 (54.5-63.9)	.81	5/4	5/1 - 5/9 (9)
	Smolt	Sawtooth Weir	ISS	747	499	234	56.8 (52.1-61.4)	.83	5/4	4/29 - 5/6 (8)
Pahsimeroi	Smolt	Upper Salmon R.	Natural	747	2507	958	47.0 (45.0-49.0)	.81	5/3	5/3 - 6/7 (26)
	Smolt	Pahsimeroi R.	IPC	630	486	160	50.1 (44.5-55.7)	.66	5/5	4/29 - 5/7 (9)
	Smolt	Pahsimeroi R.	ISS	630	484	159	50.9 (45.5-56.3)	.65	5/5	5/1 - 5/7 (7)
Rapid River	Smolt	Rapid R.	IPC	283	51,962	22,625	69.4 (68.9-69.9)	.63	5/1	4/21 - 5/5 (15)
Dworshak	Smolt	N.F. Clearwater	LSRCP	116	51,613	21,384	89.6 (88.7-90.4)	.46	5/3	4/21 - 5/9 (19)
Kooskia	Smolt	Clear Ck.	LSRCP	176	1,505	536	76.8 (73.4-80.2)	.46	4/30	4/15 - 5/10 (26)
	Smolt	Clear Ck.	Natural	176	204	-	49.0 (41.0-57.0)	-	-	-

*Natural = refers to natural-origin fish and is used as a comparison to hatchery-origin fish in areas adjacent hatchery programs; Supp.= fish released as part of the Idaho Supplementation Study; LSRCP = fish released as part of the LSRCP mitigation program; IPC = fish released as part of the Idaho Power Co. mitigation program.

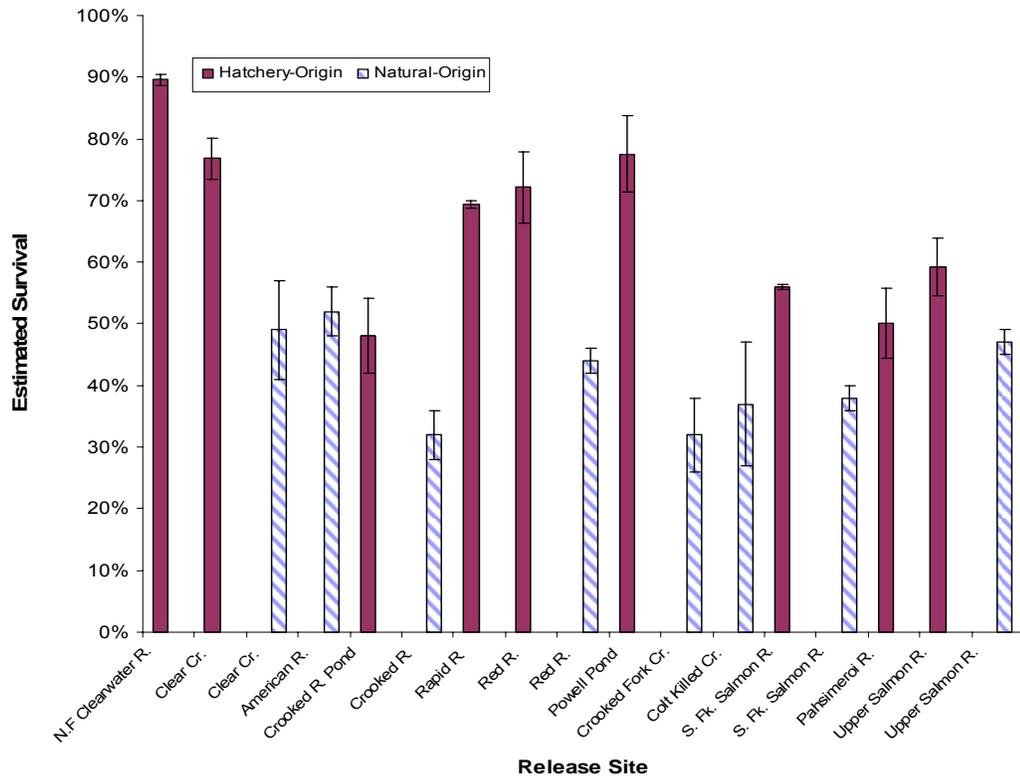


Figure 2. Estimated survival to Lower Granite Dam (LGD) of hatchery- and natural-origin Chinook salmon tagged and released as yearling smolts, spring 2004. Release sites are ordered in increasing distance from LGD (see Table 4). Error bars represent two standard errors.

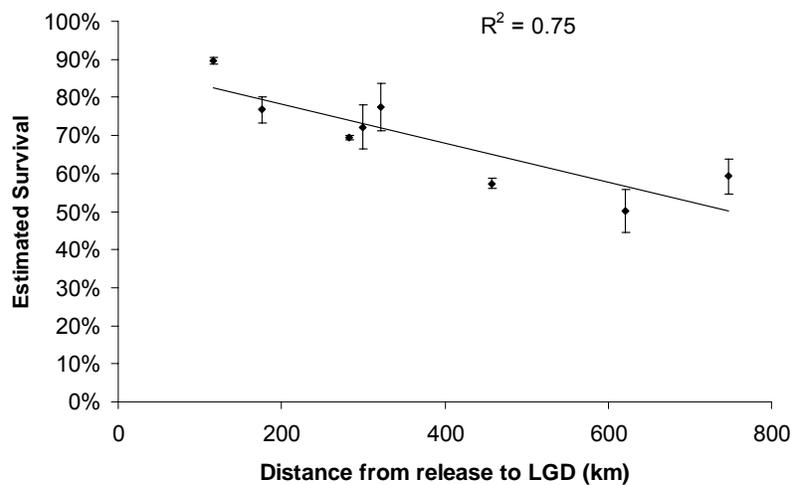


Figure 3. Relationship between estimated survival and distance from release site to Lower Granite Dam (LGD) for hatchery-origin Chinook salmon PIT tagged and released as yearling smolts, 2004. Error bars represent two standard errors.

Naturally-produced Chinook Salmon

Naturally-produced Chinook salmon were PIT tagged throughout the Salmon and Clearwater River subbasins as both subyearling parr and presmolts and yearling smolts (Table 4, Figure 2).

Arrival timing to LGD of natural-origin juveniles that were tagged as yearling smolts was later and more protracted than the hatchery-origin smolts. The date at which 50% of the natural-origin juveniles arrived at LGD was four weeks later, on average, than the hatchery-origin smolts. The "80% arrival window" for natural-origin smolts ranged from 26 to 42 days and averaged 37.2 days compared to a range of 8 to 26 days and an average of 14.3 days for hatchery-origin smolts. Averaged over all release sites, the estimated survival rate for natural-origin yearling smolts was 42.6% (range: 32.0 - 52.0%) compared to 64.1% (range: 48.0 - 89.6%) for the hatchery-origin smolts.

2004 Adult Returns to LGD

During the 2004 spawning migration, an estimated 86,501 combined hatchery- and natural-origin Chinook salmon crossed LGD between March 23 and August 17 of which 79,509 were adults and 6,992 were jacks. The 2004 return was 87% of the return in 2003 but 1.6 times greater than the previous 10 year average of 53,098 (Table 5).

Table 5. Hatchery- and natural-origin spring and summer Chinook salmon counted at Lower Granite Dam (LGD) in 2004. Spring Chinook salmon are defined as crossing LGD March 1 to June 17, and summer Chinook salmon as crossing June 18 to August 17. Data obtained from Fish Passage Center (<http://www.fpc.org>).

Return Year	LGD Count						Spring and Summer Combined
	Spring Adult	Spring Jack	Spring Total	Summer Adult	Summer Jack	Summer Total	
2004	70,742	4,482	75,224	8,767	2,510	11,277	86,501
2003	70,609	8,295	78,904	16,422	4,137	20,559	99,463
2002	75,025	2,089	77,114	22,159	1,953	24,112	101,226
2001	171,958	3,135	175,093	13,735	3,804	17,539	192,632
2000	33,822	10,318	44,140	3,939	3,756	7,695	51,835
1999	3,296	2,507	5,803	3,260	1,584	4,844	10,647
1998	9,854	109	9,963	4,355	328	4,683	14,646
1997	33,855	81	33,936	10,709	127	10,836	44,772
1996	4,207	1,639	5,846	2,607	944	3,551	9,397
1995	1,105	373	1,478	692	157	849	2,327
1994	3,120	43	3,163	795	73	868	4,031
1993	21,035	183	21,218	7,889	130	8,019	29,237
1992	21,391	533	21,924	3,014	298	3,312	25,236
1991	6,623	980	7,603	3,809	1,179	4,988	12,591
1990	17,315	244	17,559	5,093	128	5,221	22,780
1989	12,955	1,549	14,504	3,169	902	4,071	18,575
1988	29,495	924	30,419	6,145	362	6,507	36,926
1987	28,835	946	29,781	5,891	660	6,551	36,332
1986	31,576	1,307	32,883	6,154	1,255	7,409	40,292
1985	25,207	2,530	27,737	4,938	1,568	6,506	34,243
1984	6,511	1,410	7,921	5,429	1,815	7,244	15,165
1983	9,517	509	10,026	3,895	767	4,662	14,688
1982	12,367	379	12,746	4,210	318	4,528	17,274
1981	13,115	527	13,642	3,326	479	3,805	17,447
1980	5,461	1,298	6,759	2,688	759	3,447	10,206
1979	6,753	786	7,539	2,714	858	3,572	11,111
1994-2003 Ten Year Average							53,098

The estimated number of natural-origin adult Chinook salmon crossing LGD in 2004 from TAC was 79,509. Based on this TAC estimate, total adult hatchery escapement above LGD was 58,542, which is slightly above the LSRCP escapement goal of 58,000 spring/summer Chinook. However, it should be noted that not all hatchery fish crossing LGD are from LSRCP funded hatcheries but also include fish destined to return to IPC and USFWS funded hatcheries.

2004 Adult Returns and Harvest Information by Hatchery Facility

McCall Fish Hatchery

Adult Returns—Trapping of adult Chinook salmon at the South Fork Salmon River Trap began on June 18 and continued until September 7 when the weir was removed. The first Chinook salmon was captured on June 22 and the last was captured on September 7. During the

2004 trapping period, 6,189 Chinook salmon were captured including 5,594 (3,211 males and 2,384 females) hatchery- and 595 (385 males and 210 females) natural-origin fish (McPherson et al. 2006). The 2004 adult return was below the 2003 total return of 8,098, but 1.4 times higher than the previous ten year average (IDFG unpublished data).

During the 2004 adult migration, 116 CWTs were recovered from McCall hatchery Chinook salmon from fisheries in the ocean, Columbia River, Snake River below LGD, and from strays in Columbia and Snake River tributaries. Expansions based on sample and tagging rates resulted in a recovery estimate of 1,403 McCall hatchery fish (Table 6). Estimated harvest from the terminal fishery that occurred on the South Fork Salmon River from June 21 to July 4 included 2,591 from the sport fishery and 982 from the tribal fisheries. During spawning ground surveys above the SFSR weir, IDFG research staff collected 356 adipose clipped Chinook salmon that had escaped above the weir. It is suspected that some hatchery-origin fish spawned below the SFSR weir but data is not available to make that estimate. Total estimated harvest and escapement of McCall hatchery-origin Chinook salmon for 2004 was 10,926 (Table 6).

Table 6. Estimated harvest and escapement of hatchery-origin Chinook salmon in 2004. Recoveries are from fish released from McCall Fish Hatchery into the South Fork Salmon River (SFSR) above the adult weir and include fish from brood year 1999, 2000, and 2001.

Release Group/Site	Location and Recovery Type	Number CWTs	
		Recovered	Estimated Number
	Ocean	14	88
	Columbia River		
	Non-Treaty Sport	6	107
	Non-Treaty Commercial	3	17
	Treaty Net	89	1,168
	Treaty C&S	0	0
SFSR-Knox Bridge	Strays	4	23
	Snake River		
	Non-Treaty Sport	0	0
	Strays	0	0
	Idaho		
	Sport Harvest		2,591
	Tribal Harvest		982
	Strays*		356
	SFSR Weir (hatchery-origin)		5,594
Total		116	10,926

* Idaho strays include hatchery-origin fish that were recovered above the SFSR weir during spawning ground surveys. Data from Venditti et al. 2007.

Run Timing—Arrival timing of adults to the SFSR Trap in 2004 resembles a bimodal distribution and is typical of previous years. The majority of adults returned in the first mode from late June to mid-July (Figure 4). The second mode occurred during August and early-September. The median arrival date for males occurred on 7/9 and 7/14 for hatchery- and natural-origin fish respectively. Median arrival date for females occurred on 7/6 and 7/9 for hatchery- and natural-origin females, respectively.

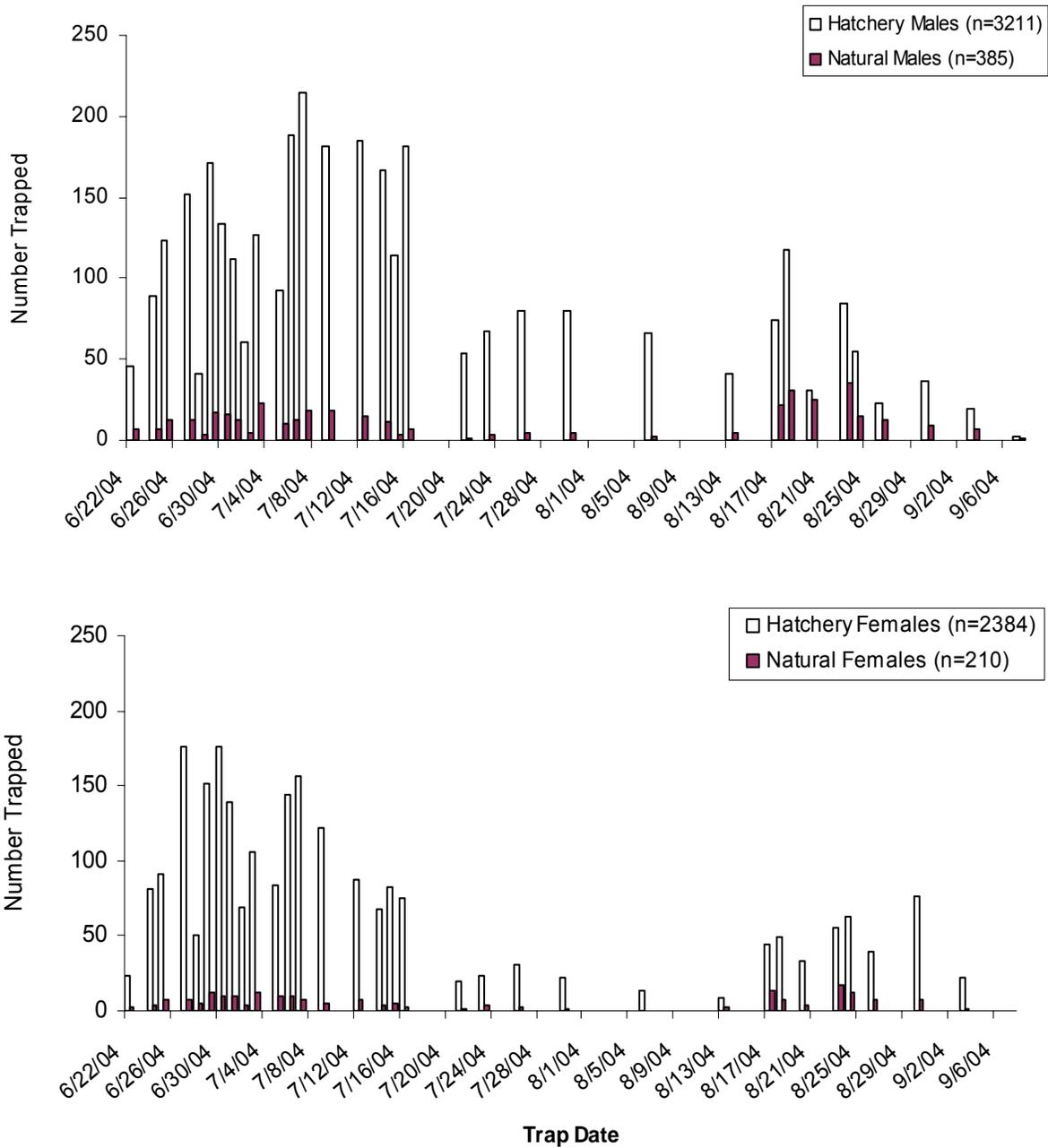


Figure 4. Run timing of hatchery- and natural-origin Chinook salmon at the South Fork Salmon River Trap in 2004.

Age Structure—Age classification of returning hatchery-origin adults was estimated using the computer program Rmix. Coded-wire tags were recovered from 606 (148 age-3, 428 age-4, and 31 age-5) of the 5,594 hatchery-origin fish that returned to the South Fork Salmon River trap in 2004. Results from the Rmix analysis indicated that the male return was composed of 27.9% age-3, 67.8% age-4, and 4.3% age-5 returns. The female return was composed of 91.4% age-4 and 8.6% age-5 fish (Table 7). One age-3 female with a CWT was recovered in

2004 but was not included in the Rmix analysis. Average length-at-age for males and females is displayed in Table 7.

Table 7. Estimated age structure of hatchery-origin Chinook salmon that returned to South Fork Salmon River Trap in 2004. Average length-at-age is based on fish recovered with CWTs. Fish lengths are in centimeters. SD = standard deviation. The “Number Represented” and 95% confidence interval are based on the Rmix analysis.

Gender	Age	CWTs Recovered	Average Length (SD)	Number Represented (95% CI)	Percent of Return
Male	3	147	56.4 (4.6)	895 (+/-51)	27.9%
	4	196	77.1 (7.7)	2,176 (+/-56)	67.8%
	5	13	95.5 (5.8)	139(+/-29)	4.3%
<i>Male Total</i>		356		3,210	100.0%
Female	4	232	77.8 (3.4)	2,180(+/-33)	46.5%
	5	18	89.8 (4.3)	204 (+/-32)	53.5%
<i>Female Total</i>		250		2,384	100.0%
Total		606		5,594	

Age classification of natural-origin adults for the 2004 adult return is based on a visual examination of the length frequency data. Length criteria used to distinguish age classes for males and females is shown in Figure 5 and Table 8 below. Based on these length criteria, the male return was composed of 7.4% one-ocean, 85.5% two-ocean, and 9.1% three-ocean fish. The female return was composed of 79.0% two-ocean and 21.0% three-ocean.

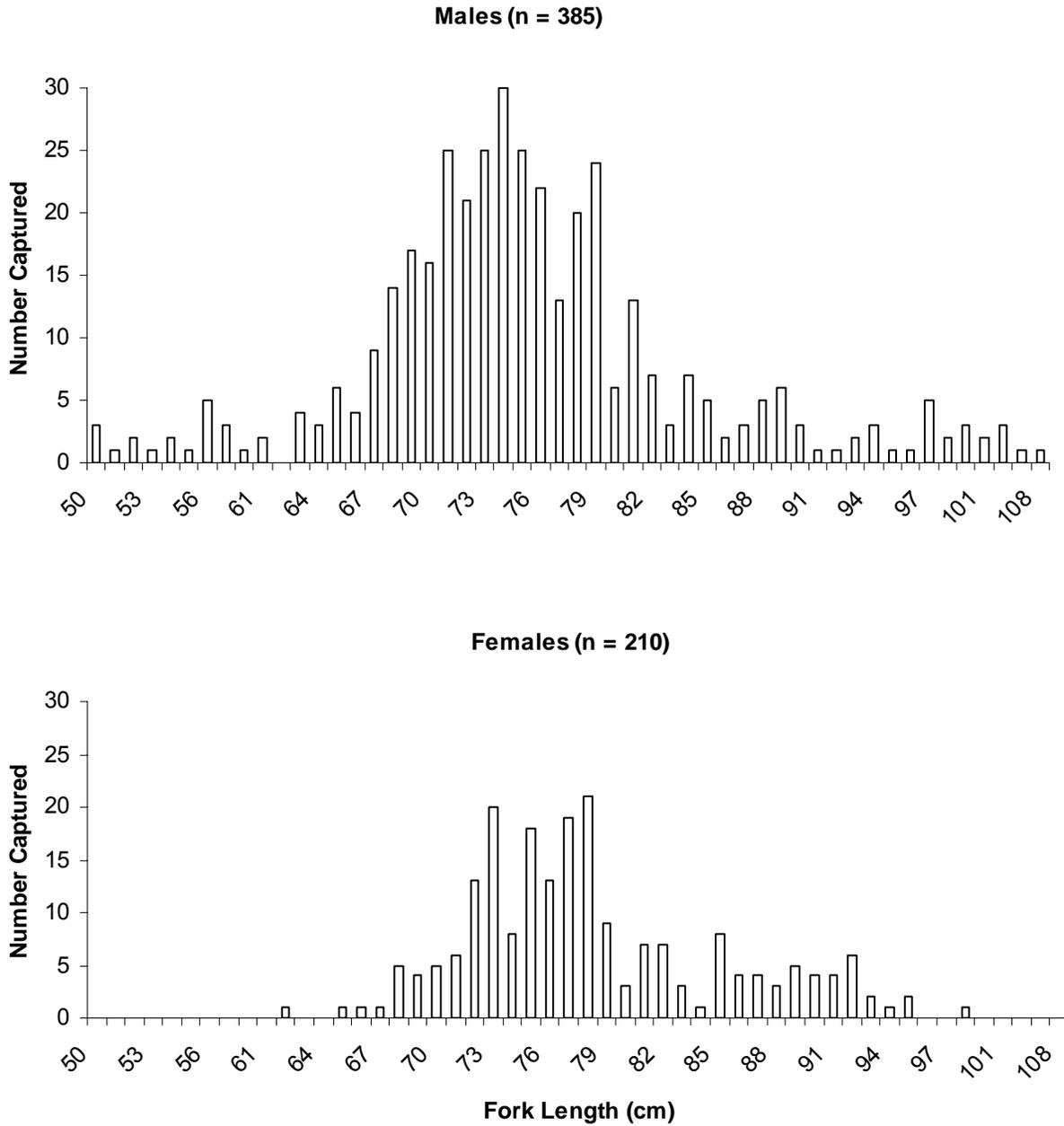


Figure 5. Length frequency and estimated age composition of natural-origin Chinook salmon trapped at the South Fork Salmon River Trap in 2004. Solid vertical bars represent length cutoffs used for age determination.

Table 8. Estimated age composition of natural-origin Chinook salmon that returned to the South Fork Salmon River Trap in 2004.

Gender	Age	Length Criteria	Number Trapped	Percent of Return
Male	3	<62	21	7.4%
	4	62-88	329	85.5%
	5	>88	35	9.1%
<i>Male Total</i>			385	
Female	4	<85	166	79.0%
	5	≥85	44	21.0%
<i>Female Total</i>			210	
Total			595	

1999 Brood Year Reconstruction and SAR—In 2004, the last of the progeny from the 1999 broodstock returned to the SFSR. In 1999, 317 females were spawned to create the release of 1,165,231 smolts in March of 2001 above the SFSR weir (Table 9). From the 1,165,231 smolts released above the SFSR weir, a total of 3,939 adults returned to the weir in 2002, 2003, and 2004 (Table 10). Additionally, an estimated 3,829 fish were harvested or recovered as strays resulting in 7,768 fish and an overall SAR of 0.67%.

Female-Progeny:Female-Parent Ratio—From the 317 females that were spawned in 1999, a total of 1,298 females returned to the SFSR weir in 2003 and 2004 resulting in a female-progeny:female-parent ratio of 4.1 (Table 10). In addition to the 1,298 females recovered at the weir, an estimated 1,553 brood year 1998 females were harvested or recovered as strays in 2003 and 2004 resulting in a total of 2,851 females and a female-progeny:female-parent ratio of 9.0 indicating that for brood year 1999, the SFSR Hatchery program was above replacement.

Table 9. Number of females spawned and survival of resultant progeny from egg to release at the McCall Fish Hatchery for brood year 1999 fish released above the SFSR weir as yearling smolts. The “# of Females Spawned” does not include females whose eggs were culled and is an estimate based on average green egg to release survival.

# of Females Spawned	Average Fecundity	# of Green Eggs	# of eyed Eggs	# of Smolts released	Green Egg to Release Survival
317	4,453	1,411,601	1,181,510	1,165,231	82.5%

Table 10. Estimated escapement and harvest of brood year 1999 hatchery-origin Chinook salmon adults from McCall Fish Hatchery in 2002, 2003, and 2004. Numbers in parentheses represent the percentage of the total for each recovery type. Estimated harvest and strays are reported for the area downstream of LGD (Blw. LGD) and upstream of LGD (Abv. LGD) separately.

Recovery Type	Age-3 Recoveries in 2002	Age-4 Recoveries in 2003	Age-5 Recoveries in 2004	Total Brood Year Recoveries
Hatchery Weir	1,119(28.4%)	2,477(62.9%)	343(8.7%)	3,939
Harvest (Blw. LGD)	0	254(87.9%)	35(12.1%)	289
Strays (Blw. LGD)	5(27.7%)	6(33.3%)	7(38.9%)	18
Harvest (Abv.LGD) ^a	337(9.6%)	3,085(88.4%)	69(2.0%)	3,491
Stray/Other (Abv.LGD) ^b	16(51.6%)	9(29.0%)	6(19.4%)	31
Total Recoveries	1,477(19.0%)	5,831(75.1%)	460(5.9%)	7,768
Estimated # of Females ^c	0	2,577(90.4%)	274(9.6%)	2,851
# of Females at Weir	0	1,094(84.3%)	204(15.7%)	1,298

^a Harvest above LGD does not include tribal terminal harvest because data was not available to estimate harvest by age class for 2002, 2003, and 2004 fisheries.

^b Only includes fish recovered with CWTs; individual fish recovered are then expanded based on the tagging rate. Includes nonstray carcasses recovered above and below the SFSR weir.

^c The fraction of total recoveries estimated to be female is based on the sex ratio of age-4 and age-5 fish observed at the hatchery weir in 2003 and 2004, respectively. In 2003, 44.2% of the age-4 hatchery-origin fish were female. In 2004, 59.5% of the age-5 hatchery-origin fish were female.

Sawtooth Fish Hatchery

Adult Returns—Trapping of adult Chinook salmon at the Sawtooth Fish Hatchery began on May 25 and continued until September 15 when the weir panels were removed. The first Chinook salmon was captured on June 6 and the last was captured on September 10. During the 2004 trapping period, 2,018 Chinook salmon were captured including 1,535 (995 males, 540 females) hatchery- and 483 (329 males, 154 females) natural-origin fish (Snider et al. 2006). The 2004 adult return was 1.6 times greater than the 2003 total return of 1,236 Chinook salmon and 2.9 times higher than the previous ten-year average (IDFG unpublished data).

Harvest of Sawtooth Hatchery fish in 2004 from ocean and Columbia River fisheries was estimated at 76, and one stray fish was recovered at Lyons Ferry Fish Hatchery (Table 11). No fisheries targeting Sawtooth Fish Hatchery stock occurred in Idaho in 2004, but one CWT from Sawtooth Fish Hatchery was recovered in the Lower Salmon River fishery. In total, an estimated 1,617 hatchery-origin fish contributed to the weir return and fisheries in 2004 (Table 11).

Table 11. Estimated harvest and escapement of hatchery-origin Chinook salmon in 2004. Recoveries are from fish released from Sawtooth Fish Hatchery.

Release Group/Site	Location and Recovery Type	Number CWTs	
		Recovered	Estimated Number
Sawtooth Weir	Ocean	2	5
	Columbia River		
	Non-Treaty Sport	1	6
	Non-Treaty Commercial	0	0
	Treaty Net	15	65
	Treaty C&S	0	0
	Strays	1	1
	Idaho		
	Harvest	1	5
	Strays	0	0
	Sawtooth Hatchery Weir	—	1,535
Total		20	1,617

Run Timing—Arrival timing of adults to the Sawtooth Fish Hatchery facility in 2004 resembles a bimodal distribution and is typical of previous years. The majority of adults returned in the first mode from mid-June to early August (Figure 6). The second mode occurred between mid-August and early September. Median arrival date for males occurred on 7/15 and 7/11 for hatchery- and natural-origin adults, respectively. Median arrival date for females occurred on 7/10 and 7/7 for hatchery- and natural-origin adults, respectively.

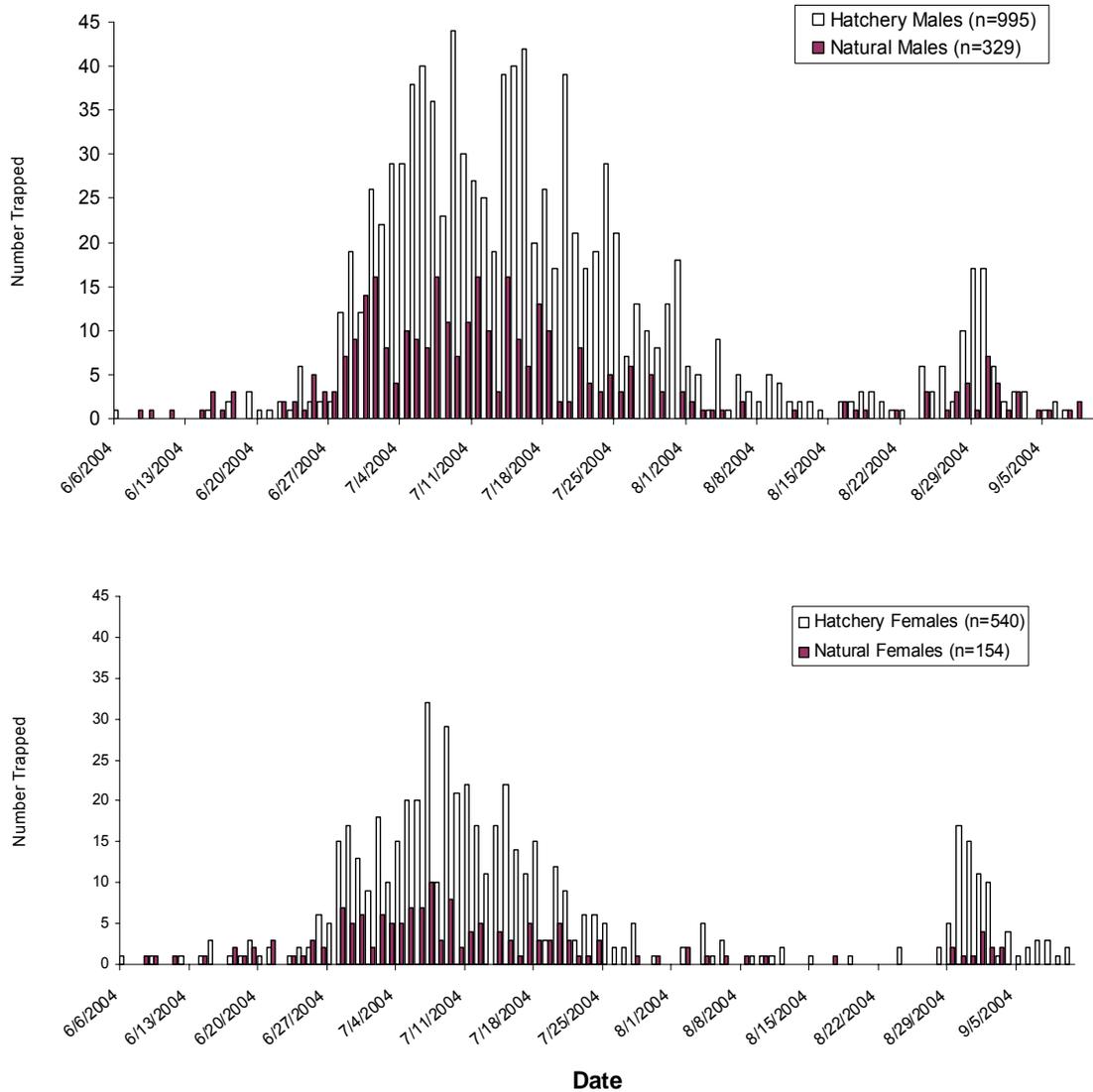


Figure 6. Run timing of hatchery- and natural-origin Chinook salmon at Sawtooth Fish Hatchery in 2004.

Age Structure—Age classification of returning hatchery-origin adults is estimated using the computer program Rmix. Coded wire tags were recovered from 797 (12 age-3, 783 age-4, and 2 age-5) of the 1,535 hatchery-origin fish that returned to the Sawtooth Fish Hatchery in 2004. In 2004, the age-5 hatchery-origin returns were from a release of 57,134 smolts released in the spring of 2001 and were 100% marked with CWTs. Therefore, all age-5 hatchery-origin fish returning to Sawtooth Fish hatchery in 2004 should have had CWTs. No CWTs were recovered from age-5 males and only two CWTs were recovered from females. This was not unexpected given the relatively small release size. With a lack of CWT recoveries from age-5 males, the age-5 male category was removed from the Rmix analysis. One hatchery-origin male measuring 101 cm fork length released above the weir is classified as age-5. Results from the Rmix analysis indicate that the male return was composed of 57.5% age-3, 42.4% age-4, and

0.1% age-5 returns. The female return was composed of 99.4% age-4 and 0.6% age-5 fish (Table 12). No age-3 females with CWTs were recovered in 2004. Average length at age for males and females is displayed in Table 12.

Table 12. Estimated age structure of hatchery-origin Chinook salmon that returned to Sawtooth Fish Hatchery in 2004. Average length-at-age is based on fish recovered with CWTs. Fish lengths are in centimeters. SD = standard deviation. The “Number Represented” and associated confidence intervals are based on the Rmix analysis.

Gender	Age	CWTs Recovered	Average Length (SD)	Number Represented (95% CI)	Percent of Return
Male	3	12	51.4 (6.1)	573 (541-604)	57.5
	4	334	76.5 (5.9)	421 (390-453)	42.4
	5*	0	NA	1 (NA)	0.1
<i>Male Total</i>		346		995	100
Female	4	449	77.9 (4.0)	536 (532-541)	99.4
	5	2	97.3 (4.6)	4 (2-8)	0.6
<i>Female Total</i>		451		540	100
Total		797		1535	

*One 101 cm age-5 male with CWT was trapped and released above weir but not included in the Rmix analysis.

Age classification of natural-origin adults for the 2004 adult return is based on a visual examination of the length frequency data. Length criteria used to distinguish age classes for males and females is shown in Figure 7 and Table 13 below. Based on these length criteria, the male return was composed of 18.8% one-ocean, 76.3% two-ocean, and 4.9% three-ocean fish. The female return was composed 84.4% two-ocean and 15.6% three-ocean.

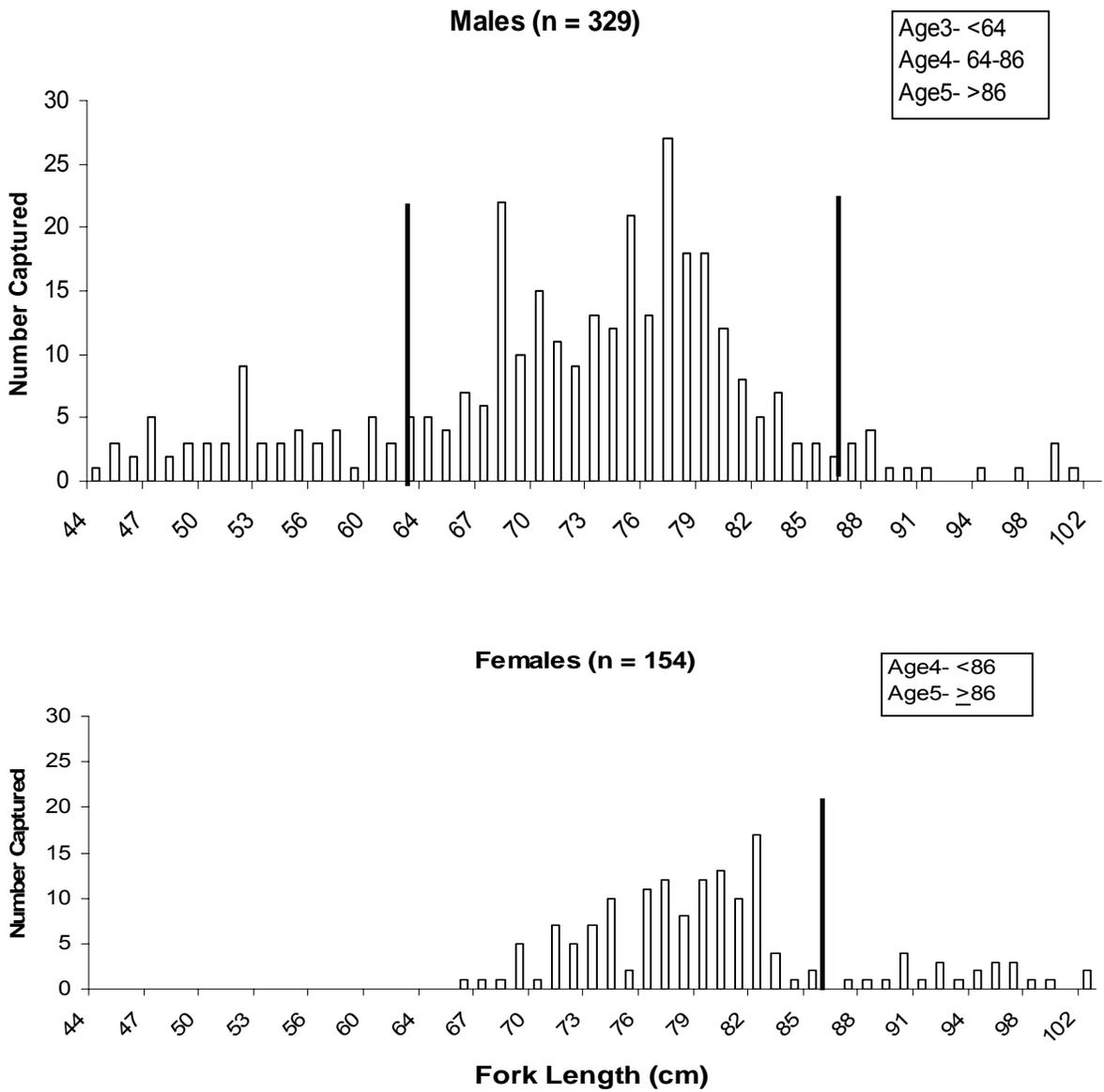


Figure 7. Length frequency and estimated age class composition of natural-origin Chinook salmon trapped at the Sawtooth Fish Hatchery weir in 2004. Solid bars represent length cutoffs used for age determination.

Table 13. Estimated age composition of natural-origin Chinook salmon trapped at the Sawtooth Fish Hatchery weir in 2004. Lengths are in centimeters and measured as fork length.

Gender	Age	Length Criteria	Number Trapped	Percent of Return
Male	3	<64	62	18.8
	4	64-86	251	76.3
	5	≥86	16	4.9
<i>Male Total</i>			329	100
Female	4	<86	130	84.4
	5	≥86	24	15.6
<i>Female Total</i>			154	100
Total			483	

1999 Brood Year Reconstruction and SAR—In 2004, the last of the progeny from the 1999 broodstock returned to the Sawtooth Fish Hatchery. In 1999, 12 females were spawned resulting in the release of 57,134 smolts in April of 2001 (Table 14). All of the smolts released were tagged with CWT but the adipose fins were not clipped and as such, this group was not subject to mark-selective fisheries.

From this smolt release, 164 adults were produced that either returned to the hatchery weir or contributed to harvest resulting in an overall SAR of 0.29% (Table 14 and Table 15).

Female-Progeny:Female-Parent Ratio—From the 12 females that were spawned in 1999, a total of 64 females returned to the Sawtooth fish hatchery weir in 2003 and 2004 resulting in a female-progeny:female-parent ratio of 5.3 (Table 15). In addition to the 64 females recovered at the weir, one brood year 1999 female was harvested in 2003 resulting in a total female-progeny:female-parent ratio of 5.4 indicating, that for brood year 1999, the Sawtooth Hatchery program was above replacement.

Table 14. Number of females spawned and survival of resultant progeny from egg to release at the Sawtooth Fish Hatchery for brood year 1999.

# of Females Spawned	Average Fecundity	# of Green Eggs	# of eyed Eggs	# of Smolts released	Green Egg to Release Survival
12	5,303	63,642	59,373	57,134	89.8%

Table 15. Estimated escapement and harvest of brood year 1999 hatchery-origin Chinook salmon adults from Sawtooth Fish Hatchery in 2002, 2003, and 2004. Numbers in parentheses represent the percentage of the total for the recovery type. Estimated harvest and strays are reported for the area downstream of LGD (Blw. LGD) and upstream of LGD (Abv. LGD) separately.

Recovery Type	Age-3 Recoveries in 2002	Age-4 Recoveries in 2003	Age-5 Recoveries in 2004	Total Brood Year Recoveries
Hatchery Weir	59 (36.6%)	98 (60.9%)	5 (2.5%)	162
Harvest (Blw. LGD)	0	2	0	2
Strays (Blw. LGD)	0	0	0	0
Harvest (Abv.LGD)	0	0	0	0
Strays (Abv.LGD)	0	0	0	0
Total Recoveries	59(35.9%)	100(61.0%)	5(3.0%)	164
Estimated # of Females ^a	0(0%)	61(93.8%)	4(6.2%)	65
# of Females at Weir	0(0%)	60(93.8%)	4(6.2%)	64

^a The fraction of total recoveries estimated to be female is based on the sex ratio of age-4 and age-5 fish observed at the hatchery weir in 2003 and 2004 respectively. In 2003, 61.2% of the age-4 hatchery-origin fish were female. In 2004, 80.0% of the age-5 hatchery-origin fish were female.

Clearwater Fish Hatchery

Adult Returns and Harvest—All three of the Clearwater Fish Hatchery satellite trapping facilities were operated in 2004 and adult returns to each facility are described below. Beginning in 1997, broodstocks for Red River and Crooked River satellites have been combined and are now referred to as the “South Fork” stock. For this report, brood year reconstruction for the South Fork stock includes the combined juvenile releases, adult returns, and harvest estimates from both Red River and Crooked River satellites.

Chinook salmon sport fisheries were held on sections of the main stem Clearwater River and its tributaries in 2004. These fisheries were targeting fish destined for Dworshak Fish Hatchery, Kooskia Fish Hatchery, and the three satellite facilities of Clearwater Fish Hatchery.

Powell Satellite Facility

Adult Returns—Trapping of adult Chinook salmon at the Powell satellite facility began on May 26 and continued until September 20 when the trap was taken out of operation. The first Chinook salmon was captured on June 6 and the last was captured on September 14. During the 2004 trapping period, 1,618 (1,570 hatchery-origin and 48 natural-origin) Chinook salmon were captured at the Powell satellite facility. Additionally, 91 hatchery-origin Chinook salmon were captured at a temporary weir on Crooked Fork Creek approximately one mile upstream of the Powell trapping facility. This trap is operated by IDFG staff associated with the ISS study to monitor the escapement of natural-origin Chinook salmon in Crooked Fork Creek and to intercept hatchery-origin strays. Hatchery-origin fish captured at this trap are considered strays from the Powell release site and, in 2004, were either transferred to the Powell holding ponds or released approximately 20 miles downstream of the Powell trap in an effort to recycle excess hatchery fish back through the sport fishery. Of the 91 hatchery-origin fish captured at the

Crooked Fork trap, 19 were transferred to the Powell holding ponds and the remainder were recycled through the fishery. The combined total of hatchery-origin fish captured at both traps is 1,661 (799 males and 862 females).

Chinook salmon returning to the Powell facility in 2004 are from groups released from brood years 1999, 2000, and 2001. None of the adipose clipped fish released from these three brood years were tagged with coded-wire tags and therefore, no estimates of harvest from the Pacific Ocean or Columbia River are made. Harvest evaluation staff from IDFG estimated that 835 Chinook salmon destined for the Powell facility were harvested in the Clearwater and Lochsa Rivers (IDFG unpublished data, Table 16). Including the harvest estimate, 2,496 Powell fish were accounted for in the 2004 return (Table 16).

Table 16. Estimated harvest and escapement of hatchery-origin Chinook salmon in 2004. Recoveries are from fish released from the Powell satellite facility.

Release Group/Site	Location and Recovery Type	Estimated Number
Powell Satellite	Idaho Harvest	835
	Strays	0
	Powell Satellite Trap*	1,661
Total		2,496

*Includes 91 hatchery-origin fish captured at the Crooked Fork Creek weir.

Run Timing—Arrival timing of adults to the Powell trap in 2004 resembles a bimodal distribution. The majority of adults returned in the first mode in June and July, and the second mode occurred during late August and early September (Figure 8). The median arrival date for hatchery-origin males and females occurred on June 18. It should be noted that the Powell trap was not operated from June 19-29 and therefore, the reported median arrival date is biased early.

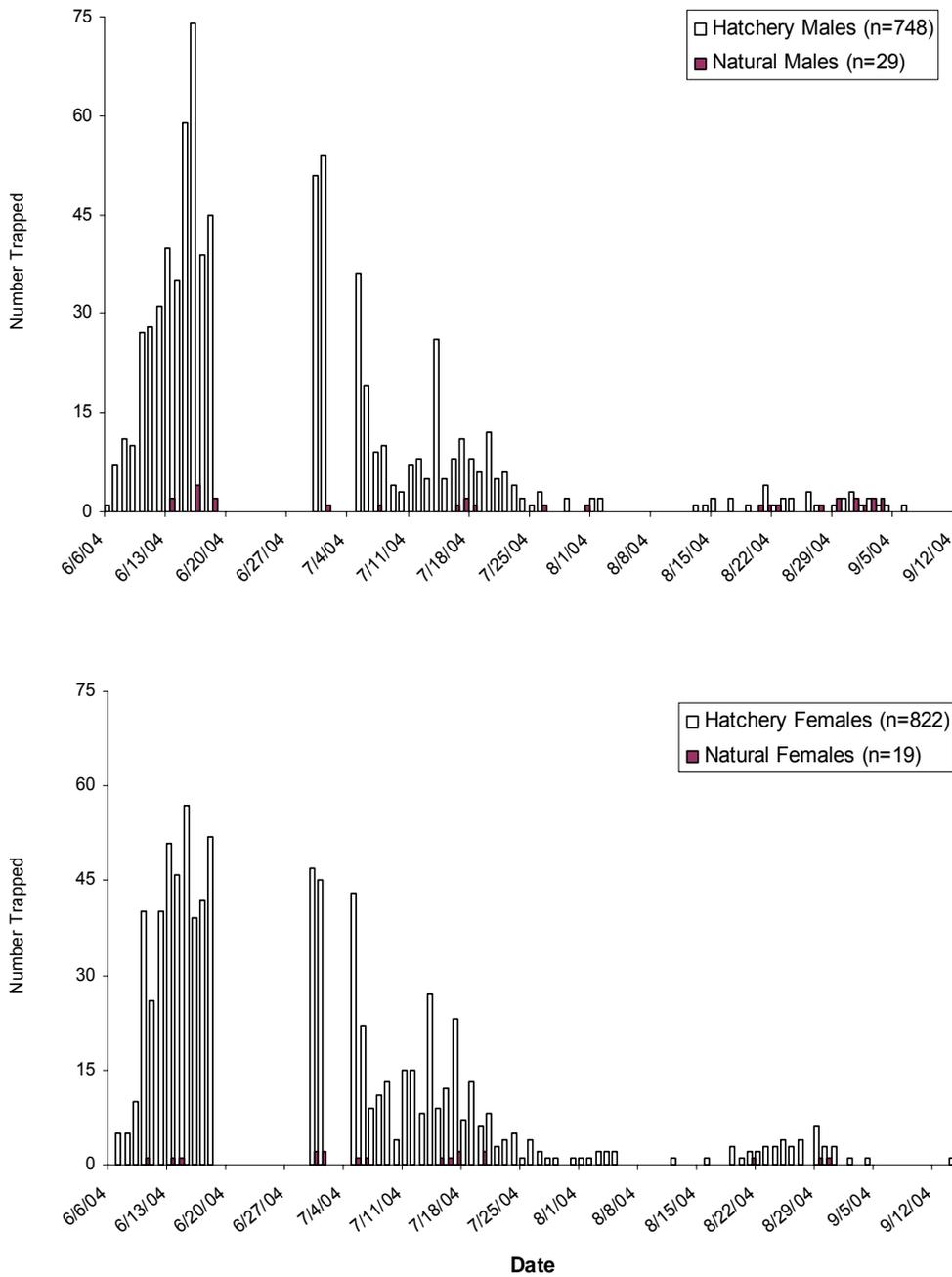


Figure 8. Run timing of hatchery- and natural-origin Chinook salmon at the Powell satellite facility in 2004. Does not include hatchery-origin adults captured at the Crooked Fork Creek weir.

Age Structure—Age classification of returning hatchery-origin adults was estimated by visual examination of length frequency data of fish recovered at the Powell trap (Figure 9). Based on length frequency data, the 2004 male return was composed of 42 age-3, 675 age-4, and 31 age-5 hatchery-origin fish, and the female return was composed of 2 age-3, 788 age-4, and 32 age-5 hatchery-origin fish (Table 17).

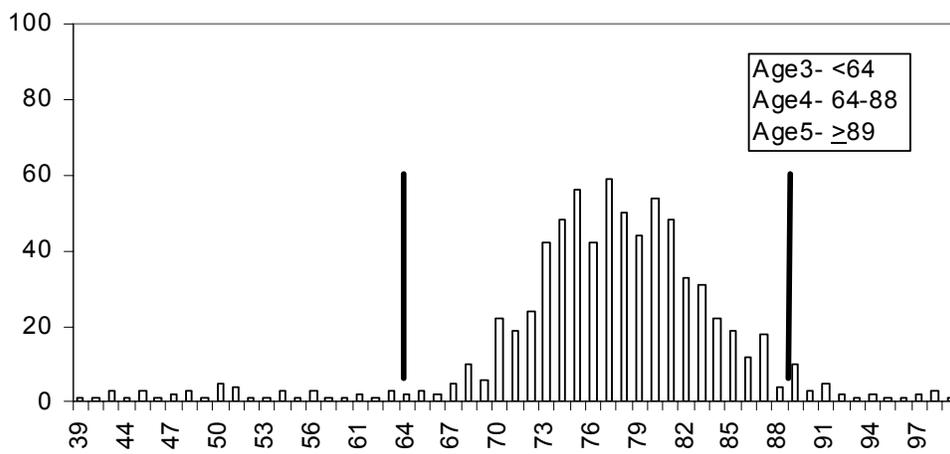
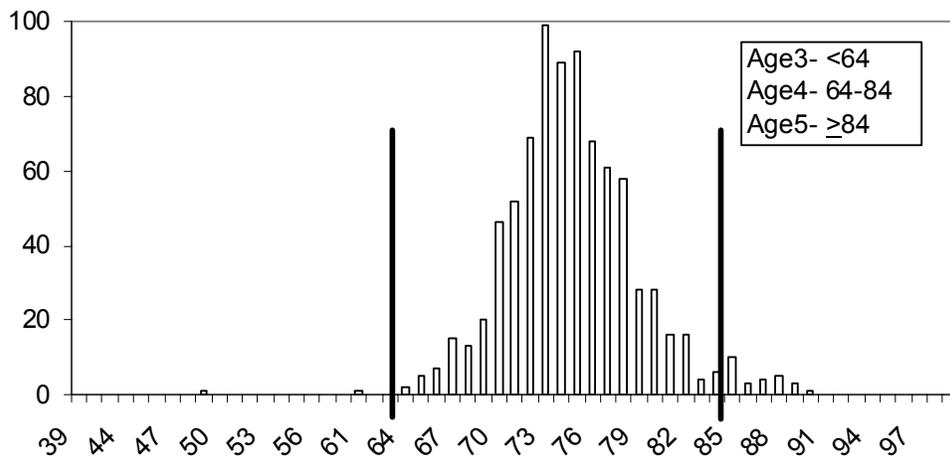


Figure 9. Length frequency and estimated age class composition of hatchery-origin Chinook salmon trapped at the Powell trap in 2004.

Table 17. Estimated age composition of hatchery-origin Chinook salmon that returned to the Powell trap in 2004.

Gender	Age	Length Criteria	Number of Fish	Percent of Return
		(cm)		
Male	3	<64	42	5.6%
	4	64-88	675	90.2%
	5	>88	31	4.2%
	<i>Total</i>		748	100.0%
Female	3	<64	2	0.2%
	4	64-84	788	95.9%
	5	>84	32	3.9%
	<i>Total</i>		822	100.0%
Total			1,570	

1999 Brood Year Reconstruction and SAR—In 2004, the last of the progeny from the 1999 broodstock returned to the Powell satellite facility. In 2001, a total of 212,648 smolts were released from the Powell facility. From these releases, 883 adults were accounted for that either returned to the hatchery weir or contributed to harvest resulting in an overall SAR of 0.41%. This SAR does not reflect any harvest that occurred in the Pacific Ocean or the main stem Columbia River due to the absence of CWTs in the release groups. Harvest rates in the main stem Columbia River for brood years 1997 and 1998 were estimated at 22.8% and 31.3%, respectively (Leth 2007; Leth and Lindley 2007). A similar harvest rate (26%) in the Columbia River for brood year 1999 would have resulted in a total contribution of 1,193 fish and an SAR of 0.56%.

Female-Progeny:Female-Parent Ratio—From the 53 females that were spawned in 1999 (Table 18), a total of 474 females returned to the Powell satellite facility or were harvested in 2003 and 2004, resulting in a female-progeny to female-parent ratio of 8.9 indicating that for brood year 1999, the Powell stock was above replacement (Table 19).

Table 18. Number of females spawned and survival of resultant progeny from egg to release at the Powell satellite facility for brood year 1999.

# of Females Spawned*	Average Fecundity	# of Green Eggs	# of eyed Eggs	# of Smolts released	Green Egg to Release Survival
53	4,716	249,992	229,393	212,648	85.1%

*includes 28 females from Lyons Ferry Hatchery. Number of females spawned is an estimate based on average fecundity and overall egg-smolt survival.

Table 19. Estimated escapement and harvest of brood year 1999 Chinook salmon from the Powell satellite facility in 2002, 2003, and 2004. Numbers in parentheses represent the percentage of the total for the recovery type. Estimated harvest and strays are reported for the area upstream of LGD (Abv. LGD).

Recovery Type	Age-3 Recoveries in 2002	Age-4 Recoveries in 2003	Age-5 Recoveries in 2004	Total Brood Year Recoveries
Hatchery Weir ^a	25 (2.9%)	763 (89.7%)	63 (7.4%)	851
Harvest (Abv.LGD) ^b	2	16	13	31
Strays (Abv.LGD)	0	1	0	1
Total Recoveries	27 (3.1%)	780 (88.3.1%)	76 (8.6%)	883
Estimated # of Females ^c	0(0%)	436 (%)	38 (%)	474
# of Females at Weir	0(0%)	426 (%)	32 (%)	458

^a Age composition at the hatchery weir in 2002 and 2003 is from Leth 2007 and Leth and Lindley 2007.

^b Idaho harvest data is from IDFG unpublished data.

^c The fraction of total recoveries estimated to be female is based on the sex ratio of age-4 and age-5 fish observed at the hatchery weir in 2003 and 2004 respectively. In 2003, 55.9% of the age-4 hatchery-origin fish were female. In 2004, 50.1% of the age-5 hatchery-origin fish were female.

South Fork Clearwater River Satellites (Red River and Crooked River)

Adult Returns—Trapping of adult Chinook salmon at the Crooked River satellite began on March 18 and continued until September 7. During the 2004 trapping period, 657 Chinook were trapped at Crooked River including 555 (276 males and 279 females) hatchery-origin and 102 (67 males and 35 females) natural-origin fish. Trapping at Red River began on March 22 and continued until September 7. During the 2004 trapping period, 575 Chinook were trapped including 549 (298 males, and 276 females) hatchery-origin and 26 (18 males and 8 females) natural origin fish. All ponded fish from the Red and Crooked River traps were combined at the Red River adult holding facility. In all, 1,104 hatchery- and 128 natural-origin Chinook were trapped in 2004.

Chinook salmon returning to the Red and Crooked River traps in 2004 were from groups released from brood years 1999, 2000, and 2001. None of the adipose clipped fish released from these three brood years were tagged with CWTs and therefore, no estimates of harvest from the Pacific Ocean or Columbia River are made. Harvest evaluation staff from IDFG estimated that 1,066 hatchery-origin Chinook salmon destined for the Red and Crooked River traps were harvested in the Clearwater and South Fork Clearwater Rivers in 2004 (IDFG unpublished data, Table 20). In all, 2,170 hatchery-origin Chinook salmon destined for the Red and Crooked River traps were accounted for in 2004 (Table 21).

Table 20. Estimated harvest and escapement of hatchery-origin Chinook salmon in 2004. Recoveries are from fish released from the Red and Crooked River satellite facilities.

Release Group/Site	Location and Recovery Type	Estimated Number
Red and Crooked River Satellites	Idaho Harvest	1,066
	Strays	0
	Red and Crooked River Traps	1,104
Total		2,170

Run Timing—Adults returning to the Crooked River trap arrived primarily in a single mode during June and July with a much smaller second mode towards the end of August (Figure 10). The median arrival date for hatchery- and natural-origin males occurred for both on 6/27. The median arrival date for hatchery- and natural-origin females occurred on 6/26 and 6/25, respectively.

Adults returning to the Red River trap arrived primarily in a single mode during late June and early July with a much smaller second mode towards the end of August (Figure 11). The median arrival date for hatchery- and natural-origin males occurred on 6/27 and 6/24, respectively. The median arrival date for hatchery- and natural-origin females occurred on 6/26 and 6/22, respectively.

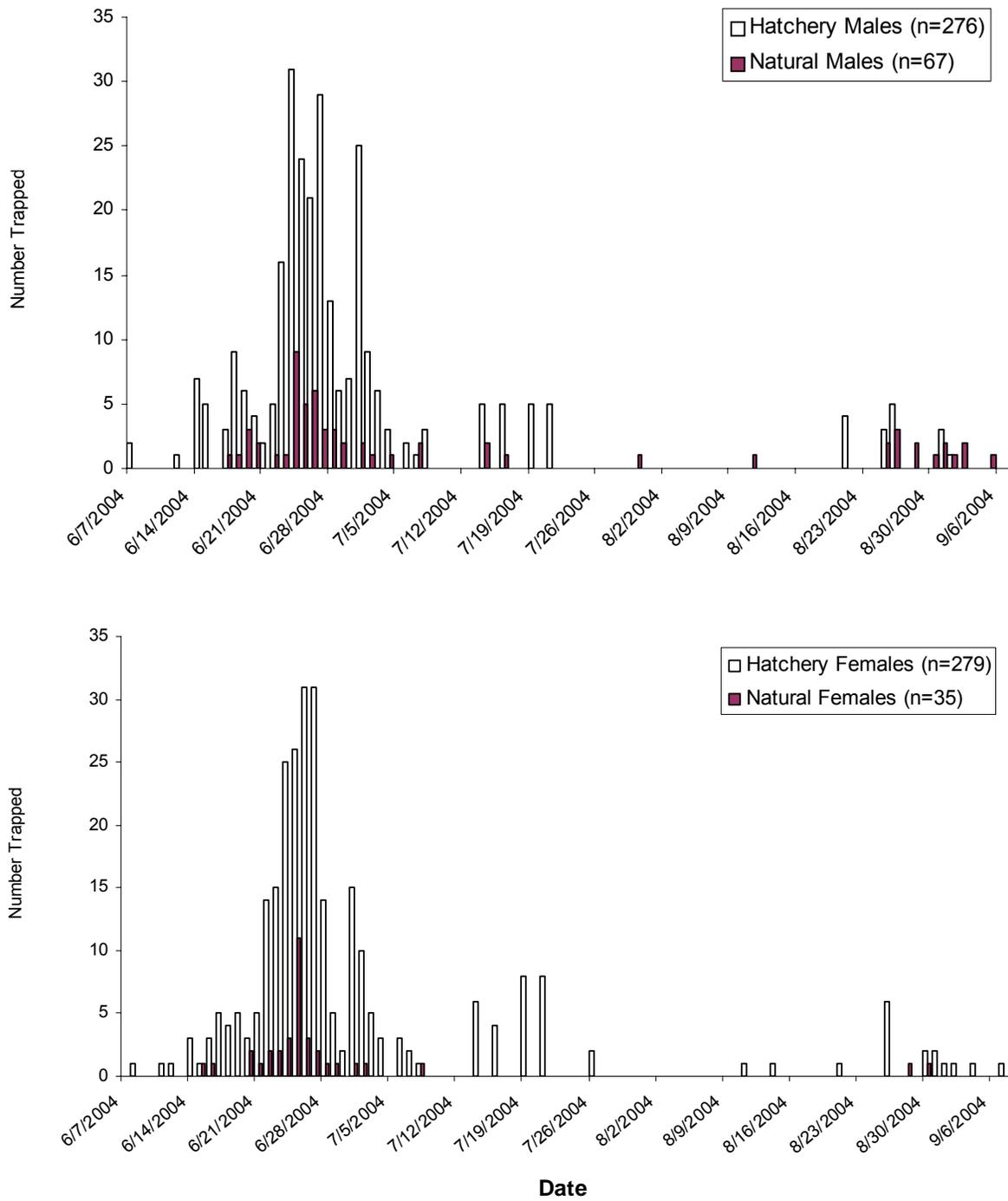


Figure 10. Run timing of hatchery- and natural- origin Chinook salmon at the Crooked River satellite facility in 2004.

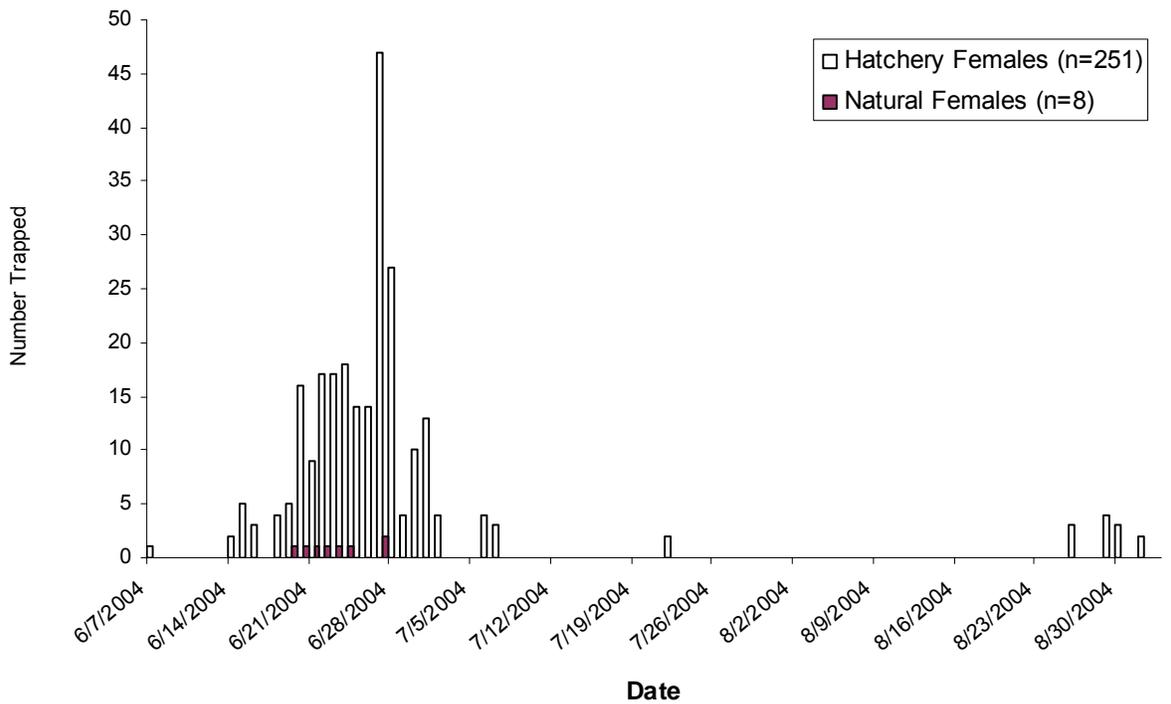
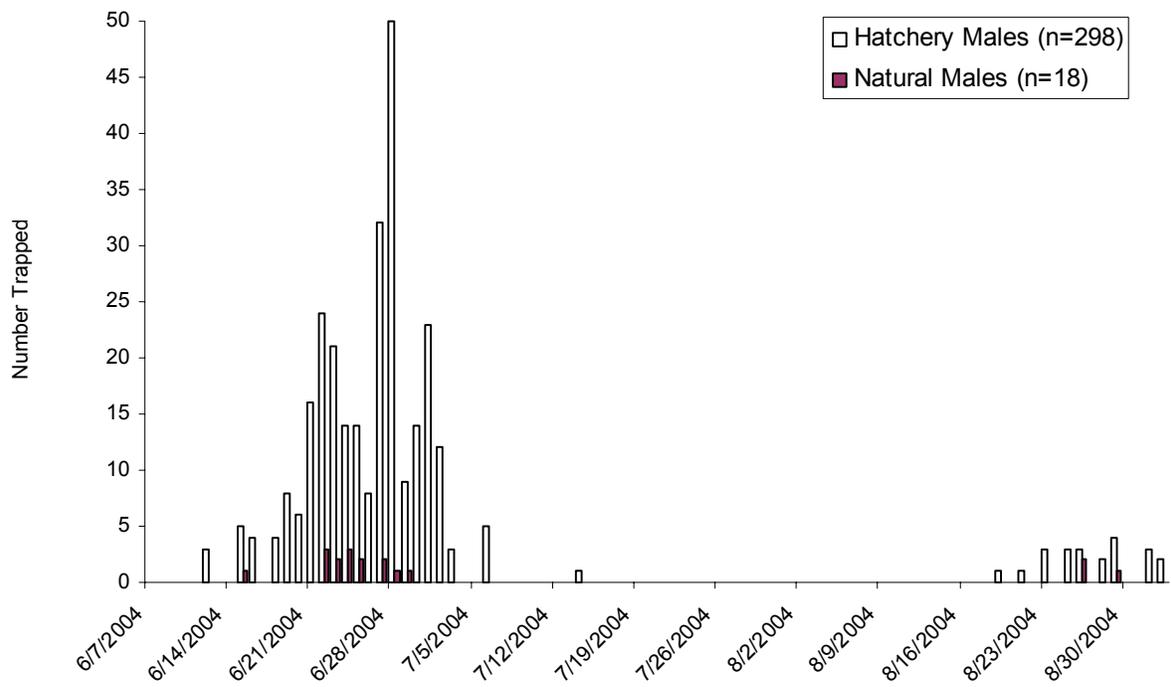


Figure 11. Run timing of hatchery- and natural- origin Chinook salmon at the Red River satellite facility in 2004.

Age Structure—Age classification of returning hatchery-origin adults was estimated by visual examination of combined length frequency data of fish recovered at the Red and Crooked River traps (Figure 12). Based on length frequency data, the 2004 male return was composed of 40 age-3, 534 age-4, and zero age-5 hatchery-origin fish, and the female return was composed of 2 age-3, 525 age-4, and three age-5 hatchery-origin fish (Table 21).

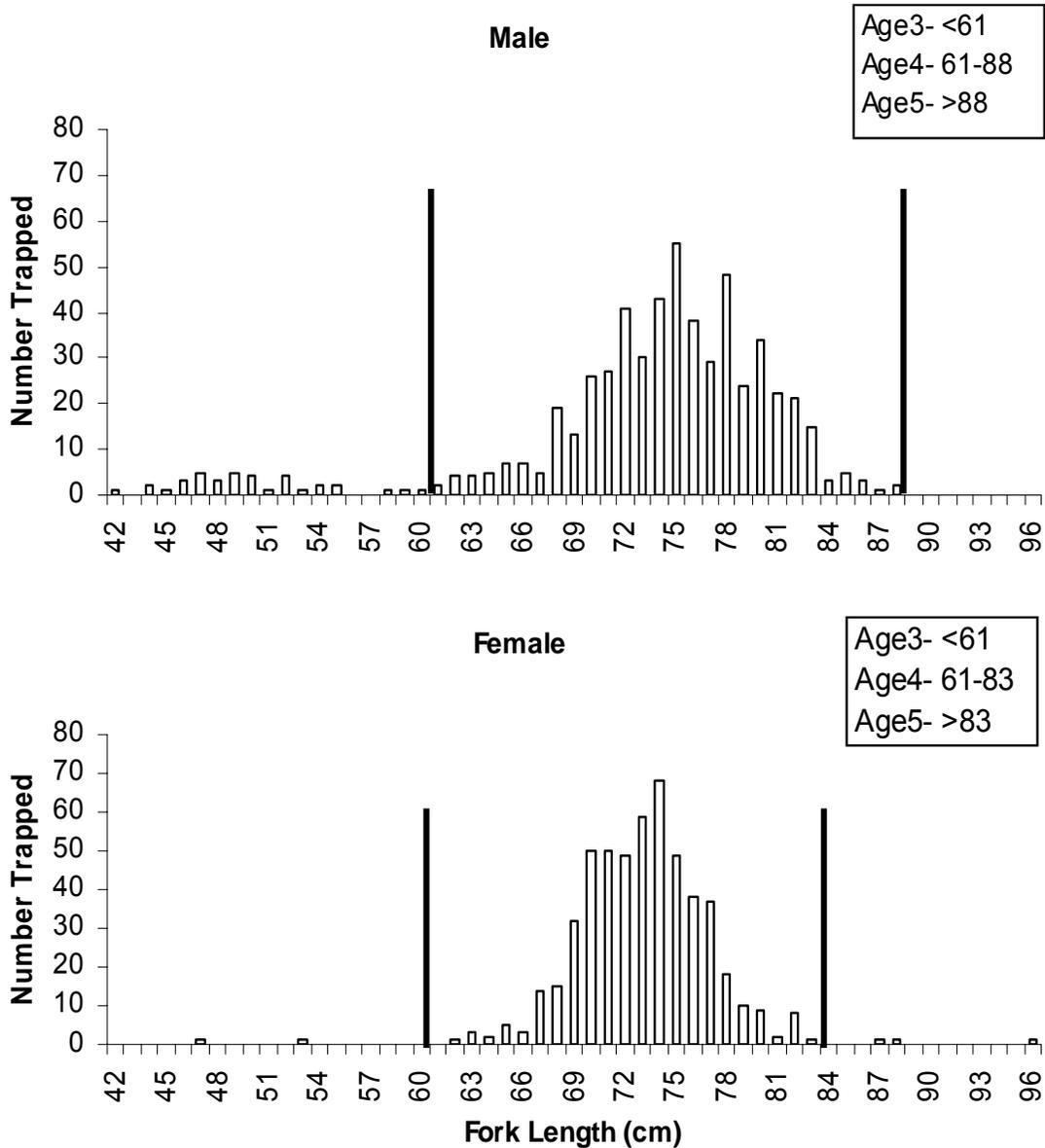


Figure 12. Length frequency and estimated age class composition of hatchery-origin Chinook salmon trapped at the Red and Crooked River traps in 2004.

Table 21. Estimated age composition of hatchery-origin Chinook salmon that returned to Red and Crooked River satellite facilities in 2004.

Gender	Age	Length Criteria (cm)	Number of Fish	Percent of Return
Male	3	<61	40	5.6%
	4	61-88	534	90.2%
	5	>88	0	4.2%
	<i>Total</i>		<i>574</i>	<i>100.0%</i>
Female	3	<61	2	0.2%
	4	61-83	525	95.9%
	5	>83	3	3.9%
	<i>Total</i>		<i>530</i>	<i>100.0%</i>
Total			1,104	

Estimated age composition of natural-origin Chinook salmon captured at the Red River and Crooked River traps is based on visual examination of length frequency data. Age composition for males is estimated at 2.6% age-3, 94.8% age-4, and 2.6% age-5. Female age composition is estimated to be 100% age-4 (Figure 13 and Table 22).

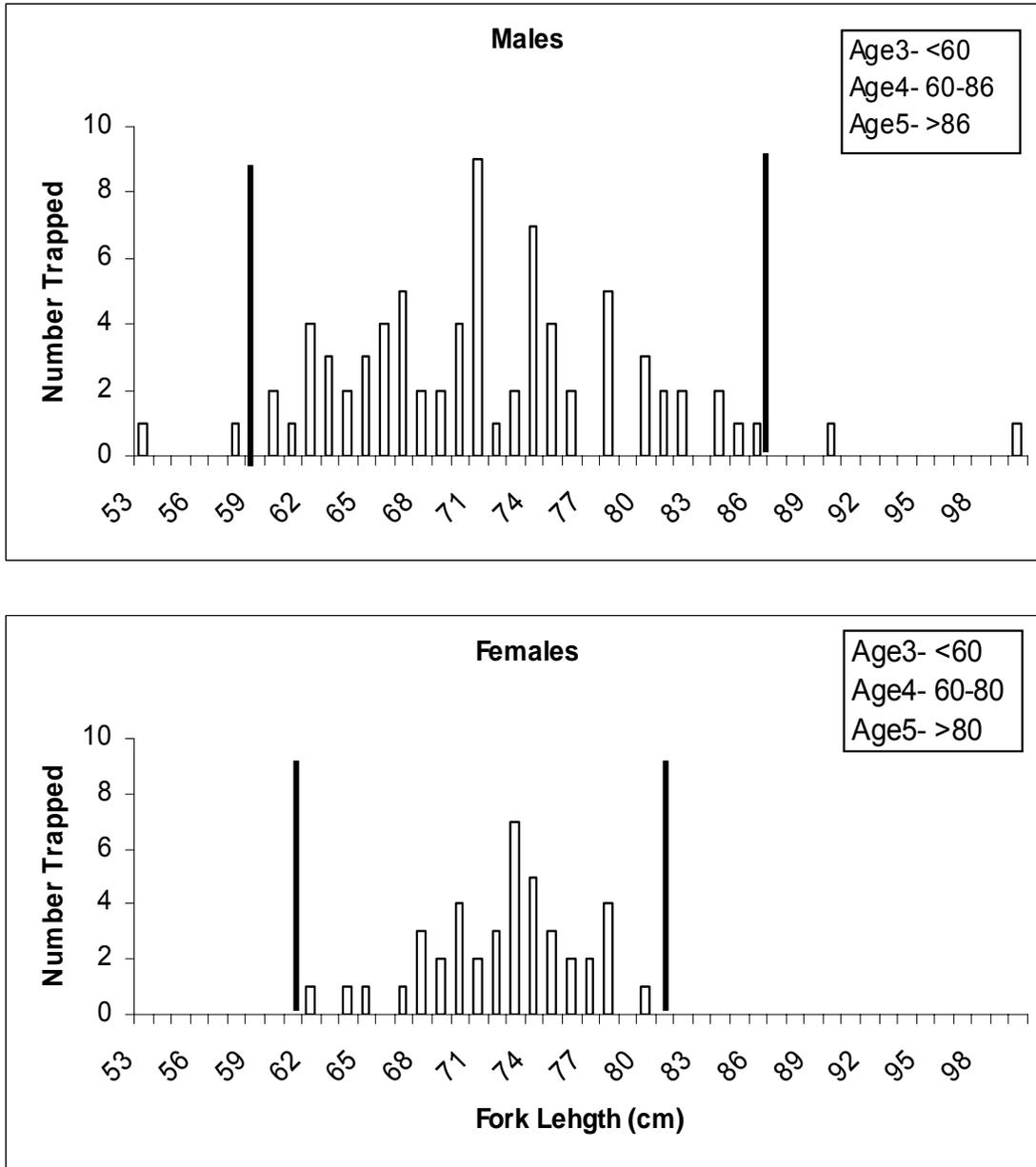


Figure 13. Length frequency and estimated age composition of natural-origin Chinook salmon trapped at the Red and Crooked River satellites in 2004. Dark vertical bars represent length cutoffs used for age determination.

Table 22. Estimated age composition of natural-origin Chinook salmon trapped at the Red River and Crooked River satellite facilities in 2004. Lengths are in centimeters and measured as fork length.

Gender	Age	Length Criteria	Number Trapped	Percent of Return
Male	3	<60	2	2.6%
	4	60-86	73	94.8%
	5	>86	2	2.6%
<i>Male Total</i>			77	100.0%
Female	3	>60	0	0%
	4	60-80	42	100%
	5	≥80	0	0%
		1		
<i>Female Total</i>			42	100.0%
Total			119*	

*Eight additional males and one additional female of unknown length were also trapped in 2004, bringing the total to 128 natural-origin fish.

1999 Brood Year Run Reconstruction and SAR—For the brood year 1999 releases in Red River and Crooked River, no adipose clipped fish were tagged with CWTs; therefore, no estimate of harvest was generated for the mixed stock fisheries that occurred in the Pacific Ocean and Columbia and Snake rivers in 2002, 2003, and 2004. However, estimates of harvest are included for the terminal fisheries that occurred in the Clearwater and South Fork Clearwater rivers. Smolt-to-adult survival and female-progeny:female-parent relationships only reflect the number of adults that returned to the weir and the estimated number harvested in the terminal fishery and, therefore, should be considered minimum estimates.

From the 185,242 presmolts (Table 23) released from the Red and Crooked River release sites in 2000, 64 adults were accounted for at the Red and Crooked River traps in 2002, 2003, and 2004 resulting in an SAR of 0.03% (Table 24). These fish were all ventral clipped and not subject to harvest in the mark selective terminal fishery. From the 84,649 smolts (Table 23) released in 2001, 228 adults were accounted for in the terminal fishery and the Red and Crooked River traps in 2002, 2003, and 2004, resulting in an SAR of 0.27% (Table 24). These fish were all adipose clipped and subject to harvest in mark-selective fisheries. Fish released as smolts showed a nine-fold survival advantage over the fish released as presmolts.

Female-Progeny: Female-Parent Ratio—From the 54 females spawned in 1999 used to create the presmolt release, 43 adult females returned to the Red and Crooked River weirs, resulting in a female-progeny to female-parent ratio of 0.8, which indicates that they were below replacement. From the 25 females spawned in 1999 to create the smolt release, 134 females were accounted for in the terminal fishery and the Red and Crooked River traps, resulting in a female-progeny to female-parent ratio of 5.4, indicating they were above replacement and showed nearly a seven-fold survival advantage over the fish released as presmolts.

Table 23. Number of females spawned and survival of resultant progeny from egg to release at the Red and Crooked River release sites for brood year 1999.

# of Females Spawned^a	Average Fecundity	# of Green Eggs	# of Eyed Eggs	# of Fish Released^b	Green Egg to Release Survival
79	3,853	304,408	291,215	269,891	88.7%

^a Includes 74 females from Lyons Ferry Hatchery and 5 females from the Red River and Crooked River facilities.

^b Includes 185,242 presmolts released in September of 2000 and 84,649 smolts released in Mar-Apr 2001.

Table 24. Estimated escapement and harvest of brood year 1999 Chinook salmon adults from the Red and Crooked River satellite facilities in 2002, 2003, and 2004. Numbers in parentheses represent the percentage of the total for that recovery type. Estimated harvest only includes the terminal fishery on the Clearwater and South Fork Clearwater River.

Recovery Type	Age-3^a Recoveries in 2002	Age-4^a Recoveries in 2003	Age-5 Recoveries in 2004	Total Brood Year Recoveries
Hatchery Weir	25 (9.4%)	238 (89.5%)	3 (1.1%)	266
Terminal Harvest	7 (26.9%)	16 (61.5%)	3 (11.5%)	26
Total Recoveries	32 (%)	254 (87.0%)	6 (2.1%)	292
Estimated # of Females ^b	0	186 (%)	6(3.1%)	194
# of Females at Weir	0	174 (%)	3 (1.7%)	177

^a Age composition for age-3 and age-4 weir returns was taken from Leth 2007 and Leth and Lindley 2007.

^b The fraction of total recoveries estimated to be female is based on the sex ratio of age-4 and age-5 fish observed at the hatchery weir in 2003 and 2004, respectively. In 2003, 73.1% of the age-4 hatchery fish were females. In 2004, 100% of the age-5 hatchery-origin fish were females.

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