



**LOWER SNAKE RIVER COMPENSATION PLAN  
STEELHEAD FISH HATCHERY  
EVALUATIONS—IDAHO**

**Brood Year 2006  
Hatchery Steelhead Report**

**Project Progress Report**



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# **Lower Snake River Compensation Plan Hatchery Steelhead Evaluations—Idaho**

## **Brood Year 2006 Hatchery Steelhead Report**

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## ABSTRACT

This report summarizes production, survival, and adult return information for brood year 2006 summer steelhead *Oncorhynchus mykiss* for the Lower Snake River Compensation Plan (LSRCP) and Idaho Power Company (IPC) hatchery mitigation programs operated within the state of Idaho.

Clearwater, Hagerman National, Magic Valley, and Niagara Springs fish hatcheries received eyed eggs from broodstock collection facilities and reared them for one year prior to release. Eyed egg-to-smolt survival across all hatcheries and stocks was high with an average of 85% (range = 76-98%). Smolts at all facilities were at or near the size target (4.5 fish per pound) when they were released. Combined, these facilities released 5,819,210 smolts at multiple sites in the Clearwater and Salmon river basins as well as the Snake River downstream of Hells Canyon Dam. Representative groups of hatchery steelhead in each rearing facility were tagged with passive integrated transponder (PIT) tags to evaluate migration timing and survival from release to Lower Granite Dam (LGD). Approximately 87% of these fish survived from release to LGD.

Brood year 2006 returned 85,687 adult steelhead to the mouth of the Columbia River during the 2008-09, 2009-10, and 2010-11 steelhead runs. It is important to note that these are minimum estimates as they do not account for undocumented straying, prespawn mortality, or fall out (fish stopping short of their release location). Production from LSRCP funded facilities (Clearwater, Hagerman National, and Magic Valley fish hatcheries) accounted for 53,384 of the steelhead, which is substantially below the annual mitigation goal of 117,780. Factors contributing to the LSRCP program's underperformance include releasing fewer smolts than intended as well as lower than anticipated survival from release to the adult life stage. The IPC funded facility (Niagara Springs Fish Hatchery) accounted for the remaining 32,303 adults.

The majority (79,569) of the returning brood year 2006 adults escaped upstream of LGD. Exploitation by recreational anglers accounts for 42,446 of the return to LGD. Lesser amounts of fish were removed by hatchery traps or observed/recovered as strays, 14,429 and 2,570 of the LGD return (respectively). The remaining fish (20,124) were classified as unharvested escapement. These fish were returning to offsite releases with no trapping facility to remove them. The majority of these unharvested fish were released with intact adipose fins (pursuant to the U.S. vs. Oregon agreement) and therefore not available for harvest in mark (clipped adipose fin) selective fisheries. Had these fish been marked, more fish would have been removed in recreational fisheries thereby reducing the unharvested escapement estimate.

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## INTRODUCTION

The Lower Snake River Compensation Plan (LSRCP) summer steelhead *Oncorhynchus mykiss* hatchery mitigation program was established to provide in-kind and in-place mitigation for lost harvest opportunity resulting from the construction and operation of the four lower Snake River hydroelectric dams (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams). Total mitigation expected for the LSRCP is 165,300 adults to be produced annually across the entire program which includes releases in Idaho, Oregon and Washington states. This is based on an assumed 2:1 ratio of catch (downstream of project area; Lower Granite Dam) to escapement (upstream of the project area) (USACE 1975). During the program development, it was anticipated that the majority of the harvest mitigation benefits would be distributed downstream of the project area. However, less than expected returns of hatchery fish produced within the program and the depressed status of natural-origin fish influenced Columbia River fisheries management programs. The anticipated 2:1 distribution of harvest benefits downstream:upstream of Lower Granite Dam has not been realized. Regardless of the actual distribution of harvest benefits, it was anticipated that the summer steelhead hatchery programs operated in Idaho at Clearwater, Hagerman National, and Magic Valley fish hatcheries would contribute 117,780 (71% of the total) adults annually towards the total LSRCP mitigation goal.

In addition to the LSRCP, Idaho Power Company (IPC) maintains a hatchery summer steelhead mitigation program as well. This program mitigates for the construction and ongoing operation of the Hells Canyon Dam Complex (Brownlee, Oxbow, and Hells Canyon dams). Mitigation goals established through the Hells Canyon Settlement Agreement specifies an annual smolt production target 400,000 pounds for Niagara Springs Fish Hatchery, which equates to approximately 1,800,000 yearling smolts at 4.5 fish per pound. While the settlement agreement does not specify an adult return goal, IDFG anticipates these releases to return at rates comparable to the LSRCP facilities.

### **Hatchery Evaluation Component**

The LSRCP includes a Hatchery Evaluation Studies component to monitor and determine the best practices for the operation of LSRCP hatcheries in each state. Evaluations consist of two major objectives outlined in the Cooperative Work Agreement established annually between the USFWS and IDFG. The first of these objectives is to document the accomplishments of the Idaho-LSRCP program towards meeting the adult steelhead production goal. The second objective is to identify factors limiting hatcheries from meeting return goals and to recommend improvements as these factors become apparent. Much of this latter task consists of performing specific experiments related to hatchery success and are generally documented in independent reports.

This report includes information from all life stages of brood year 2006 hatchery steelhead released in Idaho from the LSRCP and the IPC mitigation programs. The report was delayed seven years to allow sufficient time for adults from brood year 2006 to return (five year generation length) plus two additional years to allow for all out-of-state coded wire tag recoveries to be reported to the Regional Mark Information Center.

## Steelhead Hatchery Facilities

### Broodstock Collection Facilities

The LSRCP and IPC mitigation programs utilize steelhead eggs collected from one of the four hatchery weirs or two satellite facilities operated in Idaho (Table 1, Figure 1, and Figure 2). In most cases, broodstock collection and egg production are managed as segregated programs, only utilizing hatchery-origin adults in the broodstock. One exception is the integrated supplementation program in the East Fork Salmon River (EFNAT) that utilizes naturally produced steelhead in the hatchery broodstock.

Table 1. Hatchery broodstock collection facilities that provide steelhead eggs to the LSRCP and IPC mitigation hatcheries in Idaho.

<b>Broodstock Collection Facilities</b>	<b>Stock Abbreviation</b>	<b>Mitigation Program</b>
Dworshak National Fish Hatchery*	DWOR	USACOE
Oxbow Fish Hatchery	OX	IPC
Pahsimeroi Fish Hatchery	PAH	IPC
Sawtooth Fish Hatchery	SAW	LSRCP
East Fork Satellite Facility**	EFNAT	LSRCP
Squaw Creek Temporary Weir**	USAL	LSRCP

\* Dworshak National Fish Hatchery operates a steelhead mitigation program funded by the U.S. Army Corps of Engineers (USACOE) that is not included in this report.

\*\* Satellite facilities operated by the Sawtooth Fish Hatchery.

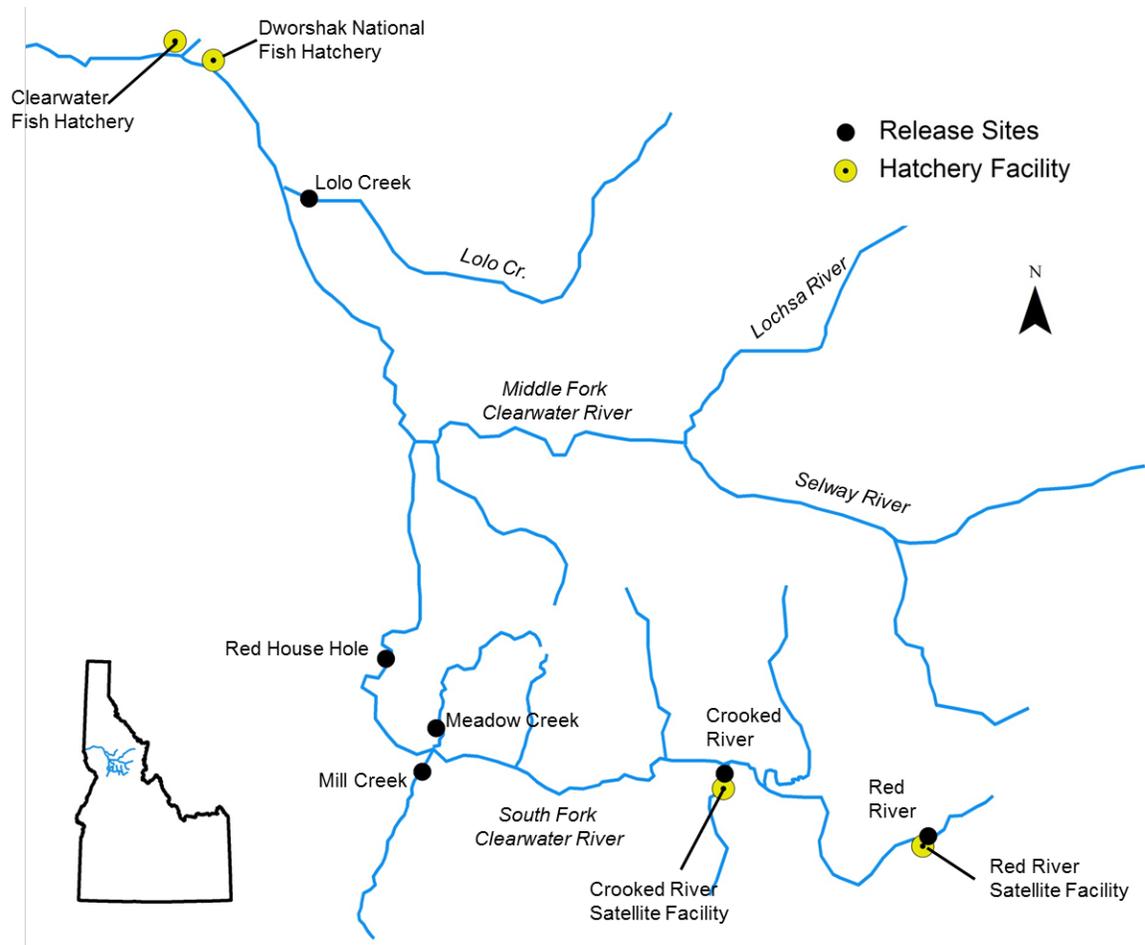


Figure 1. The location of hatchery steelhead release sites and hatchery facilities in the Clearwater River basin associated with the LSRCP mitigation program.

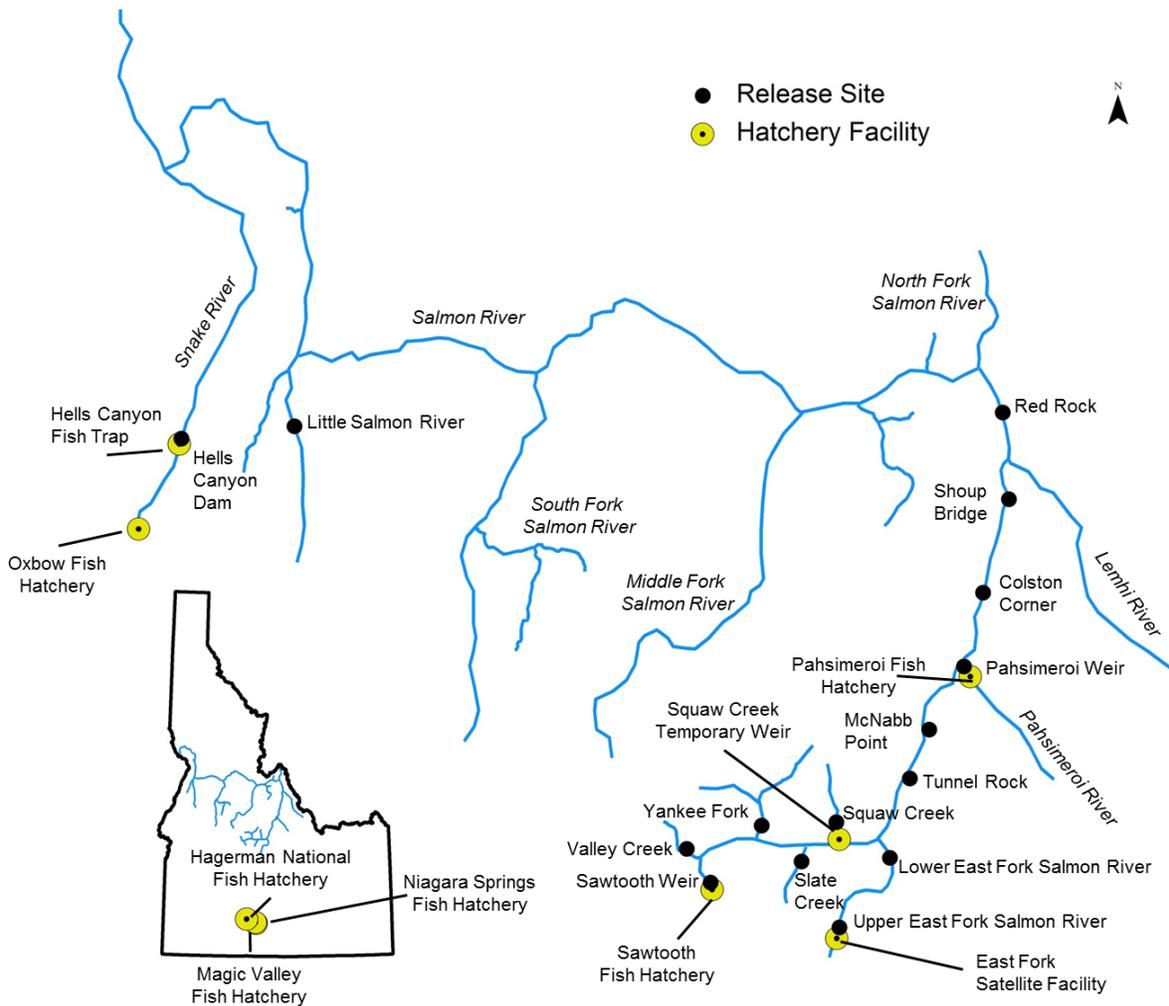


Figure 2. The location of hatchery steelhead release sites and hatchery facilities in the Salmon and Snake river basins associated with the IPC and LSRCP mitigation programs.

### Stock Descriptions and History

**Dworshak (DWOR)**—The DWOR stock was derived from wild fish returning to the North Fork Clearwater River and collected/spawned at Dworshak National Fish Hatchery (DNFH) in the late 1960s and early 1970s. This stock has been the primary source of egg production at DNFH and Clearwater fish hatcheries, which release smolts into the Clearwater River basin. Dworshak Dam blocks access to all spawning habitat in the North Fork Clearwater; therefore, the North Fork Clearwater steelhead population is entirely maintained at DNFH. This hatchery population is included in the Distinct Population Segment and therefore listed as threatened under the endangered species act (ESA; NOAA 2006). Harvest in mark selective fisheries (AD-clipped fish) for this stock is permitted despite the listing status. These fish are generally referred to as “B-run” fish, as the majority (approximately 90%) mature after two or more years in the ocean. Smolts from this stock have also been released in the Salmon River basin as part of the LSRCP mitigation program. These out-of-basin releases are not listed under the ESA.

**Oxbow (OX)**—The OX stock was developed by collecting adult steelhead returning to Hells Canyon Dam. Since its development (brood year 1966) this stock has been managed as a locally adapted stock, with few and infrequent releases of other stocks. The OX stock is not listed under the ESA. These fish are generally referred to as “A-run” fish as the majority (approximately 65%) mature after one year in the ocean.

**Pahsimeroi (PAH)**—The development of PAH stock began in brood year 1966 with the release of OX smolts into the Pahsimeroi River. Their return (brood year 1969) produced the first PAH production. The PAH stock was largely self-sustaining by 1970 and has been managed as a locally adapted stock since then, with few and infrequent releases of other stocks. Like the stock from which they were derived, the majority (approximately 80%) of PAH fish mature after one year in the ocean and are therefore referred to as A-run fish.

**Sawtooth (SAW)**—The development of the SAW stock was initiated in brood year 1982 by releasing PAH smolts at the Sawtooth weir. Their return (brood year 1985) produced the first SAW production but PAH smolt releases continued at the Sawtooth weir release site until brood year 1999, at which time the SAW stock became fully self-sustaining and PAH releases were eliminated. Since then the SAW stock has been managed as a locally adapted stock and releases of other steelhead stocks at this location have not occurred. Like the stock from which they were derived, the majority (approximately 80%) of SAW fish mature after one year in the ocean and are therefore referred to as A-run fish.

**East Fork Natural Stock (EFNAT)**—The East Fork Natural Program was initiated in brood year 2001 in as a supplementation effort to increase the abundance of naturally produced adult steelhead in the East Fork Salmon River. Adult hatchery and natural steelhead collected at the East Fork Satellite Facility are used as broodstock for this program. The EFNAT hatchery-origin steelhead are listed under the ESA.

**Upper Salmon B-run (USAL)**—The Upper Salmon B-run program was initiated to develop a locally adapted broodstock to the Upper Salmon River, in which the majority (90%) of adults mature after two or more years in the ocean. This stock was developed from DWOR adults returning to Squaw Cr. near Clayton, Idaho using a temporary weir since brood year 2002. USAL smolts are the progeny of these adults, regardless of whether the adults were one or more generations removed from Dworshak National Fish Hatchery. As the program expands, this locally adapted stock will replace DWOR releases in the Salmon River.

### **LSRCP Rearing Facilities**

The LSRCP mitigation plan identified adult return goals for each of the three LSRCP rearing facilities in Idaho (Table 2, USACE 1975). Annual smolt production targets were identified for each facility based on adult return goals and an anticipated smolt-to-adult survival rate; however, the actual production targets changed over time. These changes are discussed in the facility descriptions below. In addition to the adult return goal, the plan also identified an anticipated 2:1 distribution of harvest benefits downstream:upstream of Lower Granite Dam; which was used to identify an escapement to LGD objective.

Table 2. Adult production goals, escapement targets to Lower Granite Dam (LGD), Smolt-to-adult survival rates (SAS), and smolt production targets for the LSRCP and IPC steelhead mitigation hatcheries in Idaho.

Mitigation Program	Rearing Hatchery	Adult Production Goal	SAS (%)	Escapement to LGD	Smolt Production Target
LSRCP	Clearwater	42,000	3.91	14,000	1,750,000
LSRCP	Hagerman Nat.	40,800	3.16	13,600	1,700,000
LSRCP	Magic Val.	34,980	2.19	11,660	2,000,000
IPC	Niagara Spr.	NA	NA	NA	1,800,000*

\* The production goal for Niagara Springs is based on 400,000 pounds of steelhead being released as smolts at 4.5 fish per pound. This facility does not have an adult production or escapement goal.

**Clearwater Fish Hatchery (Clearwater)**—is located at the confluence of the North Fork Clearwater and mainstem Clearwater rivers near Ahsahka, Idaho. Clearwater’s mitigation goal is to annually produce 42,000 adult steelhead. Clearwater annually releases approximately 843,000 smolts to achieve this goal. It is important to note that Clearwater’s annual smolt production goal was originally 1,750,000 smolts but was reduced due to limited water availability and to provide more rearing space for the Chinook salmon program at that facility. Despite these smolt reductions, the adult return goal remains the same. Clearwater receives green eggs from one stock (DWOR) and rears them to yearling smolts for release into the Clearwater River basin (Figure 1). In addition to its primary mitigation function as a rearing facility, Clearwater also receives green DWOR eggs that are incubated to the eyed egg stage before being transferred to Magic Valley Fish Hatchery for final rearing and release into the Salmon River.

**Hagerman National Fish Hatchery (Hagerman National)**—is located along the Snake River in southern Idaho near the town of Hagerman, Idaho. Hagerman National’s mitigation goal is to annually produce 40,800 adult steelhead. Hagerman National was originally intended to produce 1,700,000 smolts to meet this goal; however, through the 1990s production was incrementally decreased to 1,140,000 smolts due to litigation over water rights that could have substantially reduced water availability. The litigation was resolved in the late 1990s and production was incrementally increased. Hagerman National’s brood year 2006 production target was 1,450,000 smolts. Hagerman National receives eyed eggs from three stocks (DWOR, PAH, and SAW) to meet the production target. This production is released into the Salmon River basin as yearling smolts (Figure 2).

**Magic Valley Fish Hatchery (Magic Valley)**—is located along the Snake River near Filer, Idaho. The annual mitigation goal for this facility is to produce 34,980 adult steelhead. To achieve this goal Magic Valley was originally intended to release 2,000,000 smolts annually; however, the actual annual production targets varied through the history of the facility to compensate for production reductions at Hagerman National and reduced water availability at Magic Valley. Magic Valley’s annual product target was incrementally reduced in the early 2000s due to a decline in water availability. By brood year 2005, production was reduced to 1,600,000 smolts, which was also the target in brood year 2006. Magic Valley receives eyed eggs from five stocks (DWOR, EFNAT, PAH, SAW, and USALB) to satisfy production needs. This production is released into the Salmon River basin as yearling smolts (Figure 2).

## **IPC Rearing Facilities**

**Niagara Springs Fish Hatchery (Niagara Springs)**—is located on the Snake River near Wendell, Idaho. Unlike other facilities, which receive only eyed eggs, Niagara Springs receives eyed eggs and fry from two stocks (OX and PAH). Steelhead produced at Niagara Springs are released in the Snake and Salmon rivers (Figure 2). The smolt production goal for Niagara Springs is to release 400,000 pounds of smolts annually, which equates to approximately 1,800,000 yearling smolts at 4.5 fish per pound. Although this facility/mitigation program does not have a specific adult return goal, smolts released from Niagara Springs are expected to survival to the adult life stage at rates comparable to other facilities.

## **METHODS**

### **Juvenile Production**

#### **Broodstock Collection and Smolt Production**

Adult steelhead trapping, spawning, and egg production information is compiled from brood year or run reports prepared by the broodstock collection facilities. Key parameters for broodstock collection include the total number of adults trapped, number of adult fish spawned, the number of green eggs collected, and the number of eggs shipped.

Juvenile production information is compiled from brood year reports prepared by staff at the rearing facilities. Key parameters reported included eyed eggs received, as well as the number of smolts released and their marks/tags. Hatchery staffs use these values to estimate eyed egg-to-smolt survival rates.

#### **Marking and Tagging**

IDFG staff marked (clipped fins) and tagged hatchery steelhead production to meet specific management and evaluation objectives. The presence (AD-intact) or absence of an adipose fin (AD-clip) is used as the sole designator of a harvestable hatchery-origin fish in mark selective fisheries and is also one of the primary indicators of origin at hatchery traps. Some non-Ad clipped hatchery smolts are released pursuant to the U.S. vs Oregon agreement (2008) or for other management objectives. These non-AD-clipped fish can generally be identified as hatchery origin by secondary characteristics (fin erosion). Coded wire tags (CWTs) are an important tool for monitoring and evaluating steelhead and are used to generate release group-specific harvest and stray estimates. These tags also provide a known age component at hatchery traps to use in assigning an age composition to the entire hatchery return at each trap. Lastly, CWTs are sometimes used as a differential mark for broodstock and weir management purposes. Passive integrated transponder tags (PIT) are used to generate estimates of juvenile survival to Lower Granite Dam and juvenile run timing through the Snake and Columbia river hydropower system.

#### **Juvenile Migration Timing and Survival**

I used PIT tag detection information submitted to PTAGIS to estimate juvenile survival from release to LGD. Observation sites specified in the query included seven dams on the Snake and Columbia rivers: Lower Granite (LGD), Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, and Bonneville. Using this information, the “arrival window” (the period in

which the middle 80% of smolts arrive to LGD) was summarized. Survival rates of PIT-tagged steelhead, from release to LGD, were estimated using the PitPro program (Westhagen and Skalski 2009) developed in the School of Aquatic and Fishery Sciences at the University of Washington. This program generates a point estimate and a standard error that is used to generate 95% confidence intervals. The program uses the Cormack-Jolly-Seber model (Cormack 1964; Jolly 1965; Seber 1965) for single release and multiple recapture events, which accounts for differences in collection efficiency at the main stem Snake and Columbia river dams.

## **Adult Returns**

### **Estimating Harvest in Idaho Fisheries**

After each of the fall and spring steelhead fisheries conclude, mail and/or phone harvest surveys are conducted to estimate statewide harvest (SWH). This information is summarized for each river section (Figure 3) and month combination (stratum). I allocated harvest within a stratum to individual release group(s) by expanding CWTs recovered during creel surveys by the sample rate (the fraction of harvest observed by creel staff in the stratum) and tagging rate (fraction of release group that was CW-tagged). I then adjusted these expanded estimates to the SWH estimate. To ensure all release groups were represented with CWTs, I combined AD-clipped release groups that did not contain CWT fish with other release group(s) containing CWTs. These combined groups were typically the same stock reared at the same hatchery. However, this was not always possible. Therefore, when groups from different hatcheries or of different stocks were combined, it was assumed that the survival and harvest rate of all fish within the combined group was the same. CWT tagging rate information for Dworshak National Fish Hatchery, Oregon, and Washington releases in the Snake basin was obtained from these cooperators.

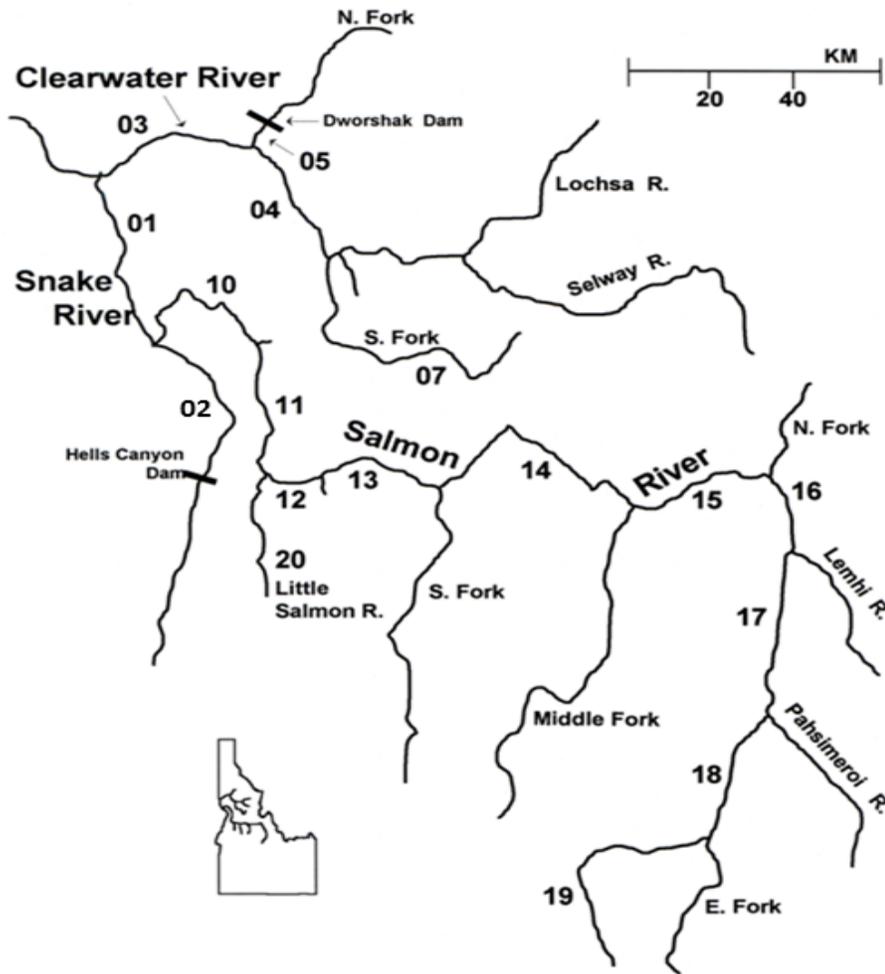


Figure 3. Idaho Department of Fish and Game river section designations where hatchery steelhead are available for harvest. Major tributaries or dams indicated on the map are used as section boundaries.

### Harvest Outside of Idaho

I used CWT recovery information submitted to the Regional Mark Information System (RMIS) to estimate harvest outside of Idaho (above LGD in Oregon, Lower Snake River, Columbia River). Coded wire tag recoveries were expanded by the tagging rate for each release group and the survey rate reported to RMIS by the respective recovery agency. If a survey rate was not reported for a given CWT recovery, it was assumed to be “1”.

### Hatchery Trap Returns

Hatchery staff enumerated and recorded biological information from steelhead that escaped fisheries and were collected at hatchery traps. I used this information to estimate the age composition of adults returning to individual hatchery facilities by one of two methods. In cases where enough known age information is available, the statistical computer program *R* (*R*

Development Core Team 2010) was used with the *mixdist* library package (Macdonald 2010) to estimate the proportion of each age group from the total return. *Rmix*, as it is called, was designed to estimate the parameters of a mixture distribution with overlapping components, such as the overlapping length distributions associated with adult steelhead returns composed of multiple age classes. If known age information was lacking, then age composition was estimated using the NORMSEP feature in the FAO-ICLARM Stock Assessment Tools (FiSAT) II software (Gayanilo et al. 2005). This method also applies the maximum likelihood concept and provides an estimated proportion of fish in each age class.

### **Estimating Unharvested Escapement for Offsite Releases**

Estimating unharvested escapement for offsite releases, where there was no weir to trap fish, presents a problem in that harvest is the only parameter that can be directly estimated for these fish using CWT. To overcome this, I used a smolt-to-adult return rate (see “Brood Year Reconstruction, SAR, and SAS” section below) from a surrogate release group to estimate adult returns upstream of LGD for each offsite release group. I then deducted harvest (a direct estimate) from the estimated return at LGD and the difference between the two values represents the unharvested escapement for the offsite release group in question. Release groups used and surrogates were typically released at a nearby broodstock collection facility with a permanent weir. The Sawtooth release group was used as a surrogate for PAH and SAW releases in the Salmon River downstream to Challis, the Pahsimeroi release group was used as a surrogate for all other PAH and SAW releases in the basin, and the Squaw Creek release group was used as a surrogate for all DWOR and USAL releases in the Salmon River basin. Dworshak National Fish Hatchery’s onsite release was used as a surrogate for Clearwater’s releases into the South Fork Clearwater River. SAR data for Dworshak National Fish Hatchery releases was provided by USFWS staff (Chris Peery personal communication).

### **Straying**

Any CWT recovered outside of the juvenile migration corridor was considered a stray. Exceptions to this include the John Day Arm and Drano Lake as these areas were inundated with slack water from the Columbia River. CWTs recovered in fisheries downstream and upstream of LGD were expanded using the methods discussed above. CWTs recovered at hatchery traps were expanded by the tagging rate of the group which they represent but not by a sample rate as it was assumed all fish were scanned for CWT.

### **Brood Year Reconstruction, SAR, and SAS**

I compiled the adult steelhead return information to reconstruct adult returns from brood year 2006. These adult returns were summarized by two large geographical areas, upstream and downstream of LGD, to evaluate mitigation goals and provide information for other management purposes. The dispositions of adults within these areas were also summarized to provide perspective on how these returns were utilized.

In addition to evaluating mitigation goals, I also used adult return estimates to evaluate survival rates to the adult life stage. The estimated number of adult steelhead escaping to LGD as adults was divided by the number of smolts released for group in question to generate a smolt-to-adult return rate (SAR). Similarly, the estimated total number of adult steelhead produced (the sum of adults accounted for upstream and downstream of LGD) was divided by the number of smolts released from the group in question to generate total smolt-to-adult

survival rate (SAS) that represents the total number of adults produced prior to any human exploitation.

Lastly, I calculated progeny-to-parent ratios (PPR) to evaluate each program's ability to contribute the mitigation goal. The PPRs were estimated by dividing the total number of adult steelhead returning from a brood year by the number of males and females that were spawned to create the brood in question. A PPR value of one is the threshold in which the brood is replacing itself or in other words each male/female pair is returning two progeny as adults to LGD. However in order for LSRCP facilities to meet their total adult return goal a PPR value of approximately 30 for A-run stocks and 70 for B-run stocks is needed. Parents whose progeny were culled to eliminate excess production or because the parents tested positive for disease were not included in the estimate.

## **RESULTS**

### **Juvenile Production**

#### **Broodstock Collection and Egg Production**

In most cases, hatchery staffs collect broodstock in late March through early May and spawn fish shortly thereafter. The exception to this is the OX stock where broodstock is collected from late September through October at the Hells Canyon Fish Trap and held for spawning until spring at Oxbow Fish Hatchery. Limited broodstock collection does occur at the Hells Canyon Fish Trap in the spring if conditions permit (high flows can prohibit the use of this trap) and generally accounts for 10% of the total adults spawned.

Prespawn mortality occurs at very low rates (<1% of total trapped) for most stocks because steelhead are held in cold water and only held for short periods of time prior to spawning. Due to the fall collection and extending holding period for broodstock captured at Hells Canyon dam, prespawn mortality does occur at a slightly higher rate for the OX stock. For brood year 2006, prespawn mortality was approximately 5%.

Fecundity rates for each stock in brood year 2006 were similar to recent years (Tables 3, Appendix A). There were consistent differences in fecundity between groups of stocks, which are due to differences in age structure. The majority of PAH and SAW fish return as smaller, less fecund adults after one year in the ocean. Conversely, the majority of DWOR and USAL fish return as larger, more fecund adults after two or more years in the ocean. It is also interesting to note that the life history of the OX stock is intermediate to the other groups (a more balanced age at maturity between one and two ocean fish).

Survival from the green egg to eyed egg stage (eye-up rate) was high for most stocks in brood year 2006 (DWOR, OX, and SAW) and egg requests were met (Tables 3, Appendix B). The PAH stock had the lowest eye-up rate of all stocks in brood year 2006 because returns were too numerous to sort and overly ripe females were incorporated as broodstock. However, Pahsimeroi staff anticipated low eye-up rates and spawned a sufficient number of females to ensure egg requests were met. The USAL stock's (a small experimental program) eye-up rate was relatively low and likely influenced by the repeated handling of females as they were checked for ripeness. In order to account for lower than expected survival rates, spawning facilities collected more eggs than necessary to ensure egg requests were met. Eggs not

needed for production were usually culled onsite; however, in some cases these eggs were used in resident trout programs.

Table 3. Spawning and egg production information for steelhead eggs shipped to LSRC and IPC rearing facilities for brood year 2006

Broodstock (stock)	Facility	Females		Green Eggs*	Production Shipped	Eye-up rate (%)
		Rearing Hatchery	Spawned Fecundity			
Dworshak (DWOR)	Clearwater	176	6,785	1,198,321	968,694	95.5
	Hagerman National	40	6,785	272,282	215,000	93.7
	Magic Valley	141	6,785	956,983	755,654	93.7
East Fork (EFNAT)	Magic Valley	14	6,267	87,737	67,000	89.7
Oxbow (OX)	Niagara Springs	199	6,448	1,286,080	930,887	81.0
Pahsimeroi (PAH)	Hagerman National	69	5,053	350,174	212,000	68.4
	Magic Valley	243	5,053	1,232,570	746,213	68.4
	Niagara Springs	401	5,053	2,032,798	1,230,682	68.4
Sawtooth (SAW)	Hagerman National	271	5,174	1,401,628	1,129,080	87.6
	Magic Valley	107	5,174	552,294	444,900	87.6
Squaw Creek (USAL)	Magic Valley	32	6,379	201,793	143,799	71.3

\* Extra green eggs are produced to ensure egg production request were met. This excess production is reflected in the green egg number.

### Onsite Survival at Rearing Hatcheries

Similar to previous years, eyed egg-to-smolt release (onsite) survival was high across all hatcheries in brood year 2006 (Tables 4, Appendix C).

Table 4. Eyed eggs received and eyed egg-to-smolt (onsite) survival estimates for LSRC and IPC steelhead rearing facility for brood year 2006.

Rearing Hatchery	Stock	Eyed-eggs Received	Smolts Released	Size at Release (fpp)	Onsite Survival (%)
Clearwater	DWOR	969,169	868,375	5.0	89.6
Hagerman National	DWOR	204,909	195,073	4.5	95.2
	PAH	200,949	197,131	4.5	98.1
Magic Valley	SAW	1,143,558	1,069,227	4.3	93.5
	DWOR	700,551	614,383	4.4	87.7
	EFNAT	66,568	50,592	4.2	76.0
	PAH*	806,837	656,765	4.2	81.4
Niagara Springs	SAW	200,736	175,644	4.3	87.5
	USAL	142,515	127,266	4.6	89.3
	OX**	916,391	767,569	5.1	83.8
	PAH**	1,211,690	1,097,185	5.0	90.6

\* Production included 135,392 swim-up OX fry that were mixed with PAH production.

\*\* Approximately half of the production was transferred as fry.

Except for Magic Valley, most rearing facilities reported little to no mortality related to disease in brood year 2006. Magic Valley experienced an acute mortality event in one vat due to the infectious hematopoietic necrosis (IHN) virus (Lowell et al. 2007). Rather than running the risk of exposing other production to this disease, Magic Valley destroyed the remaining production in the vat. This production was subsequently backfilled with OX fry so that the facility could meet its production target. Magic Valley later experienced low levels of mortality in outdoor raceways from IHN and bacterial coldwater disease (CWD); however, this mortality was low in magnitude and did not influence the facility's ability to meet production targets. Clearwater did not experience disease outbreaks during the 2006 brood year rearing cycle (Hutzenbiler et al. 2007). Hagerman National reported slightly elevated mortalities related to sore back, particularly in the DWOR stock at the end of the rearing cycle (USFWS 2007). Lastly, Niagara Springs observed low levels of mortality while fish were reared in outdoor raceways related to CWD and furunculosis (Page et al. 2008).

All smolts were at or near the targeted size (4.5 fish per pound) when released, which is consistent with releases from recent brood years (Table 4, Appendix D).

### **Smolt Releases**

All facilities met their annual release target in brood year 2006 with a combined release of 5,819,210 yearling smolts from March through May 2007. Table 5 summarizes the number of fish released at each release site and their marks/tags. Although LSRCP facilities (Clearwater, Hagerman National, and Magic Valley) met their annual production target, they were below their intended production levels due to reduced water availability and/or management priorities (see "LSRCP rearing Facilities" section in the introduction).

Table 5. Smolt release and marking information for brood year 2006 hatchery steelhead released in Idaho for the IPC and LSRCP mitigation programs.

Rearing Facility	Release Site	Stock	Marks/Tags				Total Release
			AD	AD CWT	None	CWT Only	
Clearwater	Crooked R.	DWOR	86,424	64,872			151,296
		DWOR			63,151	20,660	83,811
	Lolo Cr.	DWOR			52,415		52,415
	Meadow Cr.	DWOR			28,050		28,050
	Mill Cr.	DWOR			28,338		28,338
	Red House Hole	DWOR	207,031	65,788			272,819
	Red R.	DWOR	100,329				100,329
		DWOR					151,317
	<b>Clearwater Total</b>		<b>393,784</b>	<b>130,660</b>	<b>171,954</b>	<b>20,660</b>	<b>868,375</b>
Hagerman National	Low. E.F. Salmon R.	DWOR	102,550				102,550
	Sawtooth	SAW	741,902	79,471			821,373
	Little Salmon	DWOR	92,523				92,523
		PAH				197,131	197,131
Yankee Fork	SAW	105,513				105,513	
					142,341	142,341	
	<b>Hagerman Total</b>		<b>1,042,488</b>	<b>79,471</b>	<b>339,472</b>	<b>-</b>	<b>1,461,431</b>
Magic Valley	Colston Cnr.	PAH	135,492	29,981			165,473
	Low. E.F. Salmon R.	DWOR	207,487				207,487
	McNabb Pt.	PAH	89,957				89,957
		SAW	595	29,175			29,770
	Pahsimeroi R.	PAH	918	29,673			30,591
	Red Rock	PAH	102,898	27,032			129,930
	Shoup Brd.	PAH	78,847				78,847
	Slate Cr.	PAH	11,569	29,567			41,136
		PAH				60,392	60,392
	Squaw Creek	DWOR		57,780			191,726
		USAL	2,035	125,231			127,266
	Little Salmon	DWOR	156,349	58,821			215,170
	Tunnel Rock	PAH	60,439				60,439
Up. E.F. Salmon R.	EFNAT				50,592	50,592	
Valley Cr.	SAW			54,640		54,640	
Yankee Fork	SAW	30,827	29,956			60,783	
		SAW			30,451	30,451	
	<b>Magic Valley Total</b>		<b>877,413</b>	<b>417,216</b>	<b>145,483</b>	<b>50,592</b>	<b>1,624,650</b>
Niagara	Hells Canyon Dam	OX	496,895	30,806			527,701
	Pahsimeroi R.	PAH	768,051	62,396			830,447
	Little Salmon	OX	208,490	31,378			239,868
		PAH	237,337	29,401			266,738
	<b>Niagara Total</b>		<b>1,710,773</b>	<b>153,981</b>	<b>-</b>	<b>-</b>	<b>1,864,754</b>
	<b>Grand Total</b>		<b>4,024,458</b>	<b>781,328</b>	<b>656,909</b>	<b>71,252</b>	<b>5,819,210</b>

## Juvenile Migration Timing and Survival

PIT-tagged steelhead survived at high rates from release to LGD (Table 6). The majority of migrants arrived at LGD from April through May of 2007. It is important to note that small sample sizes led to spurious results, in excess of 100% survival, from some release groups. The unweighted average survival was 78.7% (excluding data points in excess of 100%). The Valley Cr. (Salmon River basin) release group had the highest survival (96%) while the Mill Cr. (Clearwater River basin) had the lowest survival (52%) to LGD. Survival for most hatchery/stock combinations was similar to recent years (Appendix E).

Table 6. Estimated survival from release to Lower Granite Dam for brood year 2006 (migration year 2007) hatchery origin juvenile steelhead released from LSRCP and IPC facilities in Idaho.

Hatchery	Stock	Release Site	Number PIT Tagged	Release Date	80% Arrival Window (# of days)	Survival Estimated % (+/- 95% CI)
Clearwater	DWOR	Crooked R. (AD-clipped)	300	4/12	5/4-5/17 (13)	85.4 (+/-19.8)
	DWOR	Crooked R. (AD-intact)	300	4/15	4/28-5/12 (14)	77.6 (+/-14.3)
	DWOR	Lolo Cr.	300	4/19	4/31-5/19 (18)	78.7 (+/-21.3)
	DWOR	Meadow Cr.	300	4/17	5/4-5/18 (14)	85.4 (+/-17.3)
	DWOR	Mill Cr.	300	4/17	5/3-5/17 (14)	51.8 (+/-12.4)
	DWOR	Red House Hole	202	4/13	4/24-5/12 (18)	86.5 (+/-31.9)
	DWOR	Red R. (AD-clipped)	299	4/15	5/2-5/18 (16)	68.5 (+/-15.8)
	DWOR	Red R. (AD-intact)	299	4/15	5/4-5/23 (19)	79.4 (+/-20.7)
Hagerman National	DWOR	Low. E. F. Salmon R.	290	5/1	5/9-5/24 (15)	106.5 (+/-27.1)
	DWOR	Little Salmon R.	297	4/4	4/24-5/14 (20)	87.0 (+/-17.6)
	PAH	Little Salmon R.	300	3/26	4/14-5/11 (27)	91.8 (+/-23.1)
	SAW	Sawtooth Hatchery	298	4/9	4/22-5/17 (25)	61.3 (+/-17.5)
Magic Valley	SAW	Yankee Fork	300	5/3	5/13-5/21 (8)	56.3 (+/-12.1)
	DWOR	Low. E. F. Salmon R.	300	4/23	5/3-5/20 (17)	94.2 (+/-28.9)
	DWOR	Little Salmon R.	300	4/10	5/2-5/19 (17)	82.6 (+/-15.0)
	DWOR	Squaw Cr.	482	4/25	5/5-5/18 (13)	69.5 (+/-9.7)
	PAH	Red Rock	293	4/12	4/31-5/15 (14)	92.0 (+/-19.5)
	PAH	Colston Corner	300	4/16	4/29-5/11 (12)	80.6 (+/-20.0)
	SAW	McNabb Point	297	4/19	4/31-5/10 (9)	79.9 (+/-20.7)
	SAW	Valley Cr.	299	4/30	5/9-5/16 (7)	96.0 (+/-21.8)
	SAW	Yankee Fork	298	4/27	5/5-5/25 (20)	105.5 (+/-34.9)
	USAL	Squaw Cr.	490	4/26	5/6-5/24 (18)	69.9 (+/-10.5)
Niagara Springs	DWOR/USAL	Squaw Pond	497	4/27	5/5-5/26 (21)	70.1 (+/-18.8)
	OXA	Hells Canyon Dam	289	3/23	4/26-5/30 (34)	76.6 (+/-28.6)
	OXA	Little Salmon R.	295	4/2	5/3-5/19 (16)	90.2 (+/-17.5)
	PAH	Little Salmon R.	297	4/4	4/15-5/19 (34)	105.6 (+/-28.0)
	PAH	Pahsimeroi Hatchery	297	4/10	4/24-5/9 (15)	137.1 (+/-58.0)

## Adult Returns

### Recreational Harvest in Idaho Fisheries

Adult steelhead from brood year 2006 releases contributed to fisheries over the course of multiple runs from the fall of 2008 through the spring of 2011. During that time recreational fisheries for steelhead occurred in the Snake, Clearwater, Little Salmon, and Salmon rivers in Idaho. Recreational anglers harvested approximately 42,448 adult steelhead from brood year 2006 (Table 7). Tribal harvest estimates were not available.

Table 7. Estimated recreational harvest upstream of LGD for brood year 2006 hatchery origin steelhead released from LSRCP and IPC facilities in Idaho. Estimates were derived from coded-wire-tag recoveries in the fisheries from the fall 2008 through the spring of 2011.

Hatchery	Stock	1-ocean	2-ocean	3-ocean	Total
Clearwater	DWOR*	943	6,398	-	7,341
	<b>Clearwater Total</b>	<b>943</b>	<b>6,398</b>	<b>-</b>	<b>7,341</b>
Hagerman	DWOR	52	137	-	189
National	PAH*	-	-	-	-
	SAW *	7,920	2,353	-	10,273
	<b>Hagerman National Total</b>	<b>7,920</b>	<b>2,353</b>	<b>-</b>	<b>10,273</b>
Magic Valley	DWOR	158	347	-	505
	EFNAT*	-	-	-	-
	PAH*	3,947	2,516	70	6,533
	SAW*	769	192	-	961
	USAL	125	316	15	456
	<b>Magic Valley Total</b>	<b>4,999</b>	<b>3,371</b>	<b>85</b>	<b>8,455</b>
Niagara	OX	2,067	793	-	2,860
Springs	PAH	9,276	4,054	-	13,330
	<b>Niagara Springs Total</b>	<b>11,343</b>	<b>4,847</b>	<b>-</b>	<b>16,190</b>
	<b>Grand Total</b>	<b>25,257</b>	<b>17,106</b>	<b>85</b>	<b>42,448</b>

\* All or part of these fish were released with intact adipose fins (see Table 6) and therefore not subject to harvest in selective fisheries.

### Harvest in non-Idaho Fisheries

Brood year 2006 releases from LSRCP and IPC facilities contributed 6,019 adult steelhead to fisheries in the Columbia River and Lower Snake River (Table 8). With the exception of the EFNAT (adipose intact), all stocks contributed to these fisheries. The fisheries in Zones 1-5 (sport) and Zone 6 (tribal) accounted for the vast majority of harvest downstream of LGD.

Table 8. Harvest summary in the Columbia River and Snake River downstream of Lower Granite Dam (LGD) for brood year 2006 hatchery steelhead released from LSRCF and IPC facilities.

Hatchery	Stock	Ocean	Zones 1-5 Sport	Zone 6 Sport	Zone 6 Tribal	Columbia R. McNary D. to Snake R.	Sneke R. Downstream of LGD	Total
Clearwater	DWOR*	-	171	98	509	4	100	882
<b>Clearwater Total</b>		-	<b>171</b>	<b>98</b>	<b>509</b>	<b>4</b>	<b>100</b>	<b>882</b>
Hagerman	DWOR	-	-	3	-	-	-	3
National	PAH*	-	-	-	30	-	-	30
	SAW*	-	126	55	709	63	191	1,144
<b>Hagerman Nat. Total</b>		-	<b>126</b>	<b>58</b>	<b>739</b>	<b>63</b>	<b>191</b>	<b>1,177</b>
Magic	DWOR	-	-	7	-	-	-	7
Valley	EFNAT*	-	-	-	-	-	-	-
	PAH*	-	752	30	376	59	121	1,338
	SAW*	-	15	3	55	-	16	89
	USAL	-	-	-	22	-	5	27
<b>Magic Valley Total</b>		-	<b>767</b>	<b>40</b>	<b>453</b>	<b>59</b>	<b>142</b>	<b>1,461</b>
Niagara	OX	-	571	-	339	-	40	950
Springs	PAH	-	832	41	313	81	282	1,549
<b>Niagara Spr. Total</b>		-	<b>1,403</b>	<b>41</b>	<b>652</b>	<b>81</b>	<b>322</b>	<b>2,499</b>
<b>Grand Total</b>		-	<b>2,467</b>	<b>237</b>	<b>2,353</b>	<b>207</b>	<b>755</b>	<b>6,019</b>

\* All or part of these fish were released with intact adipose fins (see Table 6) and therefore not subject to harvest in selective fisheries.

## Harvest Rates

Hatchery steelhead harvest rates downstream of LGD were consistently low, averaging 7.6% (range 1.3 - 11.5%) for AD-clipped steelhead (Table 9). However, the harvest rates presented in this report for the DWOR and USAL "B-run" stocks (1.3-8.4%) downstream of LGD are substantially lower than the 25% estimated by the Technical Advisory Committee (unpublished information) in Zones 1-6 for the 2009-10 run (the primary run for these stocks). This suggests my methods either underestimate harvest and/or overestimate total adult returns used to generate harvest rate estimate.

Harvest rates of AD-clipped steelhead upstream of LGD were substantially higher, averaging 63.7%. Harvest rates upstream of LGD were highly variable as well, ranging from 39.3% for the Niagara Springs OX stock (primarily the Hells Canyon release) to 97.0% for Clearwater's releases into the South Fork Clearwater River. Some stocks, particularly DWOR releases from Clearwater, had extremely high harvest rates upstream of LGD. Rates this high are unlikely and may have been the result of underestimating adult returns, overestimating harvest, or a combination of these factors.

Table 9. Estimated harvest and harvest rates upstream and downstream of Lower Granite Dam (LGD) for brood year 2006 steelhead released from LSRCP and IPC facilities. Unlike Tables 7 and 8, this table only includes information for AD-clipped release groups because the majority of fisheries are mark selective and would not reflect the true harvest rates of AD-intact release groups.

Facility	Stock	Downstream of LGD			Upstream of LGD			Combined	
		Return	Harvest	Harvest Rate (%)	Return	Harvest	Harvest Rate (%)	Harvest	Harvest Rate (%)
Clearwater	DWOR	8,258	690	8.4	7,564	7,340	97.0	8,030	97.2
<b>Clearwater Total</b>		<b>8,258</b>	<b>690</b>	<b>8.4</b>	<b>7,564</b>	<b>7,340</b>	<b>97.0</b>	<b>8,030</b>	<b>97.2</b>
Hagerman	DWOR	203	3	1.5	197	189	95.9	192	94.6
National	SAW	16,029	1,073	6.7	14,953	10,273	68.7	11,346	70.8
<b>Hagerman Nat. Total</b>		<b>16,232</b>	<b>1,076</b>	<b>6.6</b>	<b>15,150</b>	<b>10,462</b>	<b>165</b>	<b>11,538</b>	<b>71.1</b>
Magic	DWOR	533	7	1.3	522	505	96.7	512	96.1
Valley	PAH	13,608	1,333	9.8	12,258	6,533	53.3	7,866	57.8
	SAW	1,501	47	3.1	1,449	961	66.3	1,008	67.2
	USAL	506	28	5.5	478	455	95.2	483	95.5
<b>Magic Valley Total</b>		<b>16,148</b>	<b>1,415</b>	<b>8.8</b>	<b>14,707</b>	<b>8,454</b>	<b>57.5</b>	<b>9,869</b>	<b>61.1</b>
Niagara	OX	8,264	950	11.5	7,282	2,860	39.3	3,810	46.1
Springs	PAH	24,039	1,548	6.4	22,455	13,330	59.4	14,878	61.9
<b>Niagara Spr. Total</b>		<b>32,303</b>	<b>2,498</b>	<b>7.7</b>	<b>29,737</b>	<b>16,190</b>	<b>54.4</b>	<b>18,688</b>	<b>57.9</b>
<b>Grand Total</b>		<b>72,941</b>	<b>5,679</b>	<b>7.8</b>	<b>67,158</b>	<b>42,446</b>	<b>63.2</b>	<b>48,125</b>	<b>66.0</b>

### Hatchery Trap Returns

The number of adult steelhead from brood year 2006 trapped at broodstock facilities is summarized by age and sex in Table 10. Although three-ocean fish were occasionally encountered in fisheries, none were observed at hatchery traps this brood year. Trapping numbers at Hells Canyon Trap are minimum estimates of what returned to the trapping site because unlike other permanent weirs, the trap is operated primarily in the fall and not throughout the run. The trapping numbers at Squaw Creek, the broodstock collection site for the USAL stock, do not reflect the actual number of fish that returned to this location. This is because smaller one-ocean fish were excluded from the summary because their origin (A-run or B-run releases) was uncertain. Furthermore, the Squaw Creek temporary weir fails during high-water events allowing fish to pass undetected. Therefore, the trap value for this location is a minimum estimate of what actually returned. Appendix F provides an age summary for each broodstock collection facility across all brood years.

Table 10. Summary of age at maturity and length at age for brood year 2006 hatchery origin steelhead returning to LSRCP and IPC broodstock collection facilities in Idaho.

	Males				Females				Total
	One-Ocean		Two-Ocean		One-Ocean		Two-Ocean		
Hatchery	Number	Length (cm)							
East Fork	68	57.9	26	63.0	28	57.6	21	65.2	143
Hells Canyon	1,359	61.8	267	73.7	1,266	61.2	544	70.2	3,436
Pahsimeroi	2,959	59.1	202	69.3	2,693	58.1	1,010	67.0	6,864
Sawtooth	1,696	59.5	97	69.3	1,158	58.3	1,028	67.7	3,979
Squaw Creek*	-	-	14	80.2	-	-	19	77.4	33

\* Includes fish collected by a temporary weir and contributed by anglers. Only those fish meeting the length criteria (females >75 cm and males >79 cm) or confirmed to be of B-run ancestry, via CWT, were included.

### Stray Estimates

Stray hatchery steelhead were observed at low levels/rates across all facilities in brood year 2006. The majority of these strays were observed in fisheries upstream of LGD (Table 11). It is important to note, that these estimates represent a minimum estimate as it is unfeasible to survey all tributaries that these fish may enter. A substantial number of fish from Hagerman National, Magic Valley, and Niagara Springs releases into the Salmon River were harvested in the lower Clearwater River in late summer and early fall. These fish were likely seeking thermal refuge and may have continued on to their release location if not removed. Niagara Springs had the highest stray rates, which is consistent with recent brood years (Table 12 and Stiefel 2013). Straying rates downstream of LGD were even more likely to be underestimated. This is because CWT fish released in Idaho do not receive ventral fin clips, a differential mark. Crews in Oregon and Washington rely on this differential mark to identify and collect CWTs as they do not electronically scan for CWTs. Therefore CWTs from Idaho releases were less likely to be recovered in these areas thereby reducing stray estimates.

Table 11. Stray estimates of adult hatchery steelhead from Idaho LSRCP and IPC brood year 2006 releases observed at hatchery racks and fisheries in tributaries of the Columbia and Snake rivers.

Hatchery	Stock	Col. R. Below McNary		Col. R. Above McNary		Snake R. Below LGD		Snake R. Above LGD		Total
		Harvest	Rack	Harvest	Rack	Harvest	Rack	Harvest	Rack	
Clearwater	DWOR	-	8	-	-	-	-	-	-	8
<b>Clearwater Total</b>		-	<b>8</b>	-	-	-	-	-	-	<b>8</b>
Hagerman	DWOR	-	3	-	-	-	-	8	-	11
National	PAH*	-	-	-	-	-	-	-	-	-
	SAW*	-	2	2	-	-	-	173	2	179
<b>Hagerman Nat. Total</b>		-	<b>5</b>	<b>2</b>	-	-	-	<b>181</b>	<b>2</b>	<b>190</b>
Magic	DWOR	-	4	-	-	-	-	18	-	22
Valley	EFNAT*	-	-	-	-	-	-	-	-	-
	PAH*	-	-	8	-	8	-	138	-	154
	SAW*	-	3	2	-	-	-	37	2	44
	USAL	-	-	-	-	-	-	9	-	9
<b>Magic Valley Total</b>		-	<b>7</b>	<b>10</b>	-	<b>8</b>	-	<b>202</b>	<b>2</b>	<b>229</b>
Niagara	OX	-	-	32	-	-	-	986	-	1,018
Springs	PAH	-	9	27	-	-	-	1,199	-	1,235
<b>Niagara Springs Total</b>		-	<b>9</b>	<b>59</b>	-	-	-	<b>2,185</b>	-	<b>2,253</b>
<b>Grand Total</b>		-	<b>29</b>	<b>71</b>	-	<b>8</b>	-	<b>2,568</b>	<b>4</b>	<b>2,680</b>

\* All or part of these fish were released with intact adipose fins (see Table 6) and therefore not subject to harvest in selective fisheries.

Table 12. Stray rates of adult hatchery steelhead from Idaho LSRCP and IPC brood year 2006 releases. Unlike Table 11, this table only includes information for AD-clipped release groups as recovery rates for AD-intact release groups were substantially lower since most CWTs recovered as strays were recovered in mark selective fisheries.

Hatchery	Stock	Downstream of LGD			Upstream of LGD			Combined	
		Adult Returns	Strays	Stray Rates (%)	Adult Returns	Strays	Stray Rates (%)	Total Strays	Total Stray Rates (%)
Clearwater	DWOR	8,258	8	0.10	7,564	-	-	8	0.1
<b>Clearwater Total</b>		<b>8,258</b>	<b>8</b>	<b>0.10</b>	<b>7,564</b>	<b>-</b>	<b>-</b>	<b>8</b>	<b>0.1</b>
Hagerman	DWOR	203	3	1.48	197	8	4.1	11	5.4
National	SAW	16,029	4	0.02	14,953	175	1.2	179	1.1
<b>Hagerman National Total</b>		<b>16,232</b>	<b>7</b>	<b>0.04</b>	<b>15,150</b>	<b>183</b>	<b>1.2</b>	<b>190</b>	<b>1.2</b>
Magic	DWOR	533	4	0.75	522	18	3.4	22	4.1
Valley	PAH	13,608	16	0.12	12,258	138	1.1	154	1.1
	SAW	1,501	5	0.33	1,449	39	2.7	44	2.9
	USAL	506	-	-	478	9	1.9	9	1.8
<b>Magic Valley Total</b>		<b>16,148</b>	<b>25</b>	<b>0.15</b>	<b>14,707</b>	<b>204</b>	<b>1.4</b>	<b>229</b>	<b>1.4</b>
Niagara Springs	OX	8,264	32	0.39	7,282	986	13.5	1,018	12.3
	PAH	24,039	36	0.15	22,455	1,199	5.3	1,235	5.1
<b>Niagara Springs Total</b>		<b>32,303</b>	<b>68</b>	<b>0.21</b>	<b>29,737</b>	<b>2,185</b>	<b>7.3</b>	<b>2,253</b>	<b>7.0</b>
<b>Grand Total</b>		<b>72,941</b>	<b>108</b>	<b>0.15</b>	<b>67,158</b>	<b>2,572</b>	<b>3.8</b>	<b>2,680</b>	<b>3.7</b>

### **Brood Year Reconstruction, SAR, SAS, and PPR**

Brood year 2006 returned 85,688 adult steelhead to the mouth of the Columbia River during the 2008-09, 2009-10, and 2010-11 steelhead runs (Table 13). It is important to note that these are minimum estimates as they do not account for undocumented straying, prespaw mortality, or fall out (fish stopping short of their release location). Production from LSRCP funded facilities (Clearwater, Hagerman National, and Magic Valley fish hatcheries) accounted for 53,385 of the steelhead, which is substantially below the annual mitigation goal of 117,780. This underperformance in adult returns is consistent with the LSRCP program's history (Appendix G, Figure 1). Factors contributing the LSRCP program's underperformance include releasing fewer smolts than intended as well as lower than anticipated survival from release to the adult life stage. The IPC funded facility (Niagara Springs Fish Hatchery) accounted for the remaining 32,303 adults.

Harvest and straying downstream of LGD accounted for a relatively low amount of the adults returning from brood year 2006. Harvest accounted for 7% of adult returns, the majority of which were in the in Zones 1-5 (sport) and Zone 6 (tribal) fisheries. An extremely low number of fish (<1%) were estimated to have strayed into tributaries downstream of LGD; however as discussed in the straying section this is a minimum estimate as field crews in Oregon and Washington did not electrically scan for CWT.

The majority (93%) of returning brood year 2006 adults escaped upstream of LGD. Exploitation by recreational anglers accounts for 54% of the return to LGD. Lesser amounts of fish were removed by hatchery traps or observed/recovered as strays, 18% and 3% of the LGD return (respectively). The remaining fish (25%) were classified as unharvested escapement. These fish were returning to offsite releases with no trapping facility to remove them. The majority (61%) of these unharvested fish were released with intact adipose fins (pursuant to the U.S. vs. Oregon agreement) and therefore not available for harvest in mark (clipped adipose fin) selective fisheries. Had these fish been marked, more fish would have been removed in recreational fisheries thereby reducing the unharvested escapement estimate.

The average SAS rate for brood year 2006 was 1.5% (range = 0.1-2.3%, Table 13). Comparisons between the SAS estimates for the DWOR and USAL stock released from Magic Valley indicate the locally adapted USAL stock has higher survival than the DWOR stock for this and previous brood years. This is consistent with more recent evaluations using PIT tags to evaluate the performance of these stocks (Stiefel et al. 2013). Appendix H contains a summary of SAS information for each facility.

PPR estimates exceeded the replacement threshold for every hatchery/stock combination in each brood year with an unweighted average of 26.7 progeny/parent (range = 2.2-39.8). While these PPR values indicate that all programs are perpetuating themselves, they are below levels needed to meet LSRCP mitigation goals (approximately 30 progeny/parent for A-run stocks and 70 progeny/parent for B-run stocks).

Table 13. Brood Year 2006 reconstruction summary for Idaho LSRCP and IPC steelhead releases that includes adult returns (total and escapement to Lower Granite Dam [LGD]), smolt-to-adult survival rates (SAS), parent-to-progeny ratios (PPR), smolt-to-adult return to LGD rate (SAR), as well as known dispositions for these fish. Summaries include AD-clipped and AD-intact releases.

Hatchery	Stock	Adults Spawned	Number Released	Total Adults	SAS (%)	Downstream of LGD				Upstream of LGD				
						PPR	Harvest	Strays	Adults to LGD	SAR (%)	Harvest	Trap	Stray	Unharvested Escapement
Clearwater	DWOR*	298	868,375	11,860	1.4	39.8	881	4	10,975	1.3	7,340	-	-	3,635
<b>Clearwater Total</b>		<b>298</b>	<b>868,375</b>	<b>11,860</b>	<b>1.4</b>	<b>39.8</b>	<b>881</b>	<b>4</b>	<b>10,975</b>	<b>1.3</b>	<b>7,340</b>	<b>-</b>	<b>-</b>	<b>3,635</b>
Hagerman	DWOR	67	195,073	202	0.1	3.0	3	2	197	0.1	189	-	8	-
National	PAH*	120	197,131	4,030	2.0	33.7	30	-	4,000	2.0	-	-	-	4,000
	SAW*	498	1,069,227	18,379	1.7	36.9	1,144	4	17,231	1.6	10,273	3,980	175	2,803
<b>Hagerman Nat. Total</b>		<b>685</b>	<b>1,461,431</b>	<b>22,611</b>	<b>1.5</b>	<b>33.0</b>	<b>1,177</b>	<b>6</b>	<b>21,428</b>	<b>1.5</b>	<b>10,462</b>	<b>3,980</b>	<b>183</b>	<b>6,803</b>
Magic	DWOR	238	614,383	534	0.1	2.2	7	4	523	0.1	505	-	18	-
Valley	EFNAT*	42	50,592	135	0.3	3.2	0	-	135	0.3	-	135	-	-
	PAH*	420	656,765	14,836	2.3	35.4	1,337	16	13,483	2.1	6,533	202	138	6,610
	SAW*	196	175,644	2,903	1.7	14.8	89	3	2,811	1.6	961	-	38	1,812
	USAL	56	127,266	506	0.4	9.0	28	-	478	0.4	455	14	9	-
<b>Magic Valley Total</b>		<b>952</b>	<b>1,624,650</b>	<b>18,914</b>	<b>1.2</b>	<b>19.9</b>	<b>1,461</b>	<b>23</b>	<b>17,430</b>	<b>1.1</b>	<b>8,454</b>	<b>351</b>	<b>203</b>	<b>8,422</b>
Niagara	OX	354	767,569	8,264	1.1	23.4	950	32	7,282	0.9	2,860	3,436	986	-
Springs	PAH	692	1,097,185	24,041	2.2	34.7	1,548	36	22,457	2.0	13,330	6,663	1,199	1,265
<b>Niagara Spr. Total</b>		<b>1,046</b>	<b>1,864,754</b>	<b>32,305</b>	<b>1.7</b>	<b>30.9</b>	<b>2,498</b>	<b>68</b>	<b>29,739</b>	<b>1.6</b>	<b>16,190</b>	<b>10,099</b>	<b>2,185</b>	<b>1,265</b>
<b>Grand Total</b>		<b>2,981</b>	<b>5,819,210</b>	<b>85,690</b>	<b>1.5</b>	<b>28.8</b>	<b>6,017</b>	<b>101</b>	<b>79,572</b>	<b>1.4</b>	<b>42,446</b>	<b>14,430</b>	<b>2,571</b>	<b>20,125</b>

\* All or part of these fish were released with intact adipose fins (see Table 6) and therefore not subject to harvest in mark-selective fisheries.

## **ACKNOWLEDGMENTS**

Staff from the Pacific States Marine Fisheries Commission provided assistance with data collection, proofing, summarization, and report compilation. A special thanks is extended to Cheryl Zink for completing the report formatting and editing, as well as to Brian Leth, Stuart Rosenberger, Sam Sharr, and Steve Yundt for reviewing this report and providing feedback. Last but not least, the information included in this report would not be available without the invaluable efforts of the hatchery managers and their staff as well as staff from regional IDFG offices.

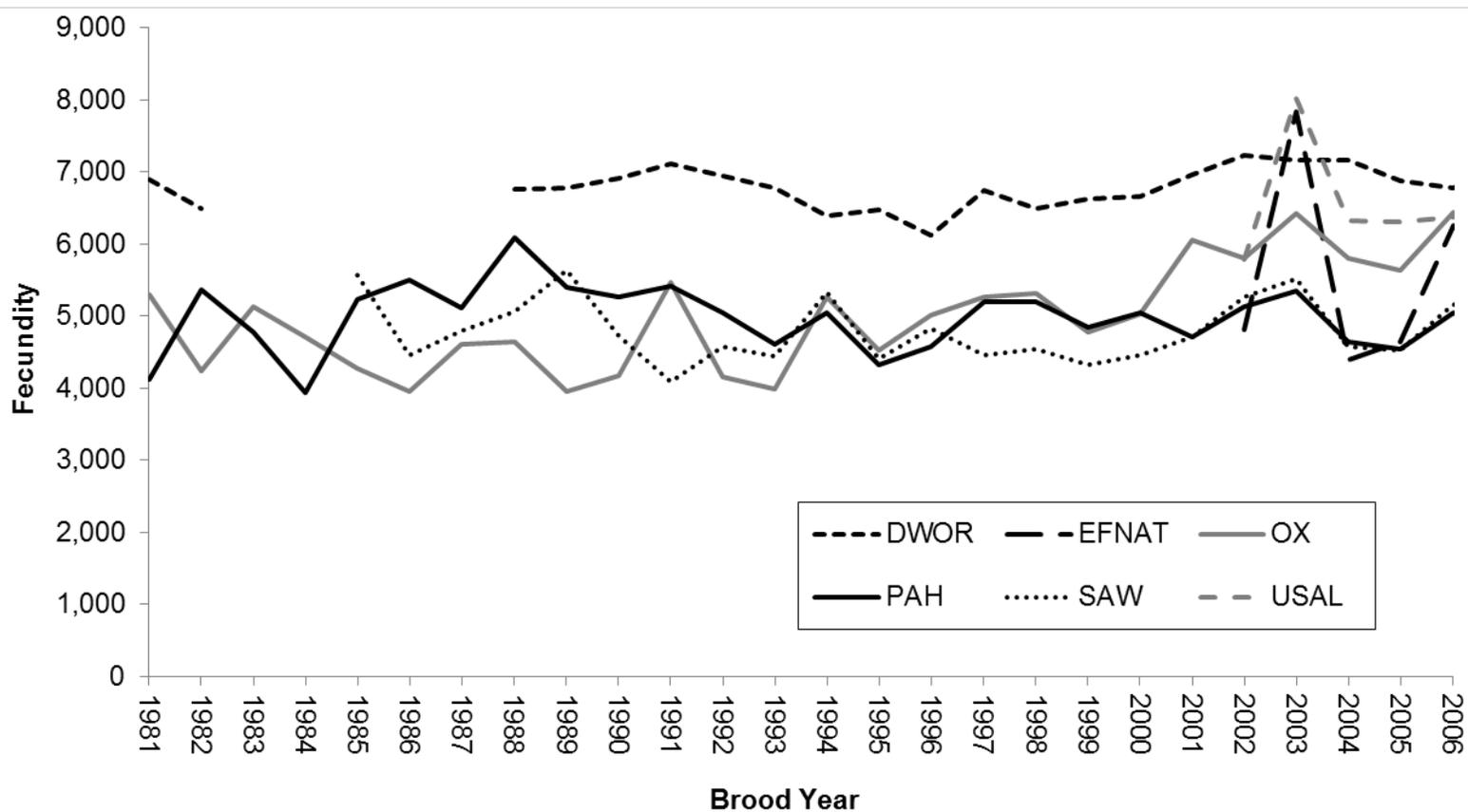
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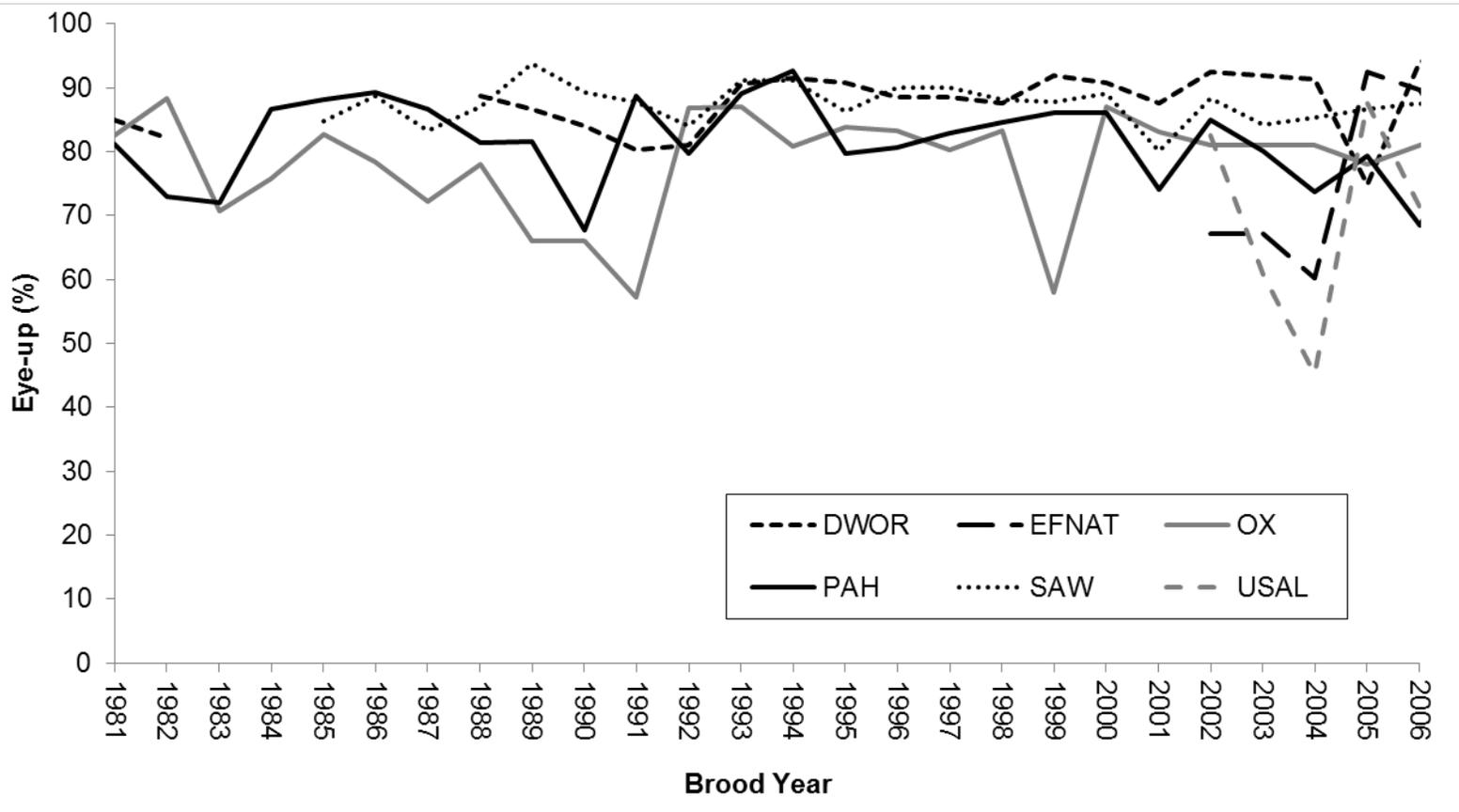
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## **APPENDICES**

Appendix A. Fecundity rates by stock for steelhead reared at LSRCP and IPC hatchery facilities in Idaho for brood years 1981 through 2006.



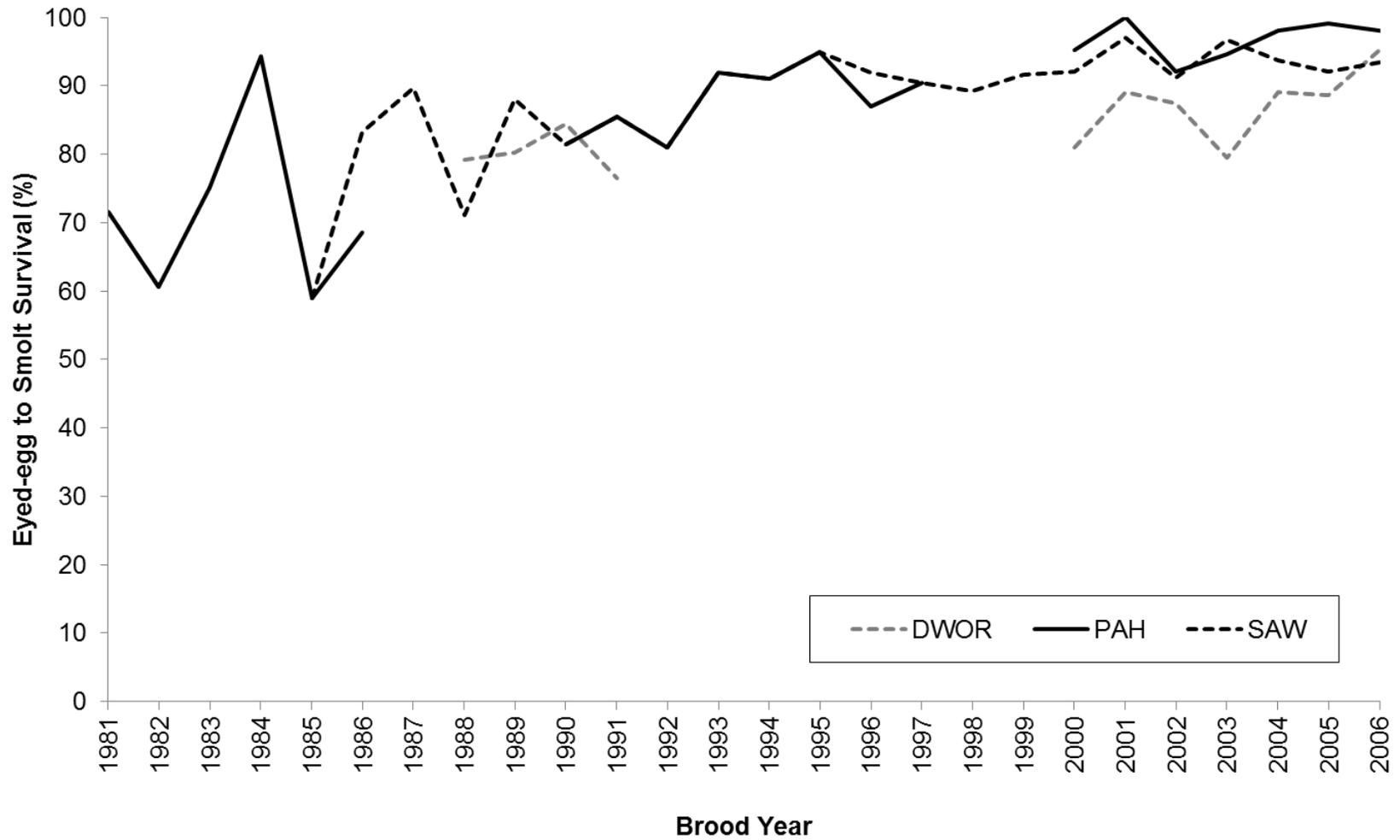
Appendix B. Eye-up rates by stock for steelhead production reared at LSRCP and IPC facilities in Idaho for brood years 1981 through 2006.



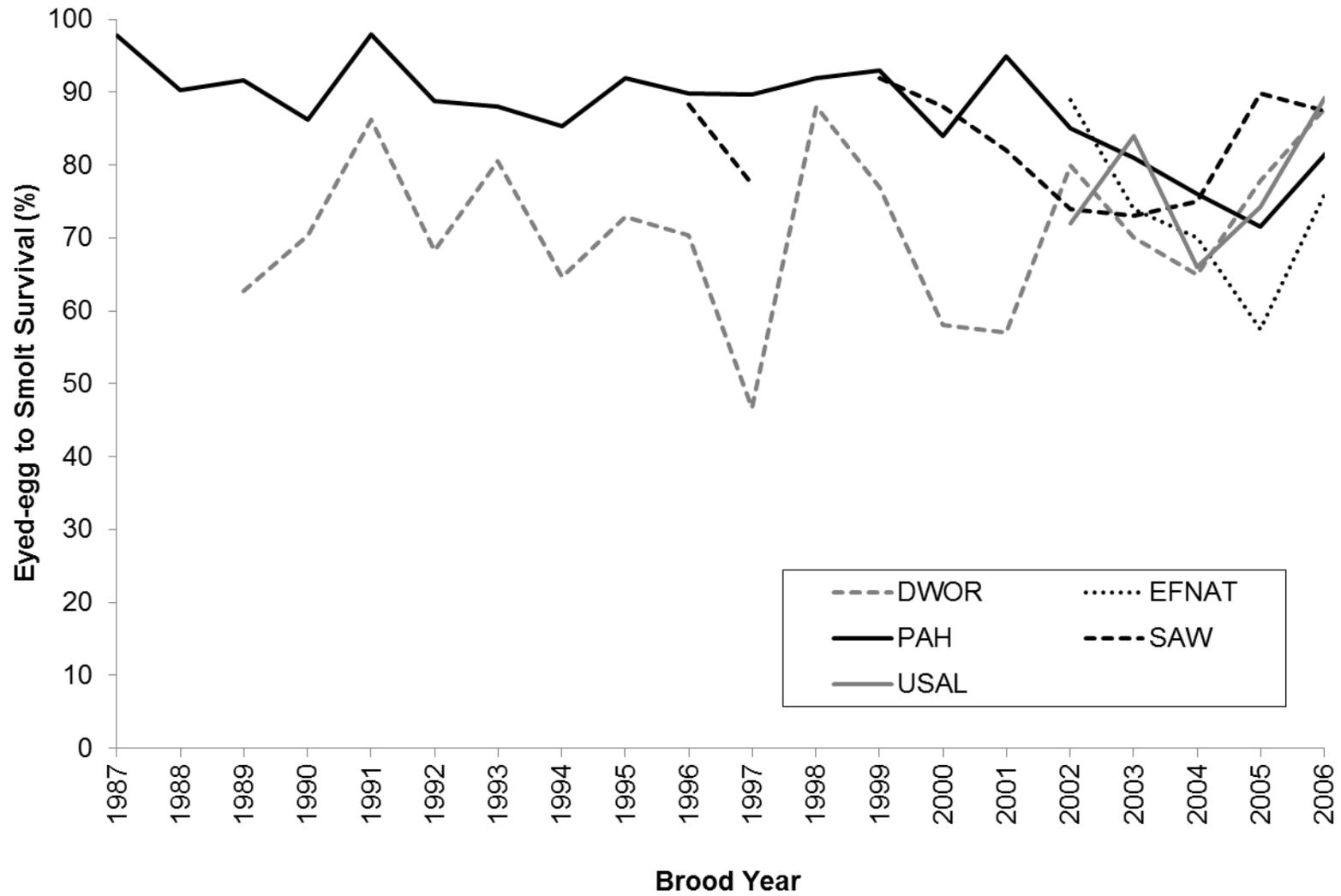
Appendix C, Figure 1. Summary of onsite survival (eyed-egg to release) for production reared at Clearwater Fish Hatchery from brood year 1992 through 2006.



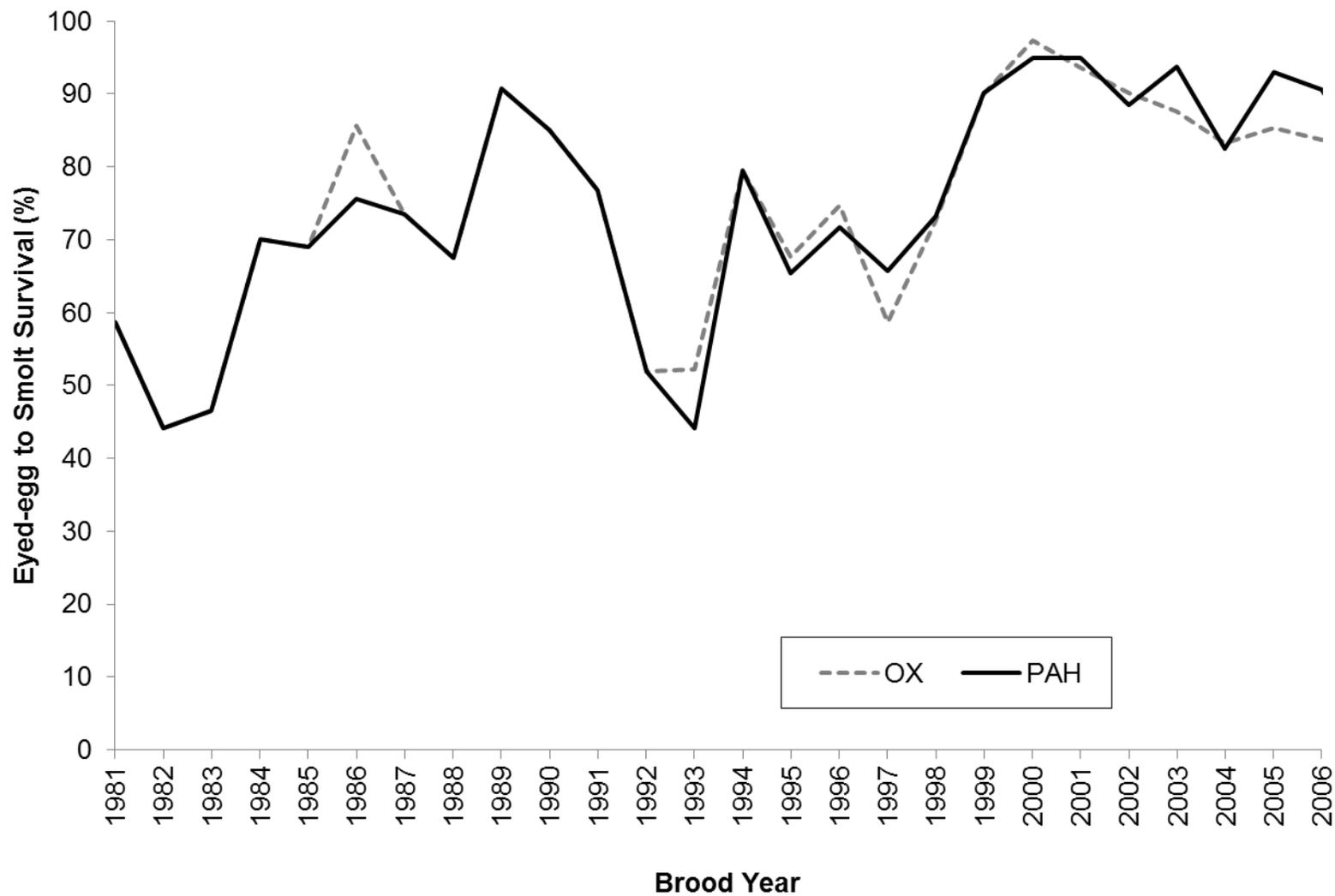
Appendix C, Figure 2. Summary of onsite survival (eyed egg to release) by stock for production reared at Hagerman National Fish Hatchery from brood year 1987 through 2006.



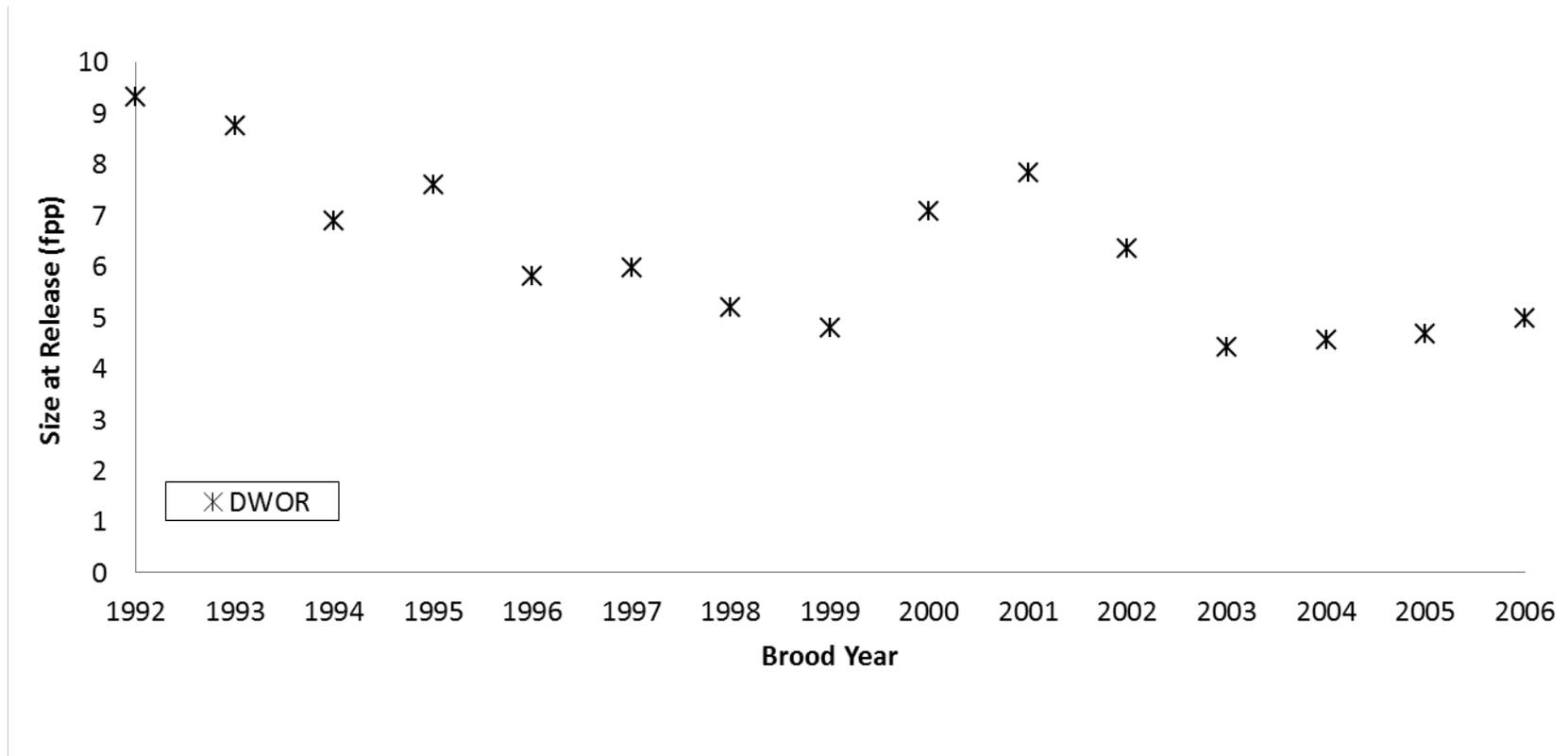
Appendix C, Figure 3. Summary of onsite survival (eyed egg to release) by stock for production reared at Magic Valley Fish Hatchery from brood year 1987 through 2006.



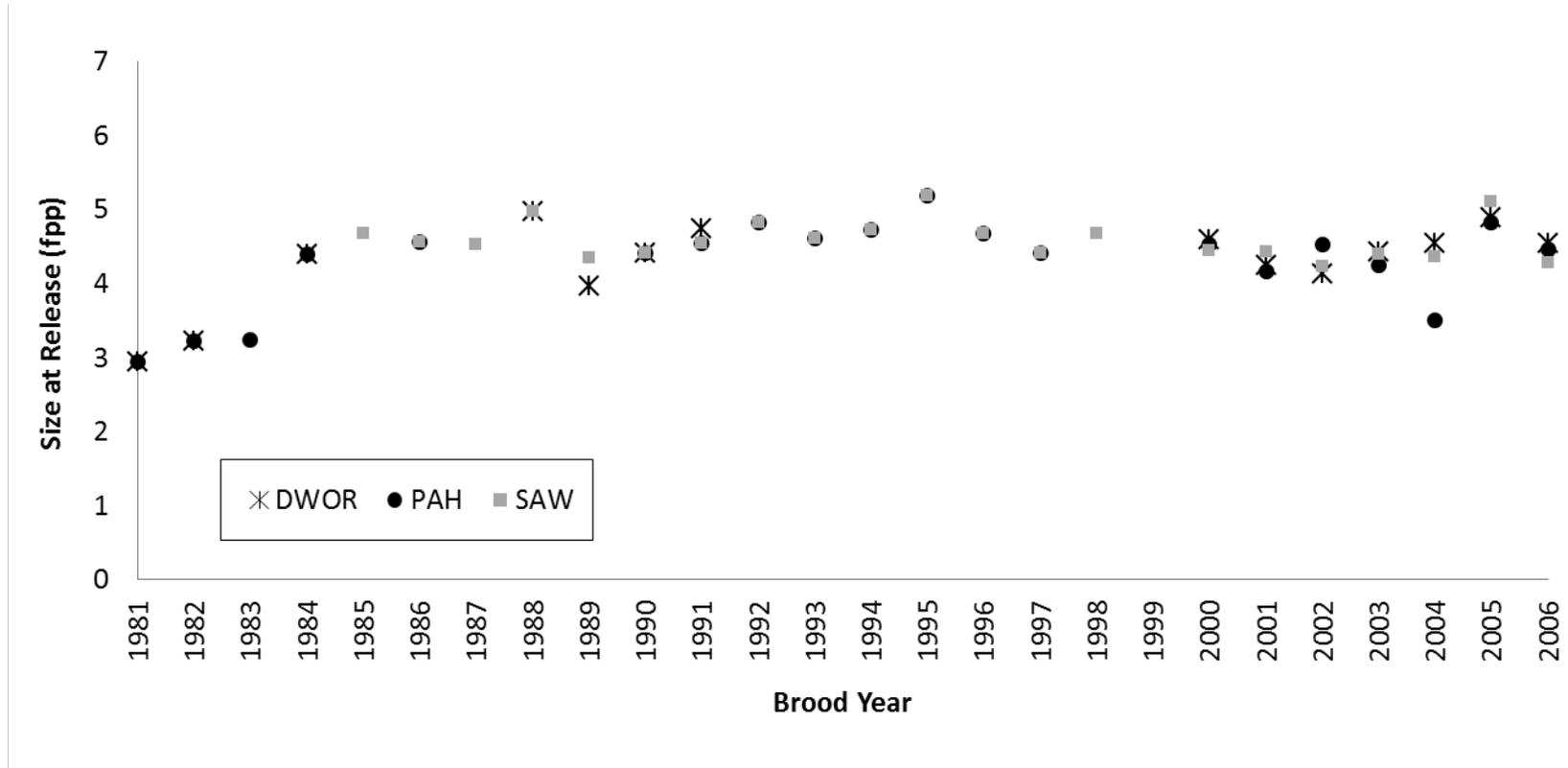
Appendix C, Figure 4. Summary of onsite survival (eyed egg to release) by stock for production reared at Niagara Springs Fish Hatchery from brood year 1981 through 2006.



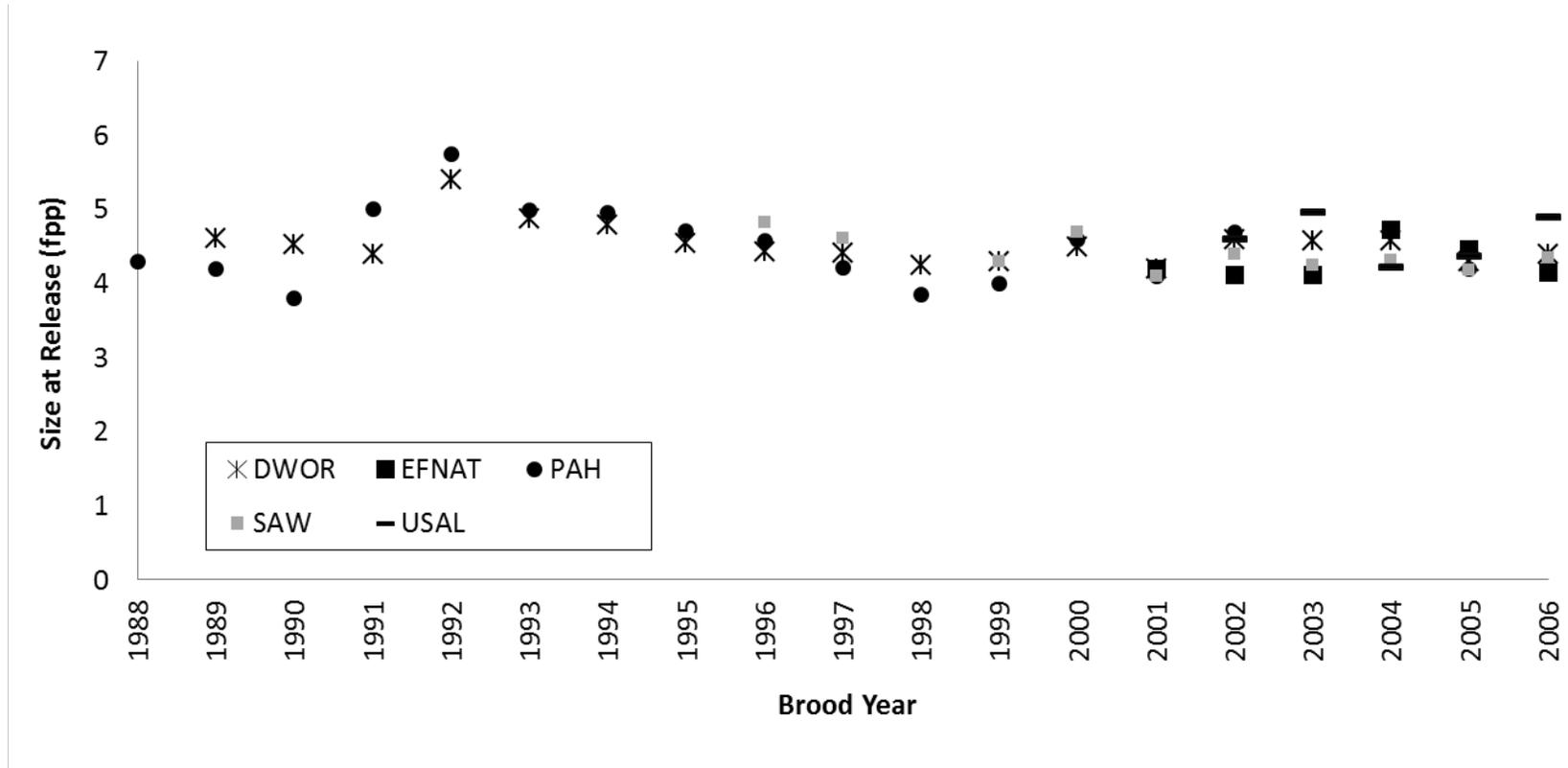
Appendix D, Figure 1. Size at release (fish per pound [fpp]) for steelhead smolts reared at Clearwater Fish Hatchery from brood year 1992 through 2006.



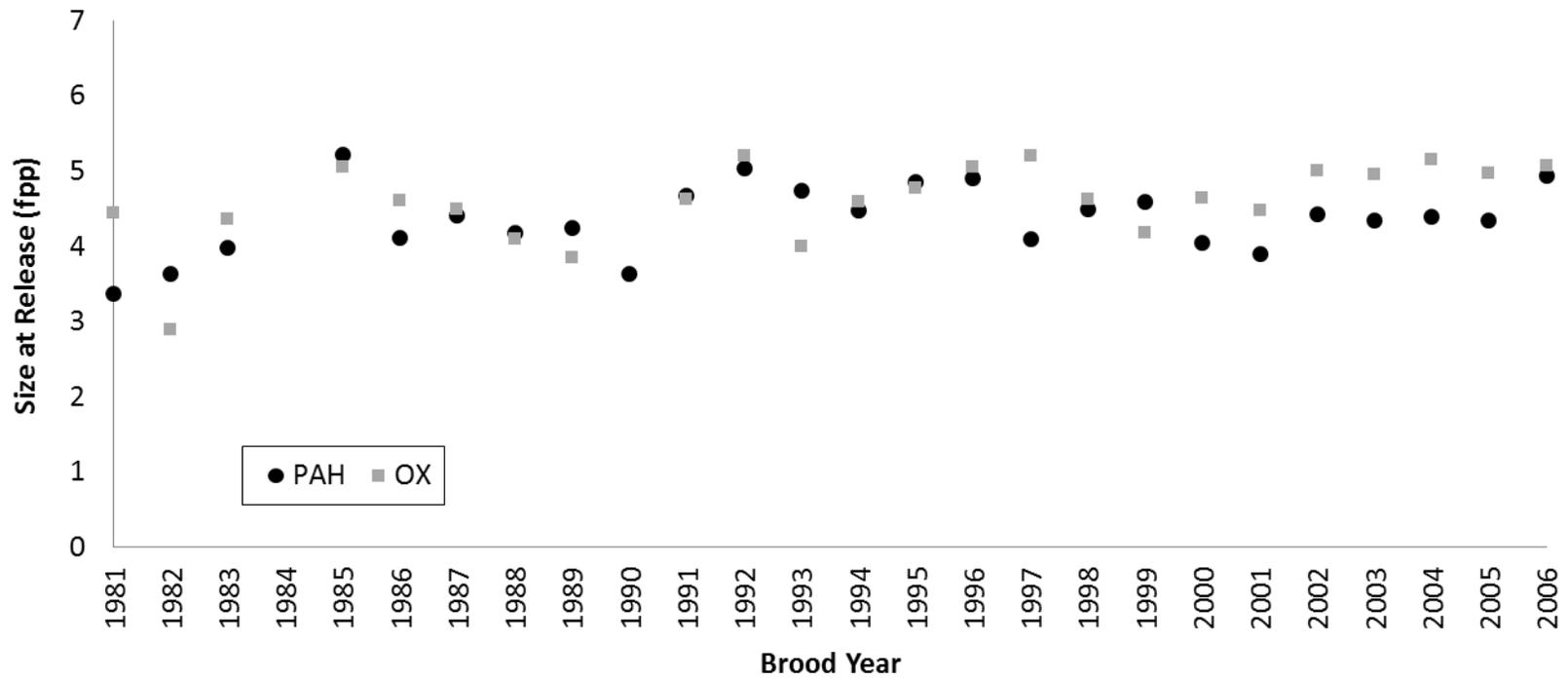
Appendix D, Figure 2. Size at release (fish per pound [fpp]) for steelhead smolts reared at Hagerman National from brood year 1981 through 2006.



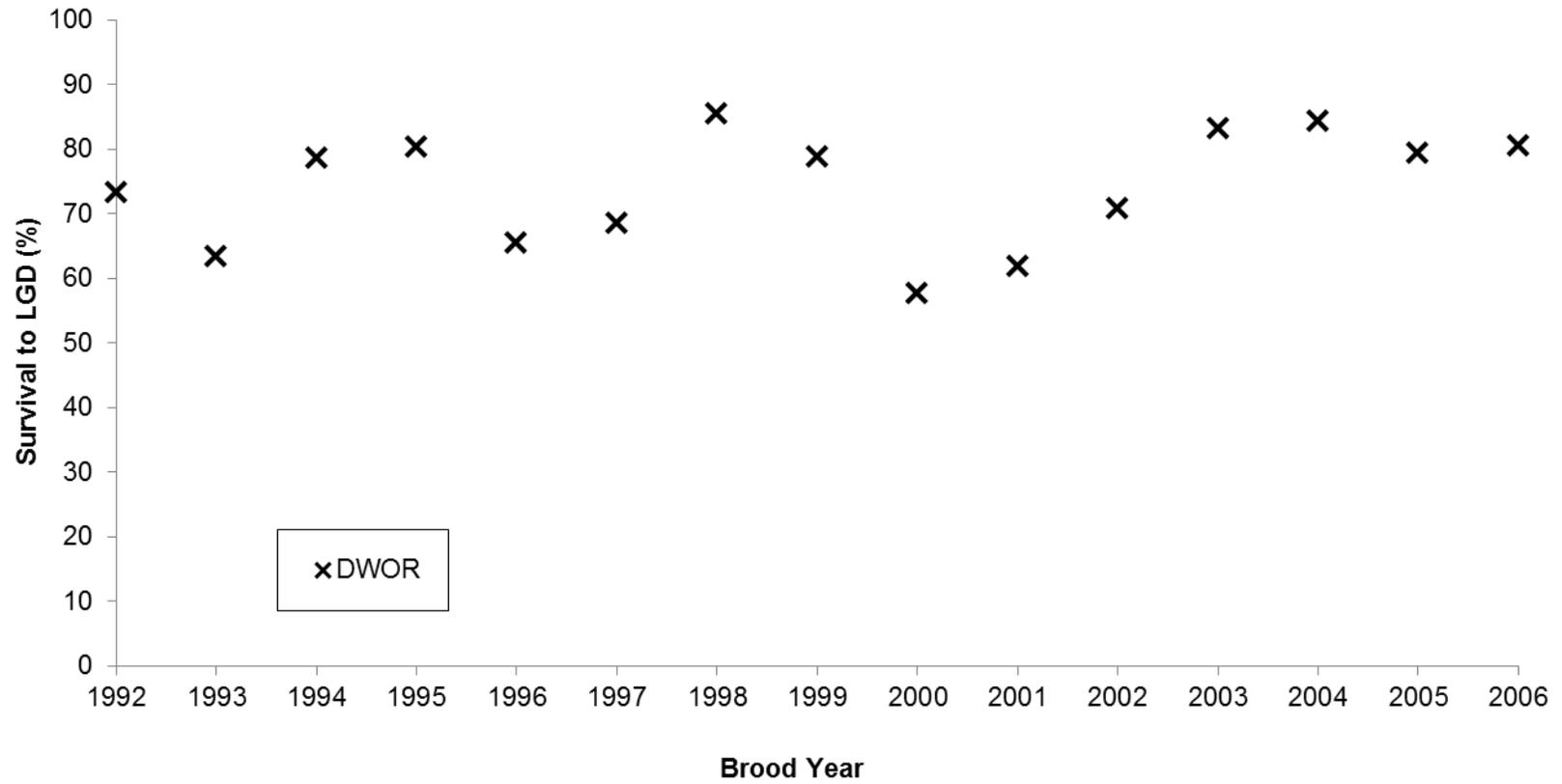
Appendix D, Figure 3. Size at release (fish per pound [fpp]) for steelhead smolts reared at Magic Valley Fish Hatchery from brood year 1987 through 2006.



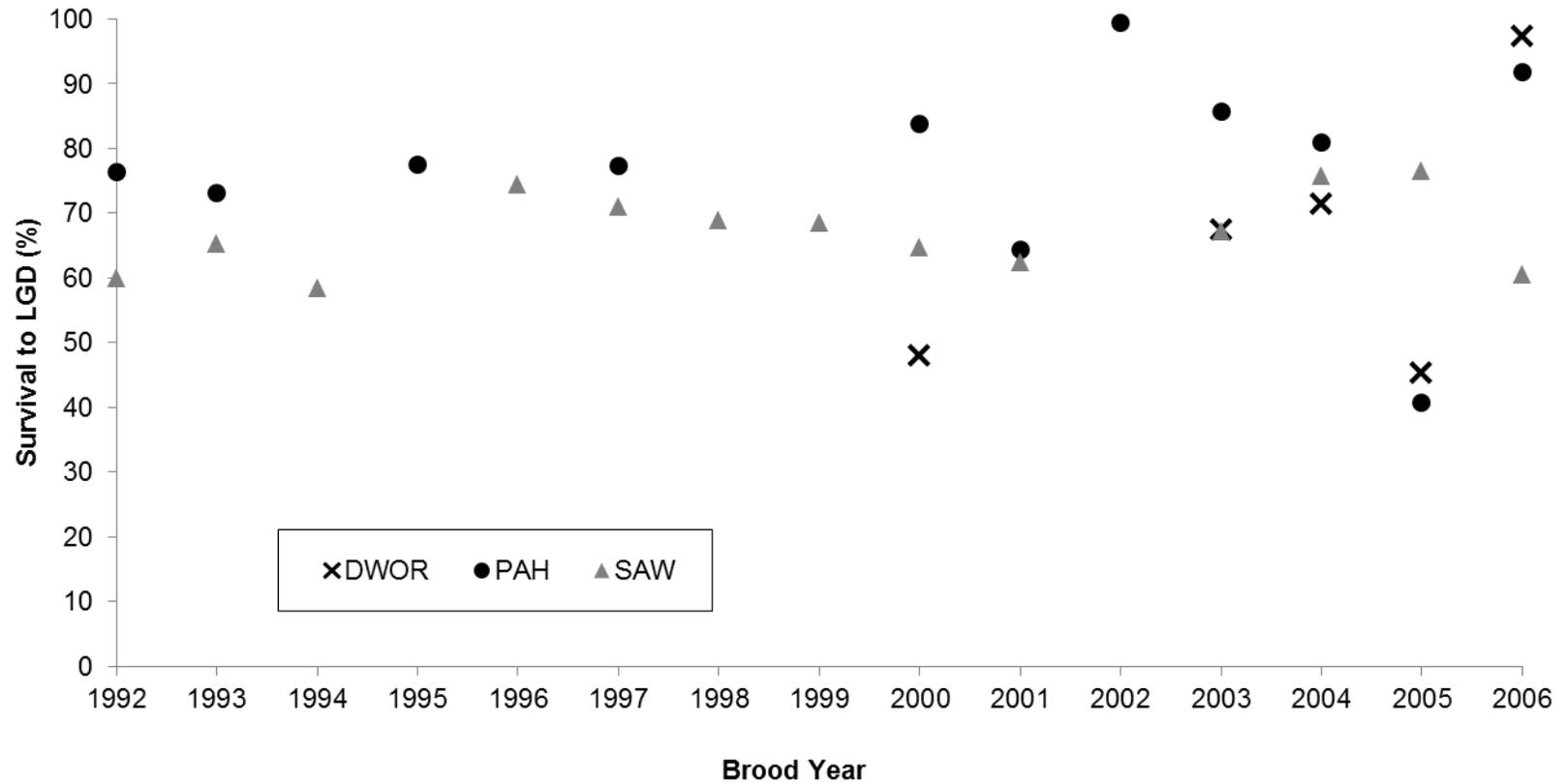
Appendix D, Figure 4. Size at release (fish per pound [fpp]) for steelhead smolts reared at Niagara Springs Fish Hatchery from brood year 1981 through 2006.



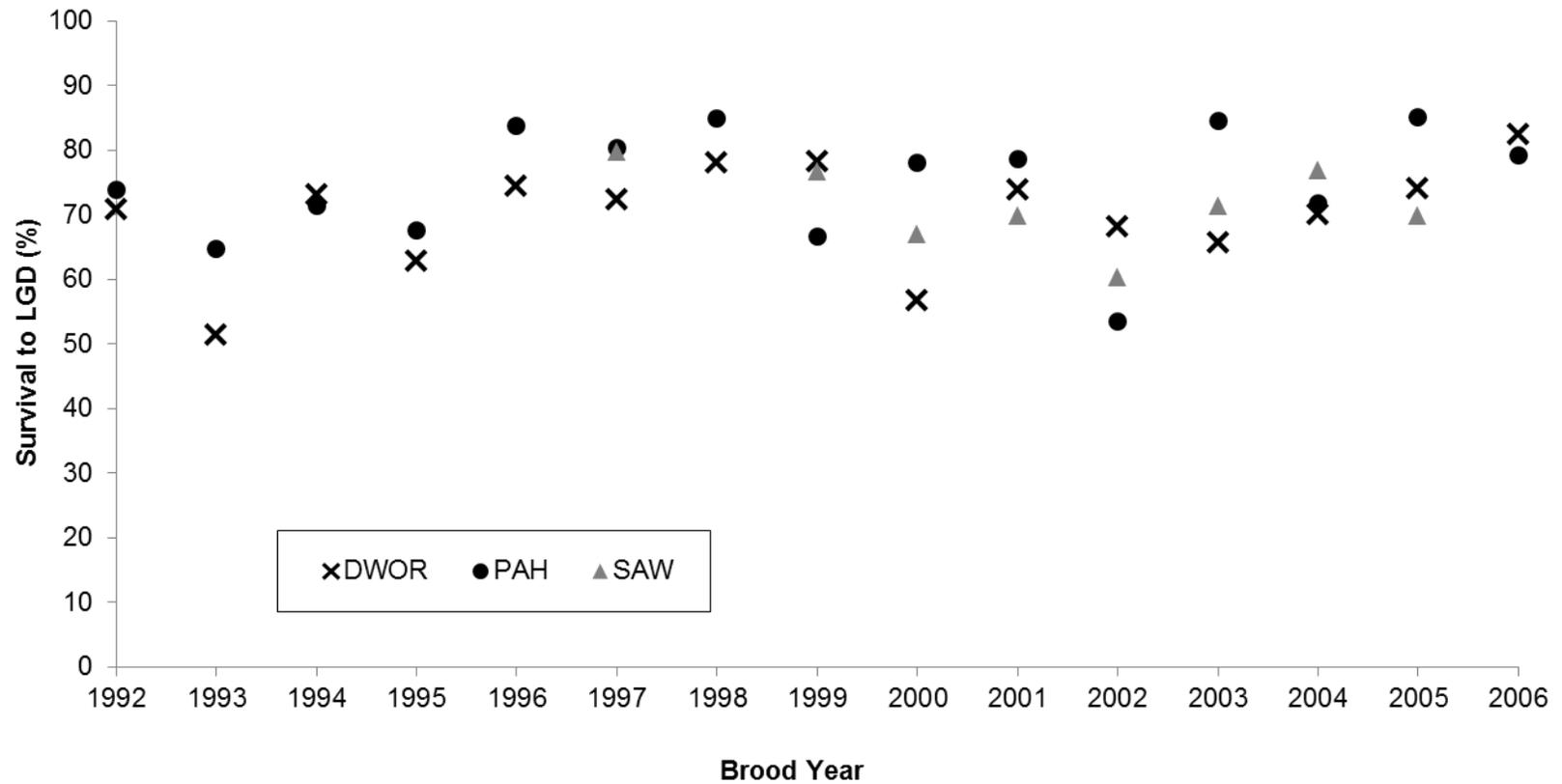
Appendix E, Figure 1. Survival of smolts from release to Lower Granite Dam for steelhead released from Clearwater Fish Hatchery from brood year 1992 through 2006.



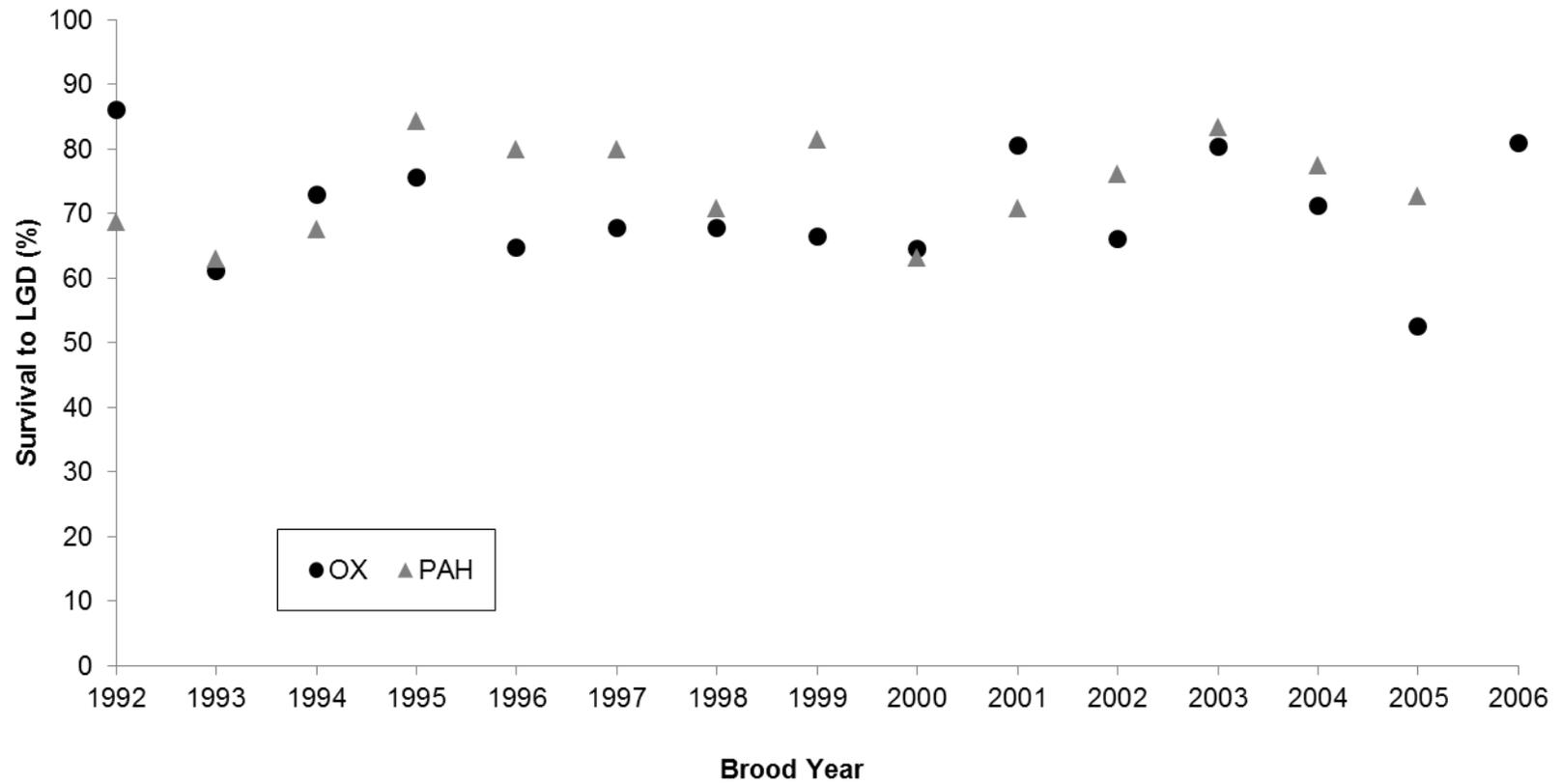
Appendix E, Figure 2. Survival of smolts from release to Lower Granite Dam for steelhead released from Hagerman National Fish Hatchery from brood year 1992 through 2006.



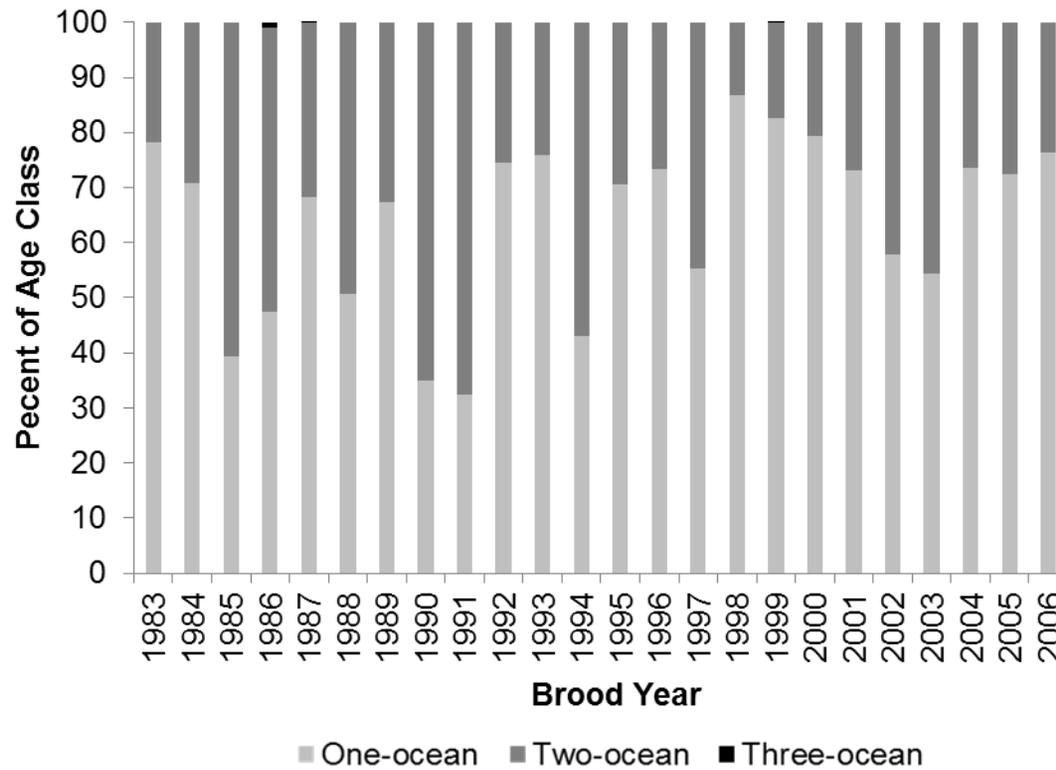
Appendix E, Figure 3. Survival of smolts from release to Lower Granite Dam for steelhead released from Magic Valley Fish Hatchery from brood year 1992 through 2006.



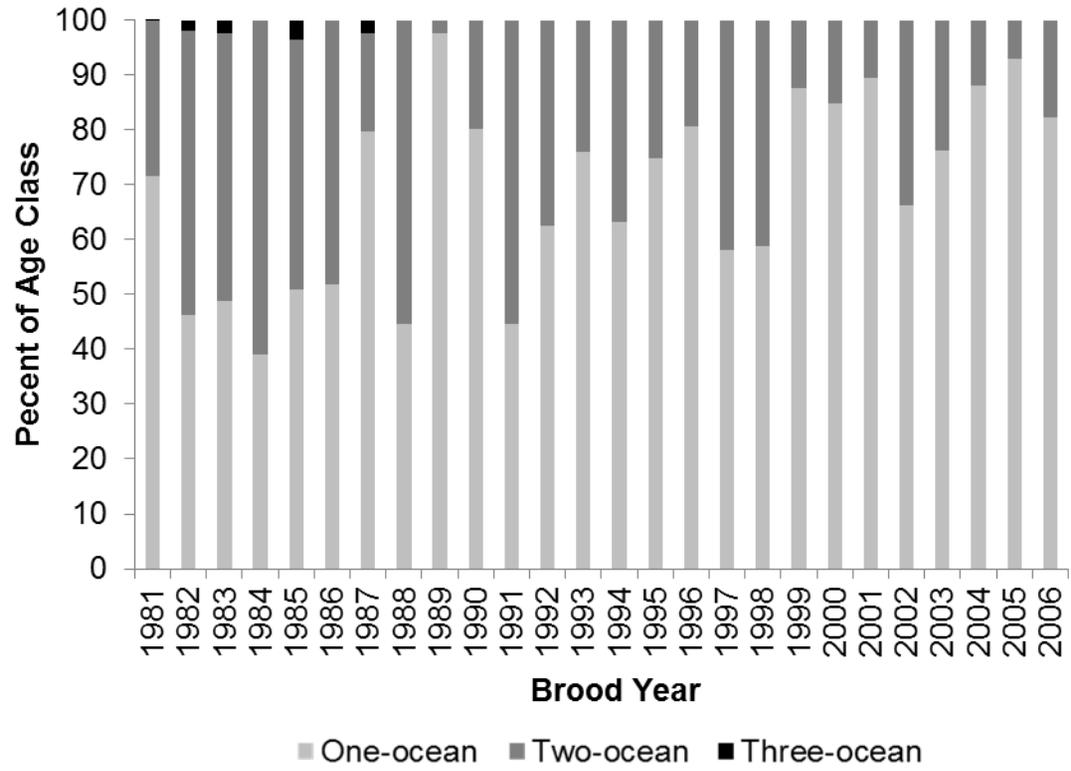
Appendix E, Figure 4. Survival of smolts from release to Lower Granite Dam for steelhead released from Niagara Springs Fish Hatchery from brood year 1992 through 2006.



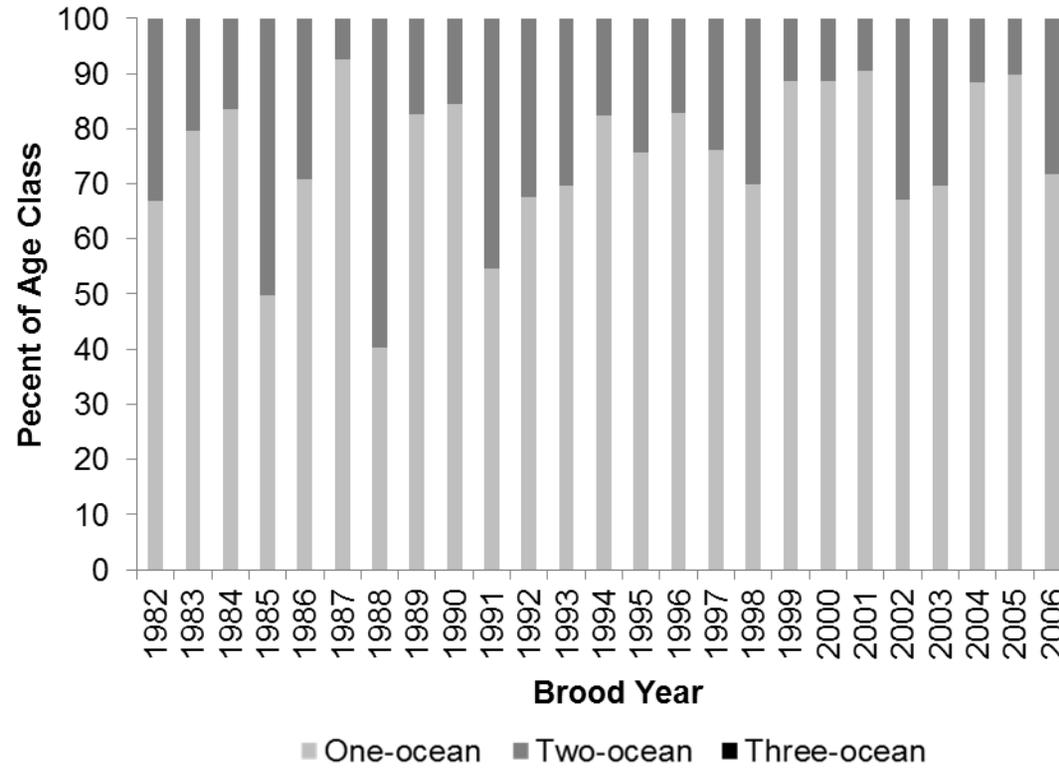
Appendix F, Figure 1. Age composition for adult hatchery steelhead returning to the Hells Canyon Trap (OX stock) for brood years 1983 through 2006.



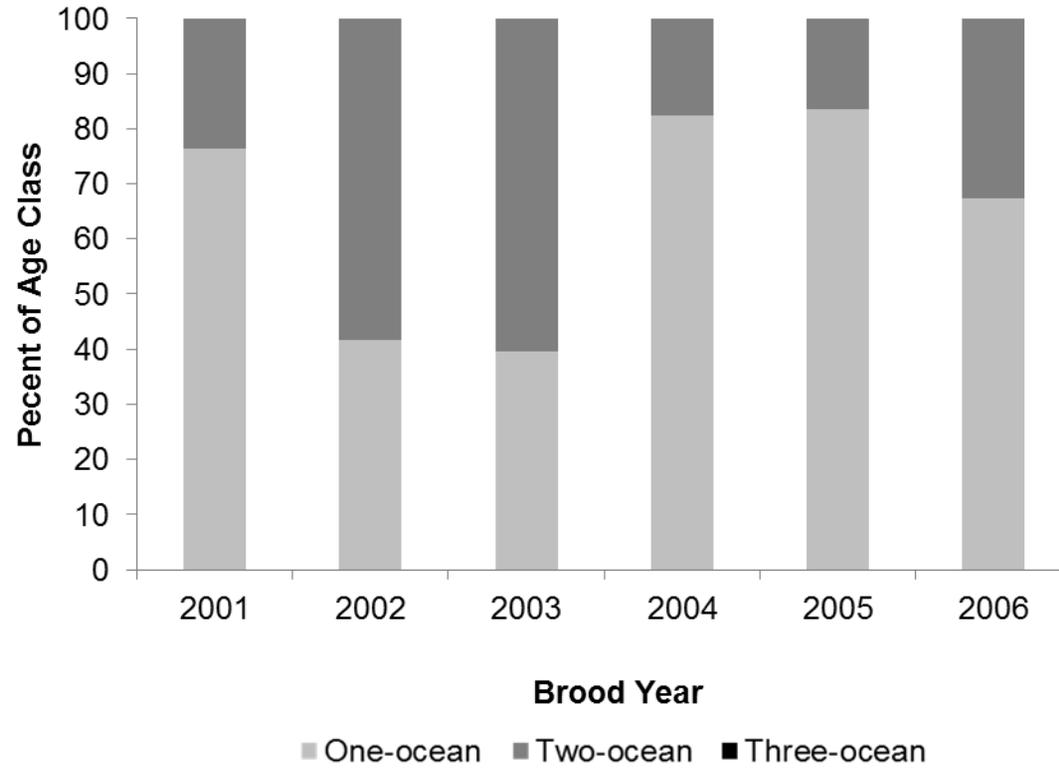
Appendix F, Figure 2. Age composition for adult hatchery steelhead returning to Pahsimeroi Fish Hatchery (PAH stock) for brood years 1981 through 2006.



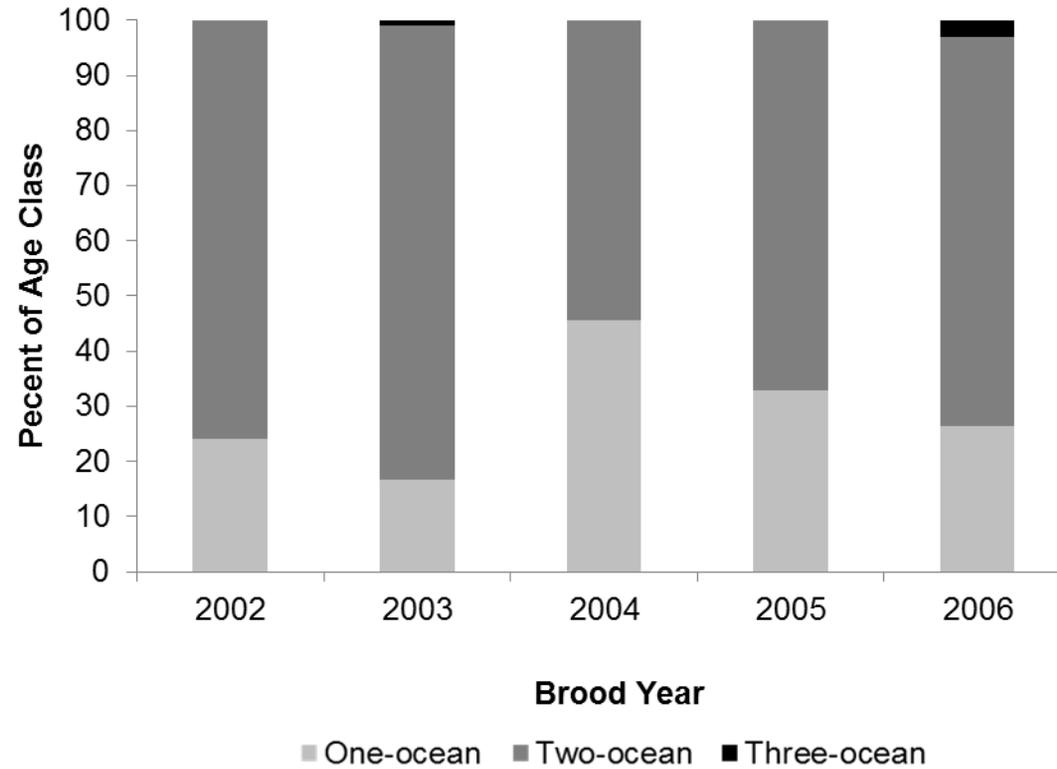
Appendix F, Figure 3 Age composition for adult hatchery steelhead returning to Sawtooth Fish Hatchery (SAW stock) for brood years 1982 through 2006.



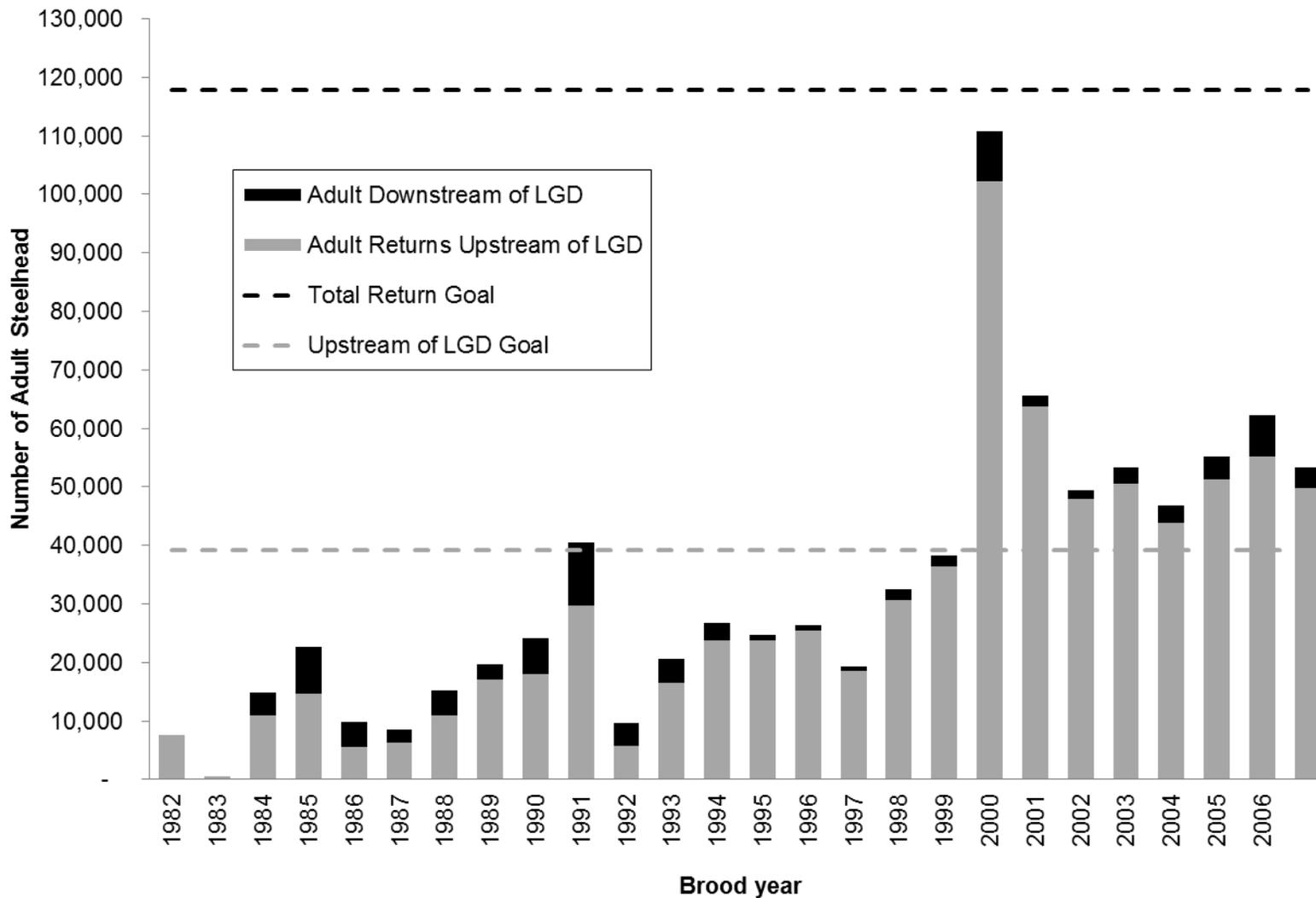
Appendix F, Figure 4. Age composition for adult hatchery steelhead returning to East Fork Satellite Facility (EFNAT stock) for brood years 2001 through 2006.



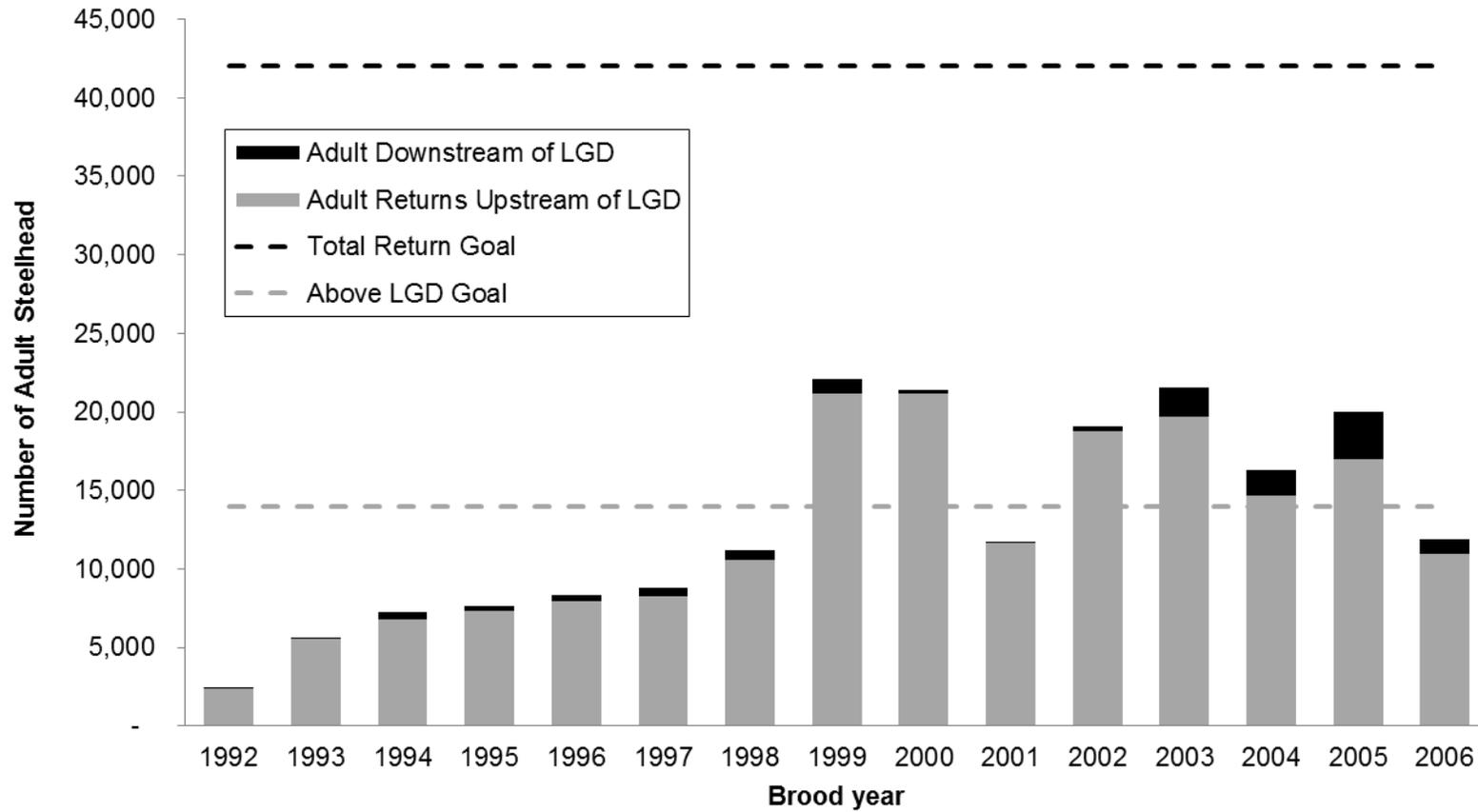
Appendix F, Figure 5. Age composition for adult USAL hatchery steelhead for brood years 2002 through 2006. Age at return was estimated using CWT recovered in fisheries due to the limited sample size of CWT recovered at Squaw Creek temporary weir.



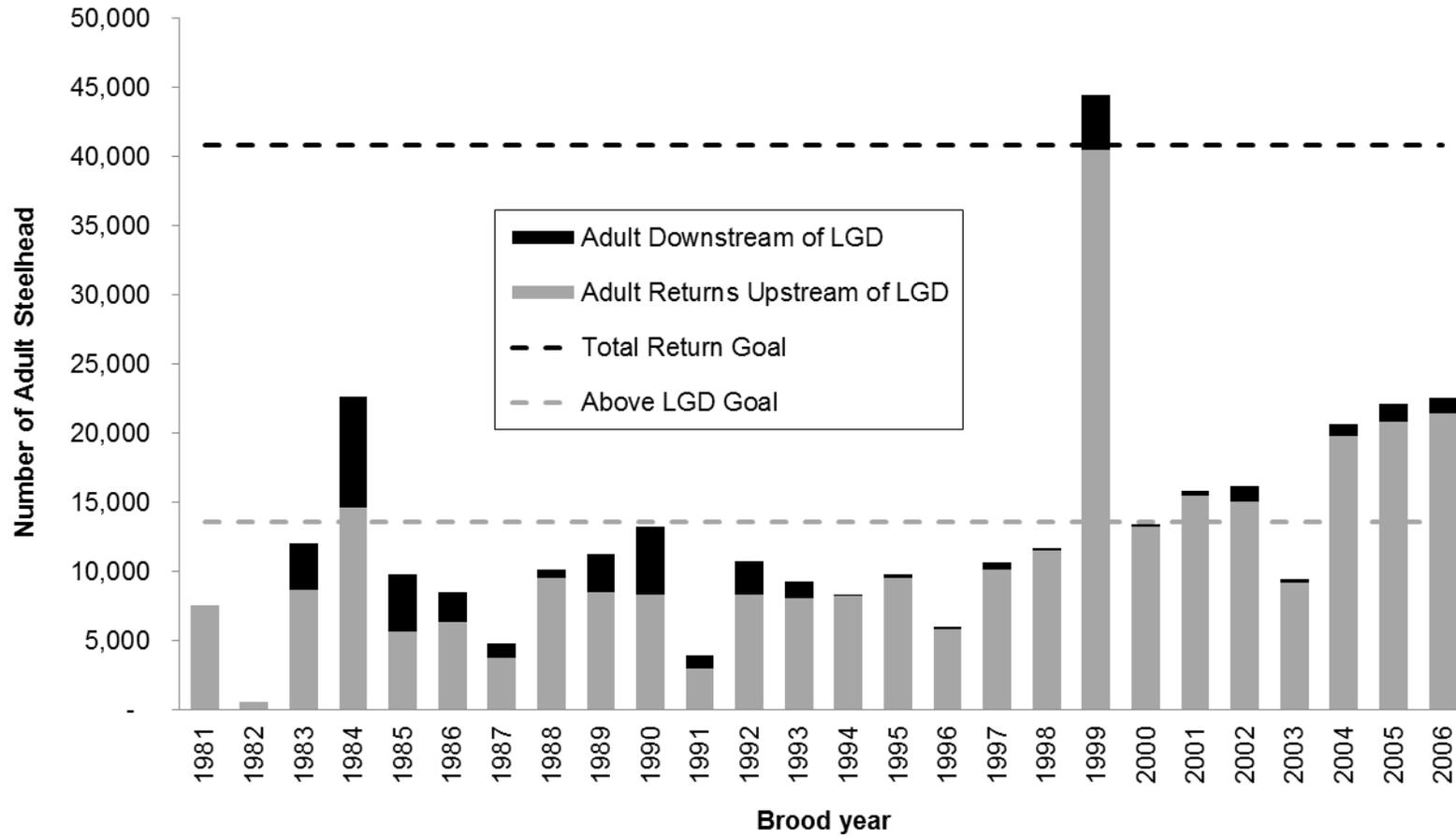
Appendix G, Figure 1. Combined adult returns summary for steelhead released from LSRCP funded facilities (Clearwater, Hagerman National, and Magic Valley fish hatcheries) for brood years 1992 through 2006.



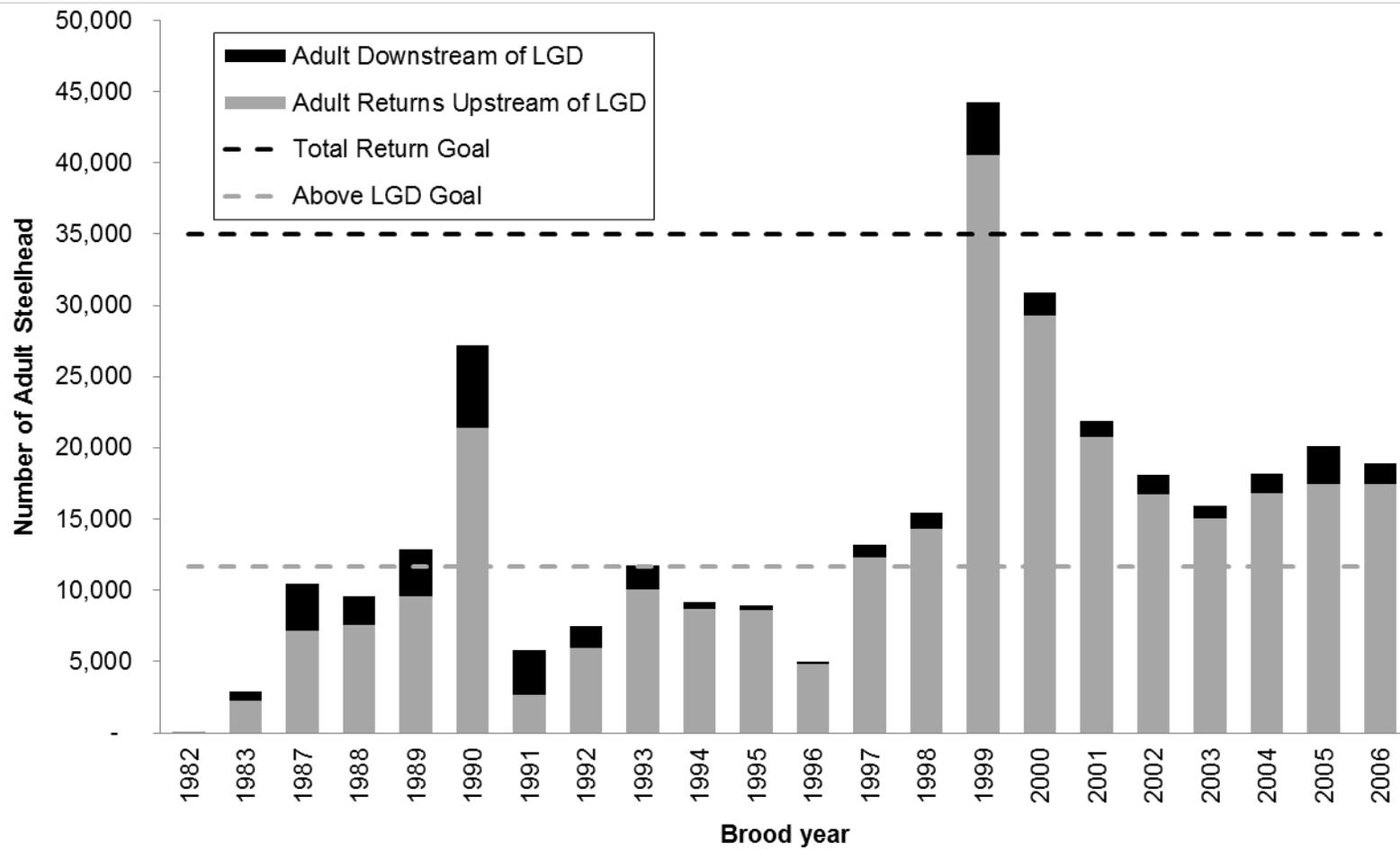
Appendix G, Figure 2. Adult return summaries for steelhead released from Clearwater Fish Hatchery for brood years 1992 through 2006.



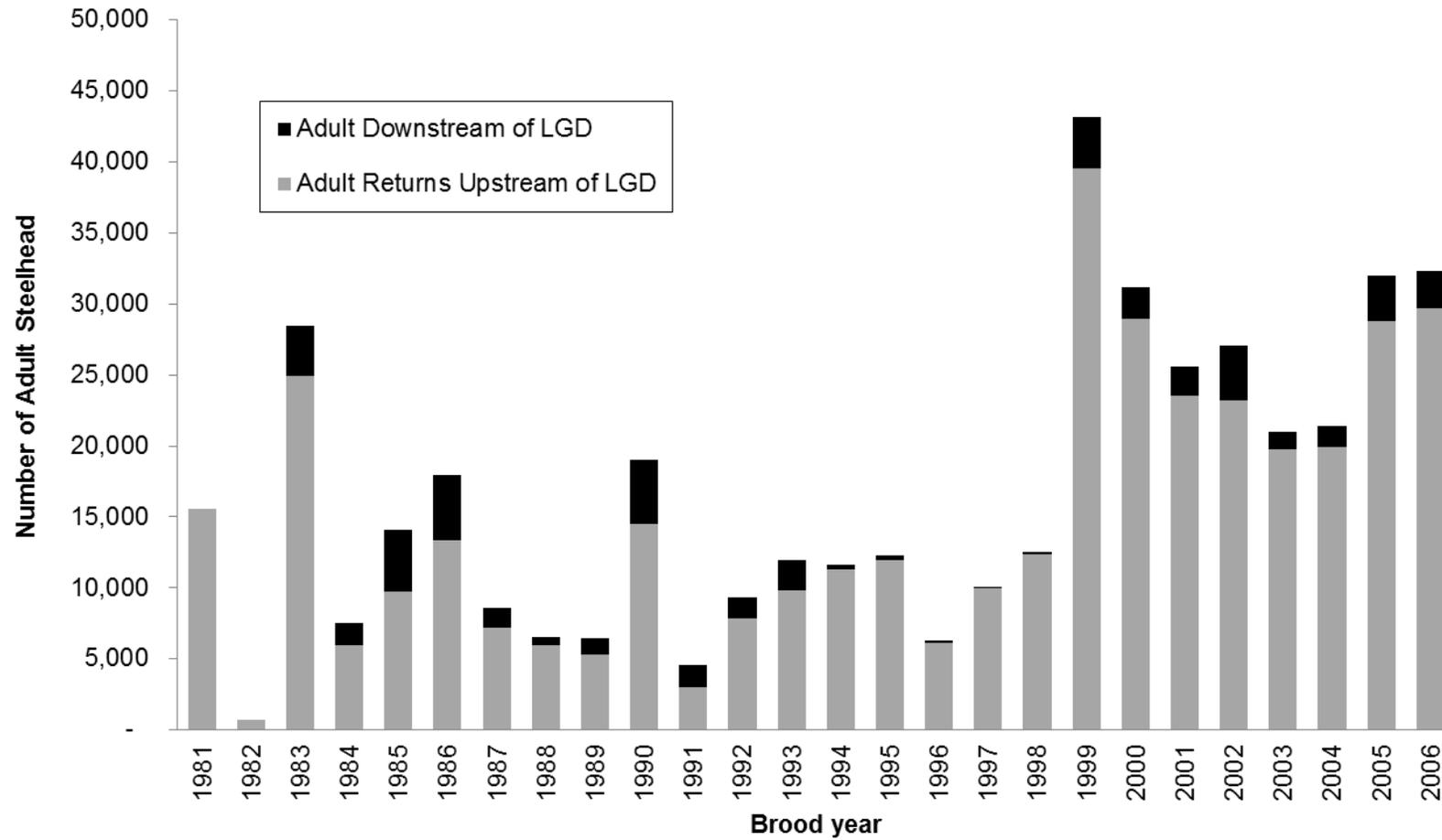
Appendix G, Figure 3. Adult return summaries for steelhead released from Hagerman National Fish Hatchery for brood years 1981 through 2006.



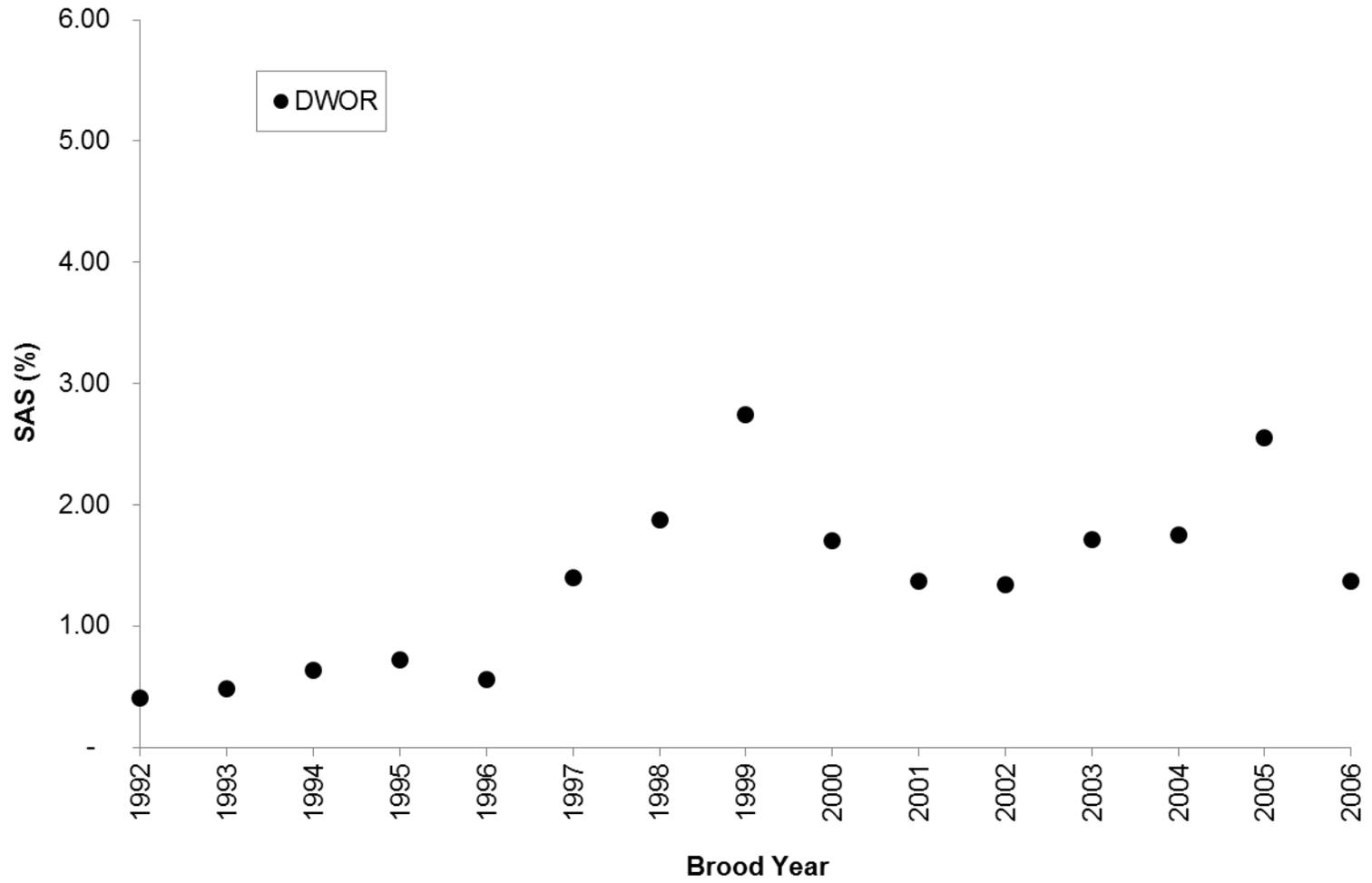
Appendix G, Figure 4. Adult return summaries for steelhead released from Magic Valley Fish Hatchery for brood years 1982 through 2006.



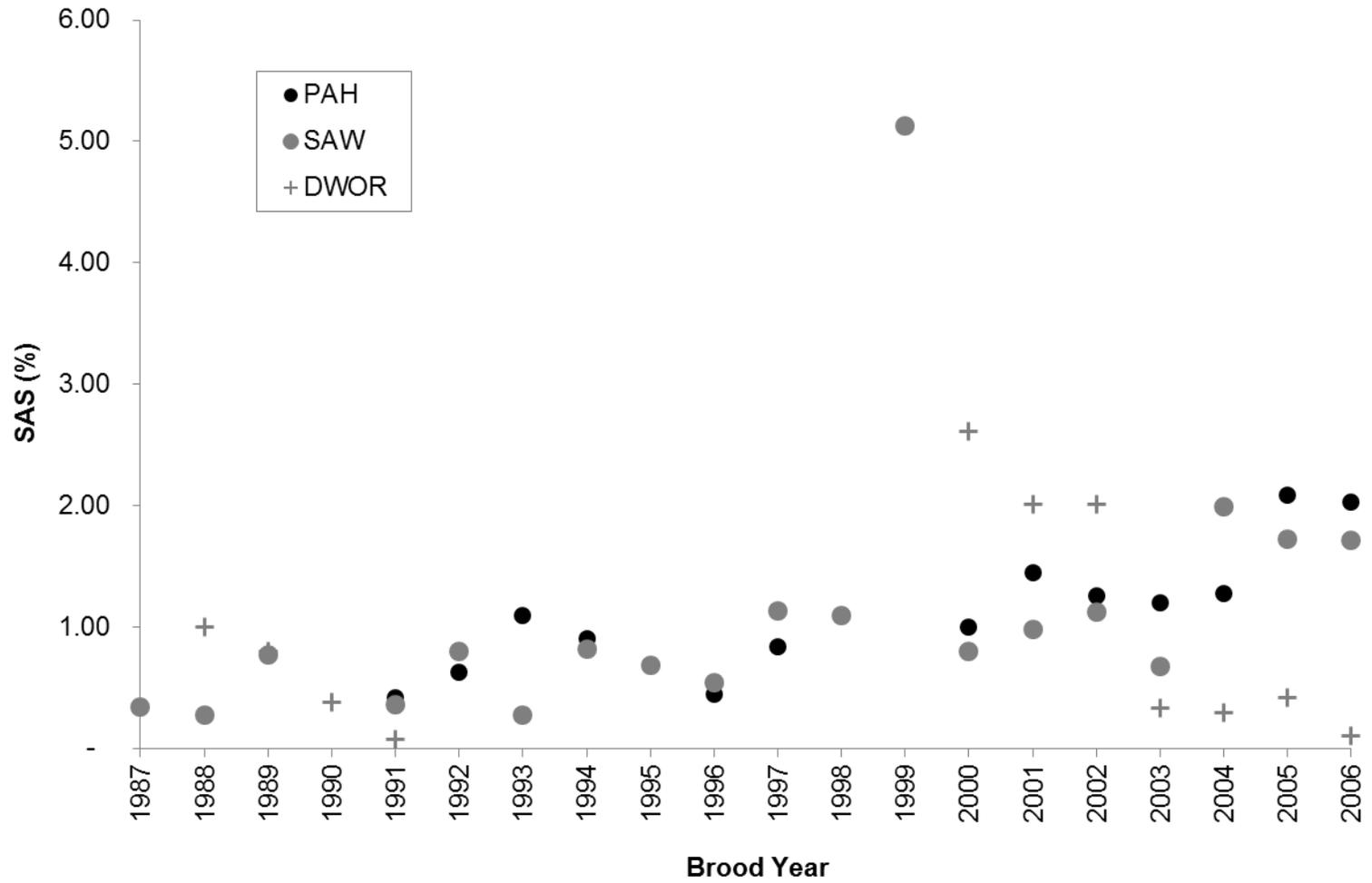
Appendix G, Figure 5. Adult return summaries for steelhead released from Niagara Springs Fish Hatchery for brood years 1981 through 2006.



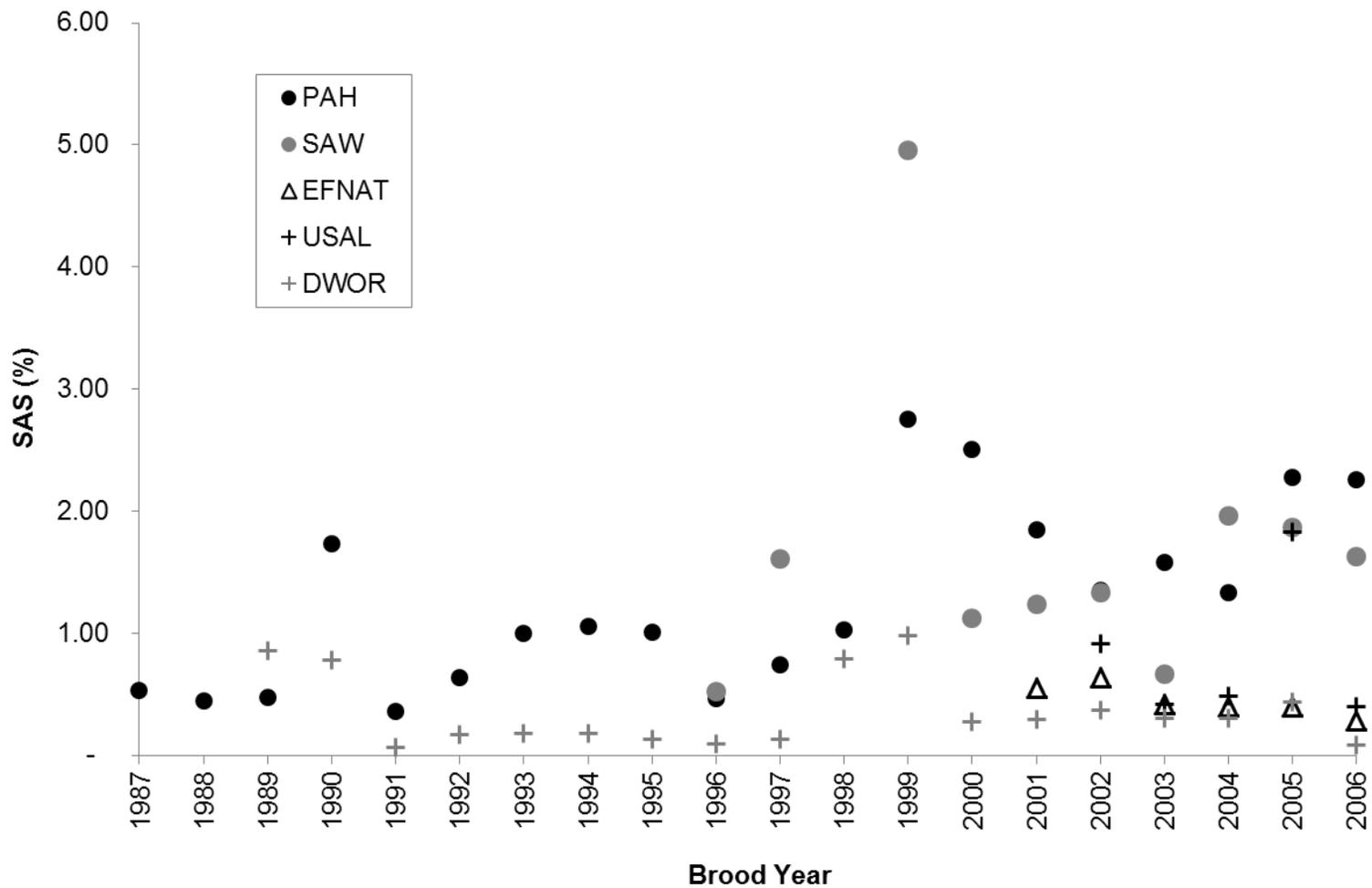
Appendix H, Figure 1. Smolt-to-adult survival rate (SAS) of steelhead released from Clearwater Fish Hatchery for brood years 1992 through 2006.



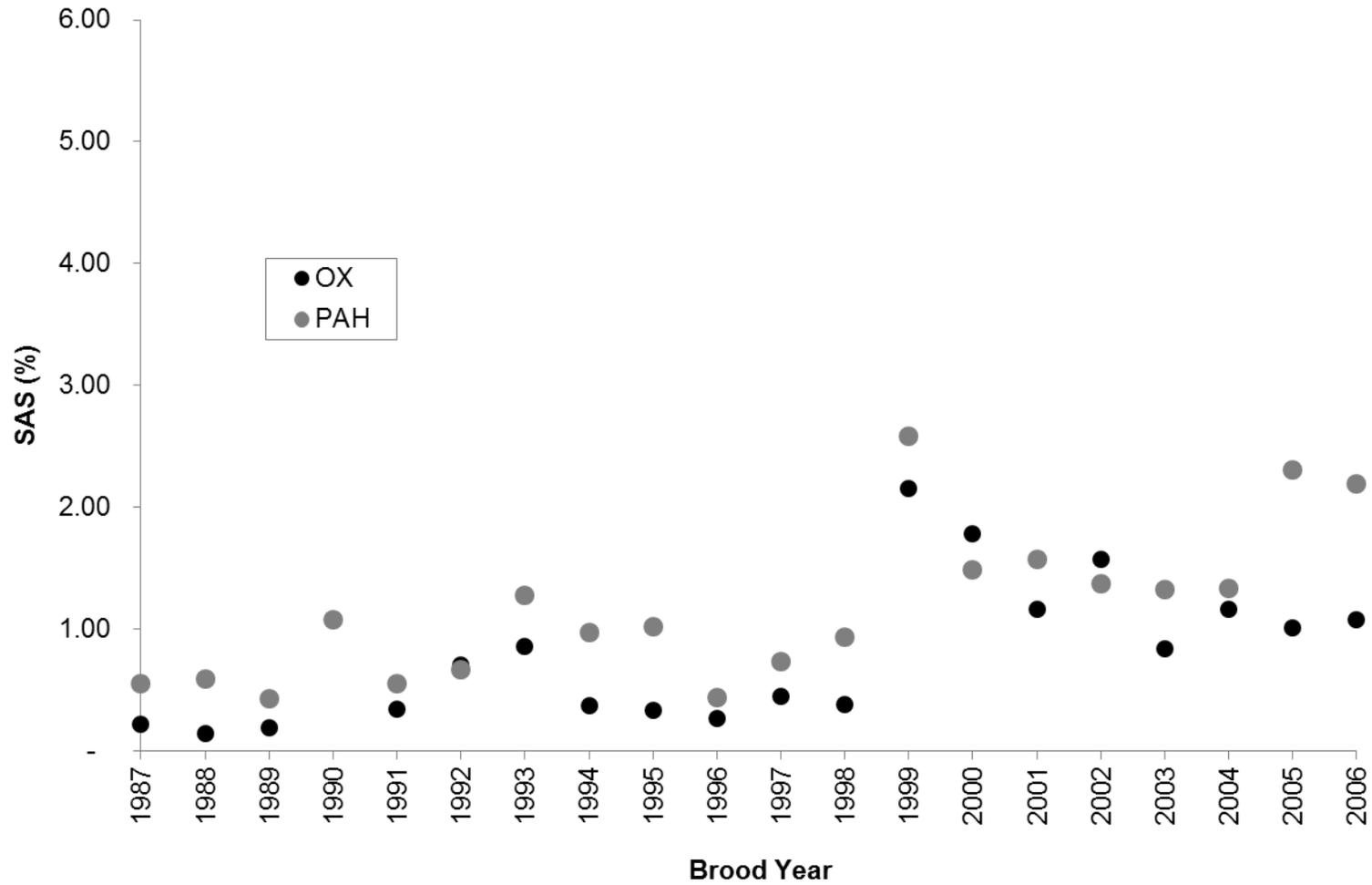
Appendix H, Figure 2. Smolt-to-adult (SAS) percentages for steelhead released from Hagerman National Fish Hatchery for brood years 1987 through 2006 for production released into the Salmon River.



Appendix H, Figure 3. Smolt-to-adult (SAS) percentages for steelhead released from Magic Valley Fish Hatchery for brood years 1987 through 2006 for production released into the Salmon River.



Appendix H, Figure 4. Smolt-to-adult (SAS) percentages for steelhead released from Niagara Springs Fish Hatchery for brood years 1987 through 2006.



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