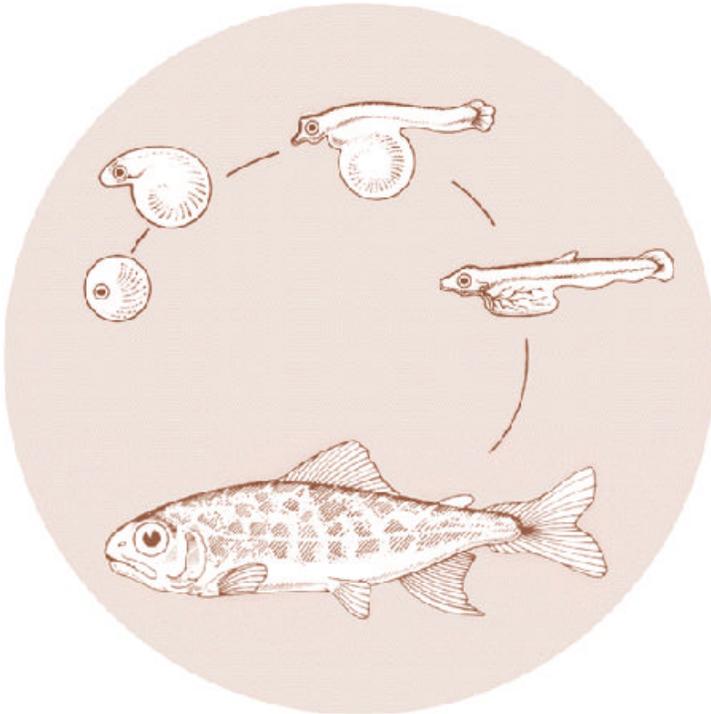


October 1998

**ANNUAL CODED WIRE TAG PROGRAM  
WASHINGTON  
MISSING PRODUCTION GROUPS**

Annual Report For 1997



DOE/BP-01873-6



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**ANNUAL CODED WIRE TAG PROGRAM**

**WASHINGTON**

**MISSING PRODUCTION GROUPS  
ANNUAL REPORT FOR 1997**

**Prepared By**

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Hatcheries Program

**Prepared For**

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October 1998

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## ABSTRACT

The Bonneville Power Administration (BPA) funds the "Annual Coded Wire Tag Program - Missing Production Groups for Columbia River Hatcheries" project. The Washington Department of Fish and Wildlife (WDFW), Oregon Department of Fish and Wildlife (ODFW) and the United States Fish and Wildlife Service (USFWS) all operate salmon and steelhead rearing programs in the Columbia River basin. The intent of the funding is to coded-wire tag at least one production group of each species at each Columbia Basin hatchery to provide a holistic assessment of survival and catch distribution over time and to meet various measures of the Northwest Power Planning Councils (NWPPC) Fish and Wildlife Program.

The WDFW project has three main objectives: 1) coded-wire tag at least one production group of each species at each Columbia Basin hatchery to enable evaluation of survival and catch distribution over time, 2) recover coded-wire tags from the snouts of fish tagged under objective 1 and estimate survival, contribution, and stray rates for each group, and 3) report the findings under objective 2 for all broods of chinook, and coho released from WDFW Columbia Basin hatcheries.

Objective 1 for FY-97 was met with few modifications to the original FY-97 proposal. Under Objective 2, snouts containing coded-wire tags that were recovered during FY-97 were decoded. Under Objective 3, survival, contribution and stray rate estimates for the 1991-96 broods of chinook and 1993-96 broods of coho have not been made because recovery data for 1996-97 fisheries and escapement are preliminary. **This report summarizes recovery information through 1995.**

## INTRODUCTION

The Columbia Basin Fish and Wildlife Program (Program) of the Northwest Power Act (Act) was adopted in 1994 with an overall goal of doubling the runs of salmon and steelhead in the Columbia River basin. The success of the Program relies on a system-wide approach to improving survival of migrating juveniles or returning adults, and improving habitat. The various artificial production measures and harvest regulations called for in the Program must work in concert to assure adequate escapement of adults, and maintain biodiversity within the system and to do so using the best available scientific knowledge. Within each program measure there are critical uncertainties that must be addressed. The proper tools must be available to those that manage the system so that informed decisions are made using the best available science.

One such tool is the coded-wire micro tag, which is inserted into the snout of juvenile salmon. Fish tagged in this manner are identified by the missing adipose fin. This method of fish identification provides a low cost method of assessing individual stocks of salmon when they are recovered on spawning grounds, hatcheries, traps or fisheries. For example, fish originating from "wild salmon" recovery projects in the mid- and upper Columbia co-mingle with fish produced from lower river hatcheries during some or all portions of their lives. The origin of a non-tagged fish cannot be easily determined when they are captured in a fishery or on the spawning grounds. Thus, without coded-wire tagged fish, it is virtually impossible to assess anthropogenic or environmental-caused impacts to each stock of fish in the Columbia Basin, It is also virtually impossible to assess rates of straying of any stocks of salmon or steelhead without coded-wire tags. Knowledge of the survival and distribution of these stocks provides some of the best science available for 'making decisions on managing and protecting critical stocks of fish.

Additionally, in "Section 7" of the Program, direction is given to improve hatchery operations so that impacts of artificially reared fish on wild fish will be minimized and the quality of hatchery fish is improved. The coded-wire tag provides the fishery manager the ability to assess both impacts and successes of hatchery and wild fish. It enables the manager to assess if hatcheries are effective in meeting their goals and objectives, allows for scientific comparison of different rearing or release strategies and helps determine if any of these hatchery practices are causing harm to sensitive wild stocks.

A system of monitoring and evaluating survival and distribution is called for in the Program and is necessary to measure present and future levels of fish production by various hatchery and natural fish production components. In order to evaluate the success of the Program in doubling the size of fish runs, a continuous long term data set is necessary. A long term set of data allows measurement of annual variation in the number of adults produced each year from each hatchery and provides a benchmark to

compare performance of fish from other projects funded by Bonneville Power Administration. Tagged hatchery fish can also serve as surrogates for the assessment of wild fish impacts and survivals if the wild fish are at critical levels and can't be effectively tagged. Because of the utility of the coded-wire tag as a stock assessment tool, the recovery information provided by these projects helps meet other Program measures. In addition, data generated by coded wire tags are used by fishery managers to assess long term changes in stock abundance, in modeling of wild stock abundance, for run reconstruction analysis to determine strength of individual runs within the Basin, and to meet obligations under U.S. v. Oregon and the Pacific Salmon Treaty. Lastly, WDFW uses these data to monitor and report compliance with Section 7 and Section 10 incidental and direct take permits used by the National Marine Fisheries Service, which regulates hatchery production under the Endangered Species Act.

This report describes project activities during fiscal year 1997 and summarizes data for recoveries occurring through 1995.

## APPROACH

The goals of this program are to use the coded-wire tag as a tool to estimate survival and distribution of hatchery reared salmon from WDFW Columbia River hatcheries. The generation of these estimates can then be used for a wide variety of purposes. For this project, meeting the objectives listed below will allow for evaluation of hatchery effectiveness, it will meet several Program measures such as those under Sections 6.1, 7.2, 8.1, 8.2, and 8.3, and allow operation of hatcheries in the Columbia Basin consistent with ESA concerns. Work has progressed under the following three objectives:

Objective 1. Coded-wire tag at least one group of fish representative of each hatchery's production of a given species that is currently not being tagged through another program.

Objective 2. Recover fish that were coded-wire tagged, decode these tags, and then estimate survival and contribution of each group released each year.

Objective 3. Develop estimates of fishery catch and contribution, and stray rates for chinook and coho released from WDFW Columbia River hatcheries. Use these estimates to determine hatchery effectiveness and report the results in an Annual Report submitted to the Bonneville Power Administration.

## RESULTS

**Objective 1.** A total of 1,131,764 fall chinook, 667,706 spring chinook, and 380,785 coho (2,180,255 for all species) were tagged during the contract period. Total estimated expenditures on tagging were \$277, 220 (Table 1). Releases of 1996 brood chinook tagged during FY-97 are given in Table 2. Releases of yearling chinook and coho (1995 brood) tagged during FY-97 are given in Tables 3 and 4, respectively. Releases of 1995 brood yearling salmon, and 1996 brood subyearling salmon tagged under other program funds are listed in Table 5.

There were differences in the number of fish proposed for tagging and the number actually tagged in FY-97 :

1. Type S coho were not tagged at Grays River hatchery (30,000)
2. An additional 30,000 coho were tagged at Washougal for planting into the Klickitat River.
3. At Lewis River, 30,000 of a budgeted 60,000 tags were applied to coho to be introduced into the Methow River.

Of the 2,192,000 tags requested for FY-97, a total of 2,180,255 were applied.

**Objective 2.** A total of 3,618 tags related to contract tagging were recovered from Columbia River fall and spring chinook, and coho during FY-97. A total of 479 fish with missing adipose fins had no tag in the snout resulting in a no or lost tag rate of 13.2%.

Table 1. Tagging summary and estimated costs during FY-97 for 1995 brood yearling coho and chinook and 1996 brood subyearling chinook. Table includes those production groups tagged under contract with BPA. F= Fall ; Sp= Spring. Cost of tagging is based on a rate of \$127.001 1000 tags which includes 19% overhead.

HATCHERY	SPECIES	TAGGING DATE	NUMBER TAGGED	COST (\$)
GRAYS	F.CHINOOK	April 10, 1997	193,675	\$24,626
GRAYS	TYPE-S COHO	Not Tagged		
ELOCHOMAN	F.CHINOOK	May 16, 1997	184,172	\$23,417
ELOCHOMAN	TYPE-N COHO	November 15, 1996	61,972	\$7,880
ELOCHOMAN	TYPE-S COHO	November 14, 1996	30,014	\$3,816
BEAVER CREEK	F. CHINOOK	April 21, 1997	90,846	\$11,564
NORTH TOUTLE	F. CHINOOK	June 6, 1997	91,377	\$11,619
NORTH TOUTLE	TYPE-S COHO	October 7, 1996	31,105	\$3,955
NORTH TOUTLE	SP. CHINOOK	November 11, 1996	110,497	\$14,050
FALLERT CREEK	F. CHINOOK	April 30, 1997	91,920	\$11,688
FALLERT CREEK	SP. CHINOOK	May 29, 1996	114,268	\$14,529
FALLERT CREEK	TYPE-S COHO	December 12, 1996	30,738	\$3,908
KALAMA FALLS	F. CHINOOK	June 2, 1997	92,008	\$11,699
KALAMA FALLS	TYPE-N COHO	December 13, 1996	29,268	\$3,721
KALAMA FALLS	SP. CHINOOK	December 16, 1996	85,750	\$10,890
WASHOUGAL	F. CHINOOK	May 30, 1997	184,985	\$23,521
WASHOUGAL	TYPE- N COHO ON-STATION	December 5, 1996	31,345	\$3,986
WASHOUGAL	TYPE-N COHO KLICKITAT RIVER	December 6, 1996	91,019	\$11,574
KLICKITAT	F. CHINOOK	April 21, 1997	202,781	\$25,784
KLICKITAT	SP. CHINOOK (subyearling)	April 8, 1997	221,890	\$28,213
KLICKITAT	SP. CHINOOK (yearling)	April 19, 1996	102,143	\$12,987
KLICKITAT	TYPE-N COHO	September 25, 1996	45,310	\$5,761
LEWIS RIVER METHOW RIVER	TYPE-S COHO	September 17, 1996	30,014	\$3,816
RINGOLD	SP. CHINOOK	October 30, 1996	33,158	\$4,216
<b>TOTALS</b>			<b>2,180,255</b>	<b>\$ 277,220</b>

Table 2. Releases in 1997 of 1996 brood subyearling fall chinook coded wire tagged during FY-97 under contract with BPA.

HATCHERY	SPECIES	RELEASE DATE(S)	NUMBER TAGGED FISH RELEASED	TOTAL RELEASE
GRAYS RIVER	FALL CHINOOK	May 24, 1997	88,272	1,104,450
	FALL CHINOOK	September 1, 1997	98,909	99,700
ELOCHOMAN	FALL CHINOOK	June 10, 1997	88,989	2,618,637
	FALL CHINOOK	June 27, 1997	78,891	622,424
NORTH TOUTLE	FALL CHINOOK	June 26, 1997	85,655	2,631,598
KALAMA FALLS	FALL CHINOOK	June 25-June 30, 1997	91,253	4,661,300
FALLERT CREEK	FALL CHINOOK	June 3-June 6, 1997	87,945	2,206,860
WASHOUGAL	FALL CHINOOK	June 27; July 25	155,852	6,139,000
KLICKITAT	FALL CHINOOK	May 22, 1997	195,203	3,625,870
BEAVER CREEK	FALL CHINOOK	May 20, 1997	85,141	1,096,198
<b>TOTALS</b>			<b>1,056,110</b>	<b>24,806,037</b>

Table 3. Releases in 1997 of 1995 and 1996 brood spring (SP.) chinook coded wire tagged during FY-97 under contract with BPA.

HATCHERY	SPECIES	RELEASE DATE(S)	NUMBER TAGGED FISH RELEASED	TOTAL RELEASE
FALLERT CREEK	SP. CHINOOK	March 25-April 1, 1997	105,757	293,740
KALAMA FALLS	SP. CHINOOK	April 1, 1997	82,467	84,000
KLICKITAT	SP. CHINOOK SUBYEARLINGS	May 27, 1997	228,811	382,500
KLICKITAT	SP. CHINOOK YEARLINGS	March 1, 1997	86,862	580,600
RINGOLD	SP. CHINOOK	April 4, 1997	12,058	180,287
NORTH TOUTLE	SP. CHINOOK	March 20, 1997	103,930	104,452
<b>TOTALS</b>			<b>537,418</b>	<b>1,625,579</b>

Table 4. Releases in 1997 of 1995 brood coho coded wire tagged during FY-97 under contract with BPA.

HATCHERY	SPECIES	RELEASE DATE	NUMBER TAGGED FISH RELEASED	TOTAL RELEASE
ELOCHOMAN	TYPE-S COHO	March 10, 1997 <sup>1</sup>	28,669	259,889
ELOCHOMAN	TYPE-N COHO	April 14-May 12, 1997	60,452	250,818
NORTH TOUTLE	TYPE-S COHO	May 1, 1997	31,055	371,069
KALAMA FALLS	TYPE-N COHO	April 22, 1997	25,908 <sup>2</sup>	152,400
FALLERT CREEK	TYPE-S COHO	April 9- April 23, 1997	27,441	489,630
WASHOUGAL	TYPE-N COHO ON-STATION	May 1, 1997	27,034 <sup>3</sup>	97,500
WASHOUGAL	TYPE-S COHO KLICKITAT R.	April 1, 1997	89,946	1,010,000
KLICKITAT	TYPE-N COHO	April 15, 1997	35,712	1,358,869
<b>TOTALS</b>			<b>326,217</b>	<b>3,990,175</b>

1 Fish planted in Klickitat River.

2 11,417 tagged fish planted in Klickitat

3 21,766 of these fish were planted into Klickitat River on April 15, 1997.

Table 5. Releases in 1997 of 1995 brood yearling chinook and coho and 1996 brood subyearling chinook during FY-97. This table represents groups coded wire tagged under other (non-BPA) funding sources. SP= Spring, SU= Summer.

HATCHERY	SPECIES	RELEASE DATE(S)	NUMBER TAGGED	TOTAL RELEASE FISH RELEASED
COWLITZ	FALL CHINOOK	May-July, 1997	190,070	5,961,500
COWLITZ	SP. CHINOOK	March-April, 1997	337,797 <sup>4</sup>	946,714
COWLITZ	TYPE-N COHO	NOT TAGGED		8,386,685
LEWIS RIVER	SP. CHINOOK	February-March, 1997	192,371	1,108,045 <sup>5</sup>
LEWIS RIVER	TYPE-N COHO	April 15, 1997	70,917 <sup>6</sup>	1,981,388
LEWIS RIVER	TYPE-S COHO	April 1, 1997	139,452	968,409
LYONS FERRY	FALL CHINOOK YEARLING	April 4-26, 1997	435,605	456,776
TUCANNON	SP. CHINOOK	March-April, 1997	61,661	62,144
RINGOLD	FALL CHINOOK	June & July, 1997	410,434	4,062,997
PRIEST RAPIDS	FALL CHINOOK	June 16-June 24, 1997	193,399	5,000,000
TURTLE ROCK	SU. CHINOOK	April 17 & June 28, 1997	506,200	1,393,600
CHIWAWA	SP. CHINOOK	NO RELEASE		
DRYDEN POND	SU. CHINOOK	May 8, 1997	662,864	687,439
LAKE WENATCHEE	SOCKEYE	October 22, 1997	284,630 <sup>7</sup>	284,630
WELLS DAM	SU. CHINOOK YEARLING	April 1, 1997	278,455	290,000
WELLS DAM	SU. CHINOOK SUBYEARLING	June 13, 1997	382,146	408,000
METHOW	SP. CHINOOK	April 15, 1997	14,176	14,258
METHOW	TYPE-S COHO	May 13, 1997	1,084	15,000
CARLTON POND	SU. CHINOOK	April 8 & April 20, 1997	338,598	353,182
SIMILKAMEEN	SU. CHINOOK	April 1, 1997	569,069	587,000
<b>TOTALS</b>			<b>5,068,928</b>	<b>32,977,767</b>

4 Includes 98,892 tagged sub-yearling chinook. Total release was 101,587 subyearlings

5 Includes 45,944 tagged fish and a total release of 155,177 fish from the "Fish First Net Pens".

6 4,439 of these tagged fish were released into the Klickitat River.

7 Ad clipped only.

**Objective 3.** Summaries of coded wire tag information for groups of 1986-1990 brood chinook and 1988-1992 brood coho are listed by hatchery. "Survivals" are calculated by dividing the total estimated recoveries by the total number of tagged fish released. "Percent of total survival to fisheries" is calculated by dividing the total estimated recoveries in each fishery or escapement by the total number of estimated recoveries. Type-N coho refer to north migrating coho and Type-S coho to south migrating coho. For descriptions of individual hatcheries the reader is referred to "Operations Plans for Anadromous Fish Production Facilities in the Columbia River Basin: Volume IV"<sup>8</sup>

**Grays River Hatchery-** Grays River Hatchery rears and releases Tule fall chinook and Type-S (early) coho. Fall chinook survivals range from 0.03% to over 8.0% for broods 1974-1990 (Figure 1). Releases of 4-5 g fish in June generally result in survivals under 1.0%. Fish released in the fall months (>20 g) generally survive at over 1.0%. A group of large (>12 g) 1985 brood fish released in May survived at over 1%. Fall chinook from the 1989 and 1990 broods had survivals of 0.07% and 0.04% respectively. These fish contributed primarily to the Canada troll and Columbia River net fishery and escapement (Figure 2).

Type-S coho survivals range from 0.03-3.7% for broods 1975-1992 (Figure 3). In recent years one group of coho has been released in April and the other in May. Data from these releases are pending. Survivals of 1988-1992 broods ranged from 0.03-3.7%. Grays River Type-S coho contributed primarily to escapement and the Oregon and Washington sport fisheries, Oregon commercial and the Columbia River net fishery (Figure 4).

**Elochoman River Hatchery-** Elochoman Hatchery rears and releases Tule fall chinook, and both Type-N and Type-S coho. Fall chinook survivals range from 0.06-0.9% (Figure 5). Most tag groups represent fish released in June at sizes ranging from 4.5-6.0 g. A group of large fall chinook (>12 g; 1985 brood) juveniles released in the spring survived at nearly 1%. Fish from the 1986 and 1987 broods were not tagged. The 1988 brood was used in a release timing study along with fish at Kalama Falls Hatchery. Survival of the three release groups averaged 0.06%, with the lowest survival occurring in the June release. These fish contributed primarily to the Canadian troll fishery and escapement (Figure 6).

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<sup>8</sup> 1992 Annual Report, U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife.

Type-N coho survivals at this hatchery range from 0.01-8.1% (Figure 7). Survival of 1988-1992 brood Type-N coho ranged from 0.01-8.1%. These fish contributed primarily to the Oregon fisheries, the Columbia River net fishery, and to the Washington coastal net fisheries (Figure 8). Survivals of Elochoman Type-S coho range from 0.03-3.5% (Figure 9). Survivals of the 1988-1992 broods ranged from 0.03-3.5%. These broods contribute primarily to the Oregon and Washington coastal sport, Columbia River net, Oregon commercial fisheries and to escapement (Figure 10).

**Cowlitz River Hatchery-** Cowlitz Hatchery rears and releases fall chinook, spring chinook, and Type-N coho. Survivals of fall chinook range from 0.05-1.7% (Figure 11). Most tag groups represent fish released in June at sizes ranging from 5.0-6.5 g, however there have been some releases of large chinook in the fall months. Survivals of 1986-1990 broods of fall chinook ranged from 0.05%-0.18%. These broods contributed mainly to escapement (53.8%) but moderate catches were made by Washington coastal sport and troll fishers and Canadian troll fishers (Figure 12).

Cowlitz spring chinook survivals range from 0.46-10.2% (Figure 13). Most tag groups represent fish released as yearlings (45-60 g) in either March, April, or May. Survivals of 1986-1990 brood fish ranged from 0.46-2.6%. The majority of the survival was as escapement either to the hatchery or freshwater sport fisheries (Figure 14). Moderate catches were made by Washington coastal sport and troll fishers, and Canadian fishers. Two broods, 1988 and 1990, of tagged subyearling spring chinook survived at 0.07% and 0.02% respectively (Figure 15). These fish contributed primarily to escapement, the Washington troll and freshwater sports fisheries (Figure 16).

Survivals of Cowlitz Type-N coho range from 0.2-6.9% (Figure 17). Survivals of 1988-1992 broods ranged from 0.17- 4.6%. Oregon and Washington fishers accounted for most of the catch of these fish (Figure 18). The Columbia River net fishery and escapement each accounted for 20% and 28% of the total survival.

**North Toutle Hatchery-** North Toutle Hatchery rears and releases Tule fall chinook and Type-S coho. The hatchery was destroyed in the 1980 eruption of Mt. Saint Helens. The hatchery was partially restored and operated in 1987, and is now in full production. Survivals of 1971-1977 brood fall chinook ranged from 0.3-0.9% (Figure 19). The survival of the 1987-1990 brood fall chinook ranged from 0.03%-0.15%. Chinook released at North Toutle Hatchery range in size from 4.5-5.5 g, and are released

primarily in June. The majority of fish were caught by Canadian fishers, and in the freshwater sport fishery (Figure 20). Escapement was nearly 52% of the total survival

Toutle Type-S coho survivals range from 0.1-5.9% (Figure 21). Survivals of the 1988-1992 brood fish ranged from 0.1- 5.2%. Oregon and Washington sport fishers and Columbia River netters caught the majority of these fish. Escapement averaged 36% of the total survival (Figure 22).

**Fallert Creek Hatchery-** Fallert Creek Hatchery rears and releases Tule fall chinook, spring chinook, and Type-S coho. Fall chinook are typically reared until June and released at 4.5-5.5 g. Tag data for this hatchery are limited (Figure 23) and have ranged from 0.06-1 .0%. This hatchery was only recently included in this project (1991 brood) and therefore no current survival or contribution data are available.

Spring chinook are normally reared until late-March or April and released at sizes ranging from 45-55 g. These fish were included in the project beginning with the 1989 brood and survival was 0.36% and 0.39% for the 1989 and 1990 broods respectively (Figure 24). Sixty two percent of the total survival was to escapement and 20% to the freshwater sport fishery (Figure 25).

Tag groups of 1980 and 1981 brood Type-N coho were released from the hatchery and had survivals of 2.7% in each brood. Survivals of the 1988-1 992 broods of Type-S coho range from 0.360% (Figure 26). Oregon and Washington coastal sport fishers harvested the largest proportion of these fish. Nearly 31% of the total survival was to escapement (Figure 27).

**Kalama Falls Hatchery-** Kalama Falls Hatchery rears and releases fall chinook, and Type-N coho. Fall chinook are reared to 4.5-5.5 g and released in late-May to July. Fall chinook (1971-1 981 broods) survivals have ranged from 0.1-1 .4% (Figure 28). The 1988 brood was most recently tagged as part of a release timing study. Single tag groups were released in each of three months: June, July, and August of 1989. The average survival of the three 1988 brood groups was 0.17%. The June release had the lowest overall survival and the July group the highest overall survival. About 41% of the total survival was to escapement and 23% to Canadian troll fishers (Figure 29).

Type-N coho survivals range from 0.1-8.9% (Figure 30). No tagged fish of this stock

were released prior to 1983. The survivals of the 1988-1992 broods ranged from 0.1%-8.9%. Columbia River gillnetters caught the highest proportion, 38%, of these fish (Figure 31). Oregon fishers and Washington coastal sport anglers also caught a large proportion of these fish.

**Lewis River Hatchery-** Lewis River Hatchery rears and releases spring chinook and both Type-N and Type-S coho. The hatchery has reared only a few broods of fall chinook. The 1988 through 1990 brood spring chinook were tagged with funds provided by Pacific Power and Light Company. Survival of these broods ranged from 0.4%- 2.1%, (Figure 32 ). Escapement and the freshwater sport fishery accounted for over 76% of the total survival (Figure 33). The Canadian and Washington troll fisheries each harvested significant numbers of these fish.

Six broods of Type-N coho have been tagged at Lewis River Hatchery. Funding for this tagging is from the Pacific Salmon Treaty (PST). Survivals range from 0.6-8.4% (Figure 34). Survivals of the 1988-1992 broods ranged 0.267%. The Washington and Oregon coastal sport fisheries caught the majority of these fish. The Columbia River net fishery and escapement accounted for the majority of the total survival (Figure 35).

Survivals of Type-S coho range from 0.2-6.9% (Figure 36). The survival of 1988-92 broods ranged from 0.3% to 5.6%. The majority of the survival of these broods was to the Oregon and Washington coastal fisheries. Escapement accounted for about 41% of the total survival (Figure 37). The 1990 brood was reared at Speelyai Hatchery.

The Lewis River supports a viable self-sustaining population of naturally reproducing fall chinook. Survivals of these wild chinook range from 0.1-1.9% (Figure 38). Survivals of the 1986-1990 broods ranged from 0.1-1.8%. The majority of the survival was to escapement (60%). Significant catches were made by Canadian, freshwater sport and Columbia River gillnet fisheries (Figure 39).

**Speelyai Hatchery-** Speelyai Hatchery rears both coho and spring chinook, but transfers most of these fish to Lewis River. Releases directly from the hatchery support a resident coho fishery in Merwin Lake. There was one release of 1990 brood year spring chinook yearlings. Survival was 0.19%, with the majority of the survival to escapement, 64%.

**Washougal River Hatchery-** Washougal Hatchery rears and releases tule fall chinook and Type-N coho. Type-S coho have been reared at the hatchery in the past. The hatchery also provides Type-N coho for off-station plants into the Klickitat River as part of mitigation for the U.S. v. Oregon court decision. These fish are released either directly into the river from transport trucks, or from Champion Pond.

Fall chinook survivals range from 0.2-1.5% (Figure 40). Generally, higher survivals have been obtained from larger fish (> 15 g) released in the early fall, however most of the chinook production is released in June at sizes ranging from 4.5-6.0 g. Survivals of the 1986, 1987 and 1989 broods were all about 0.2%. Survival increased to 0.24% for the 1990 brood. Canadian troll fisheries and escapement accounted for most of the survival (Figure 41).

Survivals of Type-N coho released on-station range from 0.1-5.2% (Figure 42). Survivals of 1988-1992 brood coho ranged from 0.1-4.6%. Most of the catch was by Oregon and Washington coastal sport fishers and Canadian trollers. Escapement and Columbia River net catches accounted for about 27% and 24% of the total survival, respectively (Figure 43).

Fewer Type-N coho released off-station into the Klickitat River survived than those released at either Washougal or Klickitat Hatcheries. Survival of the 1988-1992 broods ranged from 0.03-1.6% (Figure 44). The majority of the surviving fish released off-station contributed to the Oregon and Washington coastal fisheries and the Columbia River net fishery. Escapement was 6.0% of the total survival (Figure 45).

**Klickitat River Hatchery-** Klickitat Hatchery currently rears Upriver Bright chinook that are imported as eggs from Lyons Ferry Hatchery. Prior to introducing this stock at Klickitat, Tule fall chinook were released. The hatchery also rears and releases spring chinook and Type-N coho. Type-S coho were reared previously. Spring chinook have been tagged in recent years as part of a BPA funded experiment to determine the effects of acclimation to river water prior to release. Survivals of fall chinook range from 0.03-1.0% (Figure 46). Survival of 1986, 1989 and 1990 brood chinook was 0.44%, 0.06% and 0.18%, respectively. The majority of the catch was in the Canadian troll fishery, the Columbia River net fishery, and Alaska fisheries (Figure 47). Escapement accounted for the largest (28%) component.

Survival of 1989 and 1990 brood spring chinook was 0.29% and 0.08% (Figure 48) Nearly 91% of the total survival was in escapement (Figure 49).

Survivals of Type-N coho have range from 0.1-4.5% (Figure 50). Survival of the 1988-1992 broods ranged from 0.1-1.7%. Washington and Oregon coastal sport fishers, and Columbia River netters caught the majority of the fish from these broods (Figure 51). Few fish (0.2%) returned to the hatchery.

**Lyons Ferry Hatchery-** Lyons Ferry Hatchery rears and releases Snake River fall chinook. In recent years 100% of the releases have been marked or tagged to ensure the genetic purity of this stock. The hatchery generally releases four groups of fall chinook, both yearlings or subyearlings. About half of the yearling and subyearling production is loaded onto barges and released downstream of the hatchery, bypassing several dams. Survivals of sub-yearling fish (range: 0.02-0.6%, Figure 52 ) have been much lower than survivals of yearling fish ( 0.1-7.4%; Figure 53). Survivals of barged fish, regardless of age, have been equal to or greater than survivals of fish released on-station (Figures 52 and 53). Subyearling fish, released on-station or barged, contributed primarily to the Columbia River net fishery, the Canadian commercial fisheries, and escapement (Figure 54). Escapement of subyearling fish released on-station appears to be slightly lower than those released from barges (Figures 54 and 55). Contribution of yearling fish, regardless of release type, has been mainly to Canadian, Columbia River net, and Washington coastal troll fisheries (Figures 56 and 57). Escapement amounted to approximately 31% of the survival, however the estimated escapement reported here is an underestimate because data from trapping operations at the dams are not available. The method of release did not appear to affect fishery distribution within either the subyearling or yearling groups.

**Tucannon River Hatchery-** The Tucannon Hatchery is a satellite rearing and capture location operating in conjunction with the Lyons Ferry Hatchery. Wild spring chinook returning to the Tucannon River were captured at the Tucannon River trap beginning in 1985 to supply to supply brood for the hatchery releases. Adults are now transported to the Lyons Ferry Hatchery and spawned there. This change in procedure has resulted in higher adult pre-spawning survivals, and higher egg to fry survivals. After rearing to approximately 18 g at the Lyons Ferry Hatchery, these fish are transported to an acclimation pond at the Tucannon Hatchery, reared through the winter, and volitionally released in the spring. Survivals of these yearling plants have ranged from 0.03-0.35%

(Figure 58). About 98% of the total survival of the 1986-1990 broods was to escapement. A few fish have been captured in Oregon commercial, Canada troll and Washington freshwater sport fisheries (Figure 59). No tag recoveries from these broods were found in the Columbia River net fishery.

**Ringold Springs Hatchery-** Ringold springs hatchery rears spring chinook and in the past has reared a few groups of upriver bright fall chinook. The fish are released as yearlings ranging in size between 45-115 g. Broods between 1978 and 1988 were not tagged. Survival of the 1989 and 1990 brood spring chinook was 0.41% and 0.19%, respectively (Figure 60). All surviving fish were recovered at the hatchery (53%) or the freshwater sport (45%) fishery (Figure 61).

**Priest Rapids Hatchery-** Priest Rapids Hatchery rears and releases Upriver Bright chinook. Most fish are released in June as subyearlings ranging in size from 5-9 g. Survivals have ranged from 0.1-2.0% depending on brood (Figure 62). Survivals of the 1986-1990 broods ranged from 0.1%-0.6%. The majority of the survival of these broods was Alaska and Canadian fisheries, the Columbia River net fishery, and escapement (Figure 63).

**Hanford Reach Wild Upriver Bright (URB) Fall Chinook:** In 1988 efforts were begun to capture juvenile fall chinook that are naturally produced along the Hanford Reach of the Columbia River. Juveniles are captured in June when about 1.5-2.5 grams in size. The fish are tagged and released back into the river. Survivals of the 1986-1990 broods ranged from 0.12-0.49% (Figure 62). The majority of the survival was to the Alaska, and Canadian fisheries, the Columbia River net fishery, and 49% to escapement (Figure 64).

**Rocky Reach Hatchery-** Rocky Reach Hatchery rears fall chinook and coho, although the coho program was discontinued after 1993 and replaced with a subyearling fall chinook program. Rocky Reach rears and releases both yearling and subyearling fall chinook. The yearling fish are released at 41-50 g in April or May. Survivals of yearling fish have ranged from 0.08-3.6% (Figure 65). The 1986-1990 brood survivals ranged from 0.08-0.66%. Chinook released as yearlings contributed primarily to the Canadian and Columbia River net fisheries (Figure 66). Escapement was approximately 27% of the total survival.

Rocky Reach coho were tagged only in 1976, 1989 and 1991. Survivals were 0.9%, 0.15% and 0.01%, respectively (Figure 67). The majority of survivors contributed to the Oregon sport fishery (65%) the Canadian troll, and the Columbia River net fishery (Figure 68). Escapement was less than 3%.

**Eastbank Hatchery Complex-** The Eastbank complex consists of a central adult holding, incubation, and rearing facility with associated acclimation ponds located on the Chiwawa River, Wenatchee River, Similkameen River, and net pens located on Lake Wenatchee. Chiwawa River spring chinook yearlings are released from acclimation ponds located on the Chiwawa River. The 1989 and 1989 broods survived at 0.44% and 0.04%, respectively (Figure 69). Most of this survival was to escapement (82%), although some fish (16%) were caught by the Fresh water sport fishery, (Figure 70). Dryden Pond is located on the Wenatchee River and rears and releases Wenatchee summer chinook yearlings. Survival of the 1989 and 1990 broods was 0.58% and 0.06%, respectively (Figure 71). Alaska and Canadian fishers caught the majority of these fish, although catches were made in a number of fisheries (Figure 72). Escapement was 55% of the total survival. The Similkameen Pond rears and releases yearling summer chinook. Survival of the 1989 and 1990 broods was 1.97% and 0.22% (Figure 73). Fishery catches for this group were very similar to the Dryden Pond group (Figure 74). with most fish caught by Alaska and Canadian fishers, however Similkameen Pond had a large escapement of 66%. There was one release of 1990 brood spring chinook from the Carlton Rearing Pond. Survival was 0.06% (Figure 79). As with Dryden and Similkameen Ponds, Alaskan fishers caught the largest percentage (10%) of fish (Figure 80). Escapement was 79%.

**Wells Dam Hatchery-** Wells Dam Hatchery rears and releases yearling and subyearling summer chinook. Yearling summer chinook are released at sizes ranging from 30-45 g in mid-April. Survivals of yearling releases have ranged from 0.1-0.9% (Figure 75). Survivals of the 1986-1990 brood yearlings ranged from 0.03%-0.50%. These broods contributed primarily to Canadian and Alaskan fisheries and to escapement (Figure 76).

Survivals of 1986-1990 brood subyearling releases ranged from 0.03%-0.20%, (Figure 77). Contribution of subyearling fish was primarily to Canadian fishers, Columbia River net fisheries and to escapement (Figure 78).

## Hatchery Effectiveness

In this report hatchery effectiveness is defined as the capability of hatcheries to produce adults. In order for this measure to have meaning it must be compared against something. We took two approaches. First, we looked at the rate of adults produced per 1000 smolts released compared over periods of 5 brood years. Second, we compared these rates with those of naturally produced fish when this comparison was possible. For example, average survival of lower river hatchery tule fall chinook were compared to survival of Lewis River wild chinook.

In general, the rate of adult production of lower river hatchery fall chinook has declined from 7.3 adults/1000 smolts during the brood year interval 1971-75 to 1.2 adults during the brood year interval 1986-90 (Table 6). In contrast, during the interval 1976-80 the ratio for Lewis River wild chinook was 7.6 adults/ 1000 smolts compared to 4.2 for hatchery fish. During the 1986-90 interval the ratio for Lewis River wild chinook was 7.5 adults compared to 1.2 for hatchery releases. Lewis River wild chinook produced between 3.4 and 6.3 more adults per 1000 smolts than did the hatcheries in the lower river between 1976 and 1990.

In contrast, comparisons can only be made between Priest Rapids Hatchery upriver bright fall chinook and Hanford Reach wild chinook for the brood period 1986-90 (Table 6). During this interval wild fish production was 3.1 adults/1000 smolts compared to 2.7 for the hatchery. The Priest Rapids Hatchery in general is more productive than the lower river hatcheries in producing fall chinook. For the brood periods 1976-80, 1981-85, and 1986-90, Priest Rapids Hatchery produced between 1.5 and 4.1 more adults per 1000 smolts than the lower river hatcheries. Fall chinook released as yearling fish from Lyons Ferry Hatchery during the 1986-90 brood period produced 11.8 and 15.3 adults/1000 smolts if released directly from the hatchery or after barging (Table 7). This compares to much lower rates for subyearling releases directly from the hatchery or after barging (0.88 and 0.85 adults/1000 smolts, respectively).

Data for spring chinook are somewhat limited for broods before 1986. Cowlitz Hatchery spring chinook broods survived best during the 1976-80 period (5.53 adults/1 000 smolts) and poorest from 1986-90 (1.71 adults/1000 smolts) (Table 8). Spring chinook production below Bonneville Dam is considerably higher than above the dam. During the 1986-90 brood period, lower river production averaged 1.2 adults/l 000 smolts compared to 0.21 adults for above Bonneville production (includes Klickitat, Tucannon,

Ringold, Wenatchee, and Methow hatcheries).

Coho, because they are released at larger sizes, are generally survive better than subyearling chinook. The ratio of Type N coho adults produced per 1000 **smolts** is slightly higher in 3 of 5 brood periods (Table 9). From 1971-90, the ratios for Type N coho ranged from 24-29 adults per 1000 **smolts**, and 15-31 adults for Type S coho. However, for the last two broods (1991 and 1992) the ratio for each coho strain declined to 1.4 adults per 1000 smolts. Transporting coho resulted in reduced production. During the 1986-90 brood period, coho released from Washougal Hatchery produced 26.7 adults/1000 smolts compared to 6.3 adults for the same fish transported and released directly into the Klickitat River. In contrast, coho released from the Klickitat Hatchery produced 7.9 adults/ 1000 smolts. Production in 1991-92 declined in all three release groups, but on station releases produced three times more adults than transported groups (1.4 vs. 0.3).

Table 6. Number of adult fall chinook produced per 1,000 smolts from WDFW hatcheries and Washington rivers for 5 year brood periods. Number of adults is calculated by averaging survivals among hatcheries during the 5 year brood period and multiplying by 1,000. The survival data for wild chinook is the averaged over the brood period. ND indicates that no survival data exists for the period,

Brood Period	Lower River Hatchery Chinook	Lower River Wild Chinook	Priest Rapids Hatchery Upriver Bright Fall Chinook	Hanford Reach Wild Upriver Bright Fall Chinook
1971-75	7.3	ND	ND	ND
1976-80	4.2	7.6	5.8	ND
1981-85	7.5	12.0	11.6	ND
1986-90	1.2	7.5	2.7	3.1

Table 7. Number of adult Lyons Ferry Hatchery fall chinook produced per 1,000 smolts released on-station or from barges as yearling or subyearling fish

Brood Period	Yearling, On-station release	Yearling, Barged	Subyearling-On-station release	Subyearling, Barged
1985-88	11.8	15.3	0.88	0.85

Table 8. Number of adult spring chinook produced per 1,000 smolts from WDFW hatcheries for 5 year brood periods. Number of adults is calculated by averaging survivals among hatcheries during the 5 year brood period and multiplying by 1,000. ND indicates that no survival data exists for the period. Lower river hatchery spring chinook includes data from Cowlitz, Lewis River, and Fallert Creek hatcheries. Upper River hatchery spring chinook includes data from facilities located at Klickitat, Ringold, Tucannon, Chiwawa, and Carlton Pond.

Brood Period	Cowlitz Hatchery Spring Chinook	Lower River Hatchery Spring Chinook	Upper River Hatchery Spring Chinook
1971-75	3.73	ND	ND
1976-80	5.53	ND	ND
1981-85	2.58	ND	ND
1986-90	1.71	1.21	0.21

Table 9. Number of adult coho produced per 1,000 smolts from WDFW hatcheries for 5 year brood periods. Number of adults is calculated by averaging survivals among hatcheries during the 5 year brood period and multiplying by 1,000. ND indicates that no survival data exists for the period. Type S coho are south migrating coho and Type N north migrating fish

Brood Period	Type N Coho	Type S Coho	Washougal Hatchery Type N Coho	Washougal Hatchery to Klickitat River transfer (Type N Coho)	Klickitat Hatchery Type N Coho
1971-75	24.3	31.3	ND	ND	25.7
1976-80	27.4	15.1	34	ND	17.5
1981-85	28.9	24.6	13	ND	14
1986-90	24.9	20.5	26.7	6.3	7.9
1991-92	1.4	1.4	1.1	0.3	1.4

### SUMMARY

In FY-97 all three objectives were met. Under **objective one**, at least one production group from every hatchery was coded-wire tagged. The difference between budgeted and realized tag numbers was very small. Under **objective two**, returning adults to each hatchery were surveyed for the absence of an adipose fin and the snout from these fish was removed. Coded-wire tags were extracted from these snouts and the data will be sent to the PSMFC data base in Portland, Oregon. Money from this project did not pay for extraction of tags from the snouts. For **objective three** survival and contribution rates were determined for coho salmon released between 1990 and 1994 (1988-1 992 broods) and chinook released between 1987 and 1991 (1986-1990 broods). Figures 1-80 depict the data base for both estimated survival and contribution by brood.

The data show a continued trend toward low survival for both strains of coho from the 1989-1 992 broods. Coho survivals vary among hatcheries but in some cases, are equal to, or lower than survivals of subyearling fall chinook of the same brood. The cause for the continued low survivals of coho may be due to unfavorable ocean

conditions caused by the 1992-93 El Nino and the lingering pool of warm water that resided off the Washington coast through 1994. Survivals of fall chinook sub-yearlings and spring chinook yearlings tended to be lower than 0.5% for the past few broods, regardless of hatchery or natural origin. Presumably the same factors affecting coho survival are affecting chinook survivals. Because of low survivals for fish during the period 1992-95, the production of adults has declined for all species.

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## Columbia River Fall Chinook Grays River Hatchery

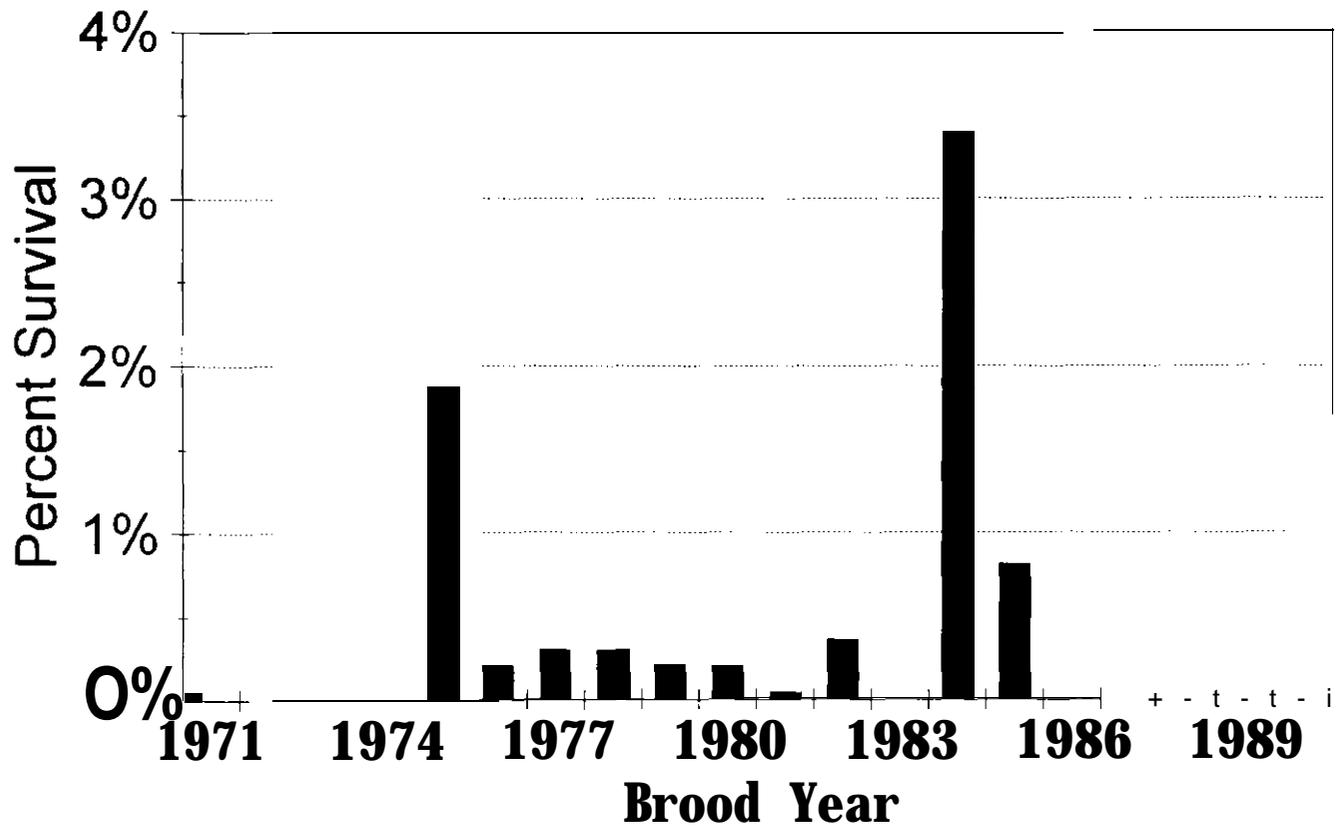


Figure 1. Survival by brood of Grays River Hatchery fall chinook. Data for a single release of 1974 brood chinook was removed to allow better viewing of the other years data. Survival of the 1974 brood was 8.9% (41 g/fish).

## Columbia River Type S Coho Grays River Hatchery

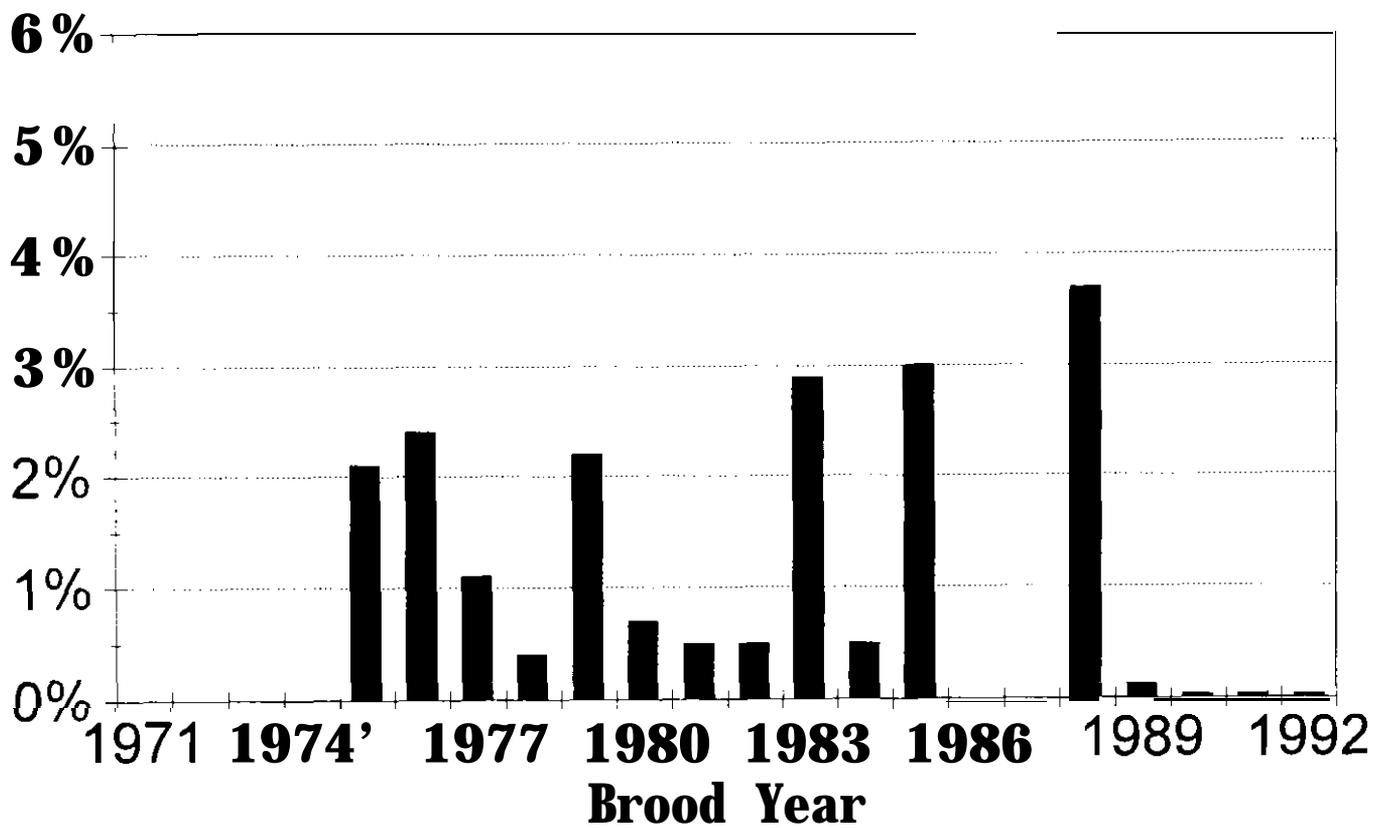


Figure 3. Survival by brood of Grays River Hatchery Type S coho.

# Columbia River Type S Coho Grays River Hatchery

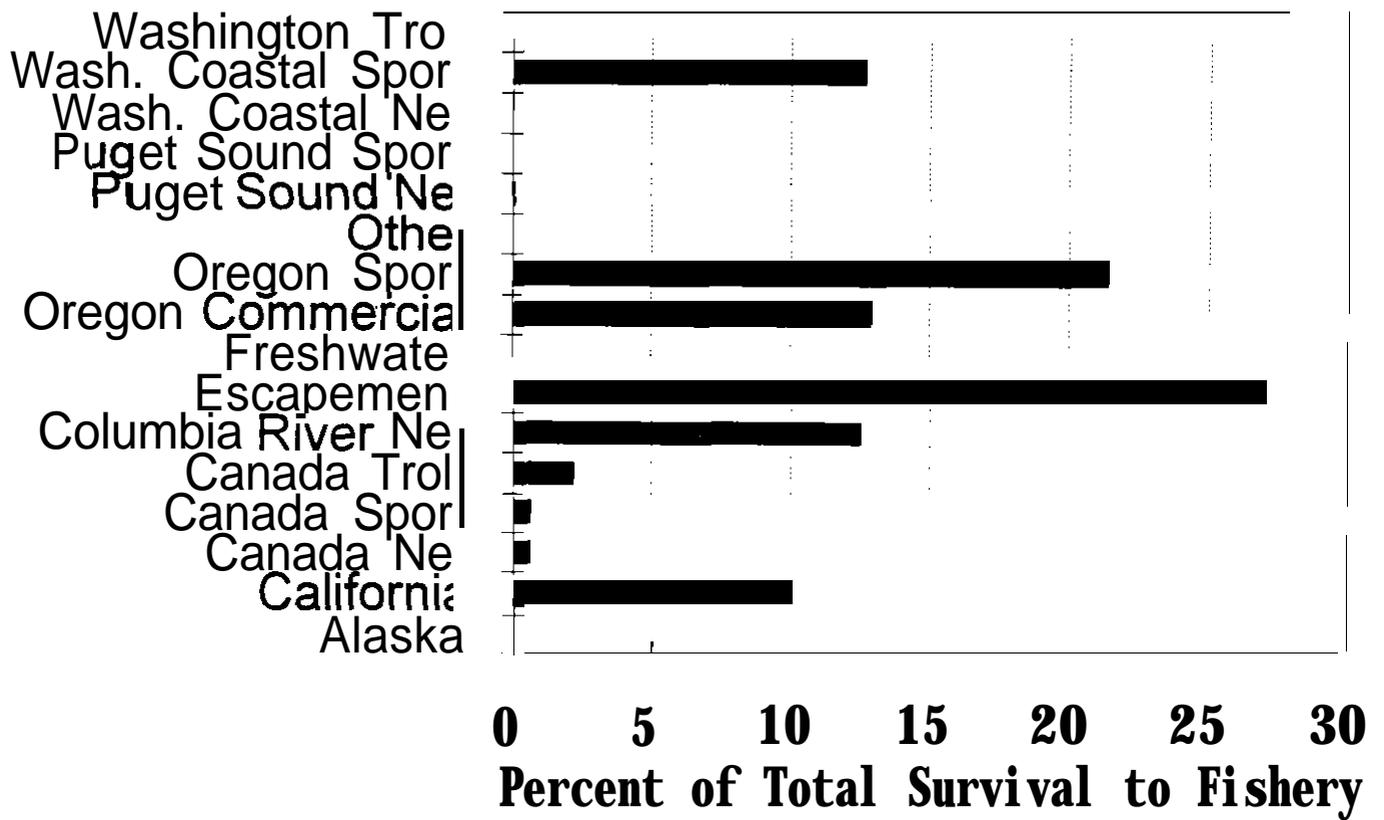


Figure 4. Percent of total survival to fisheries and escapement of Grays River Hatchery 1988-1992 broods Type S coho.

## Columbia River Fall Chinook Elochoman Hatchery, Subyearlings

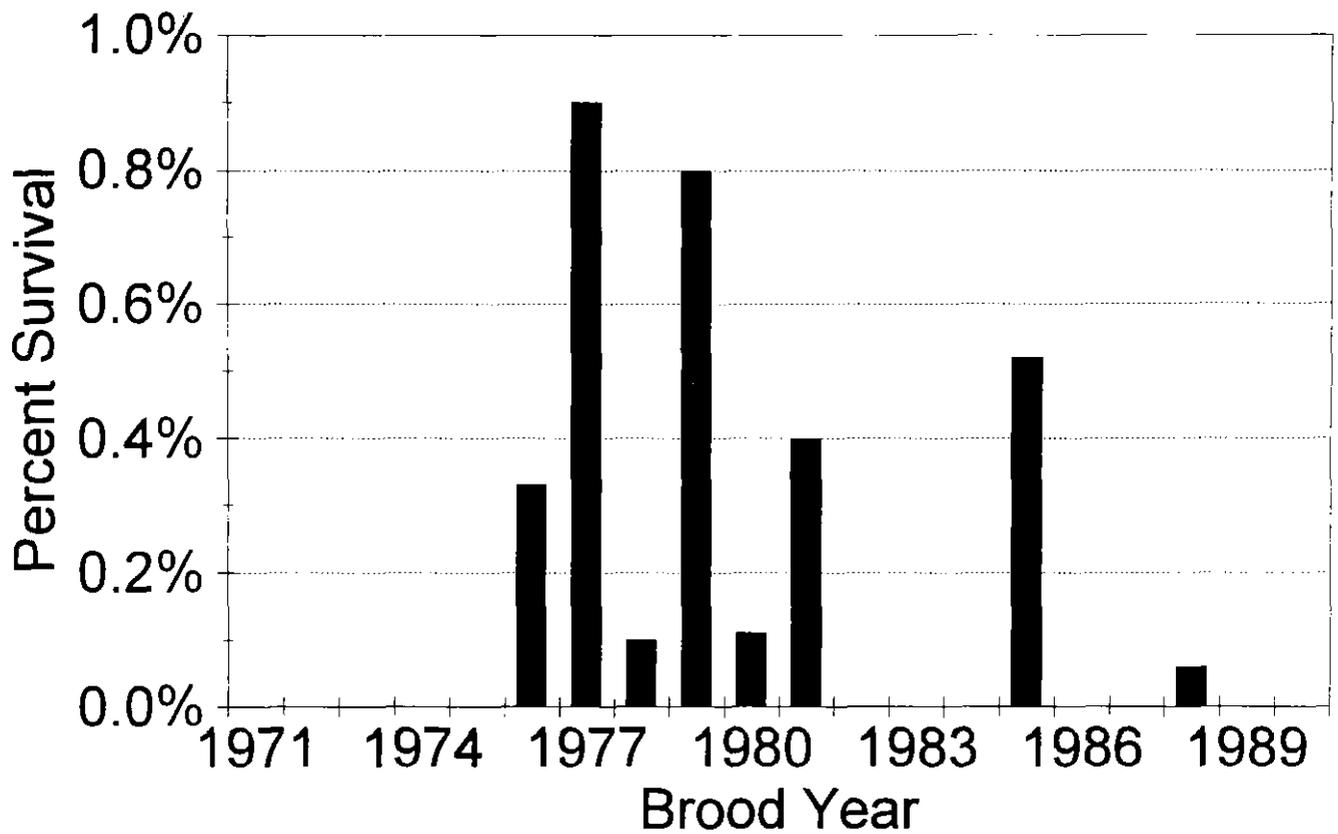


Figure 5. Survival by brood of Elochoman Hatchery fall chinook.

# Columbia River Fall Chinook Elochoman Hatchery

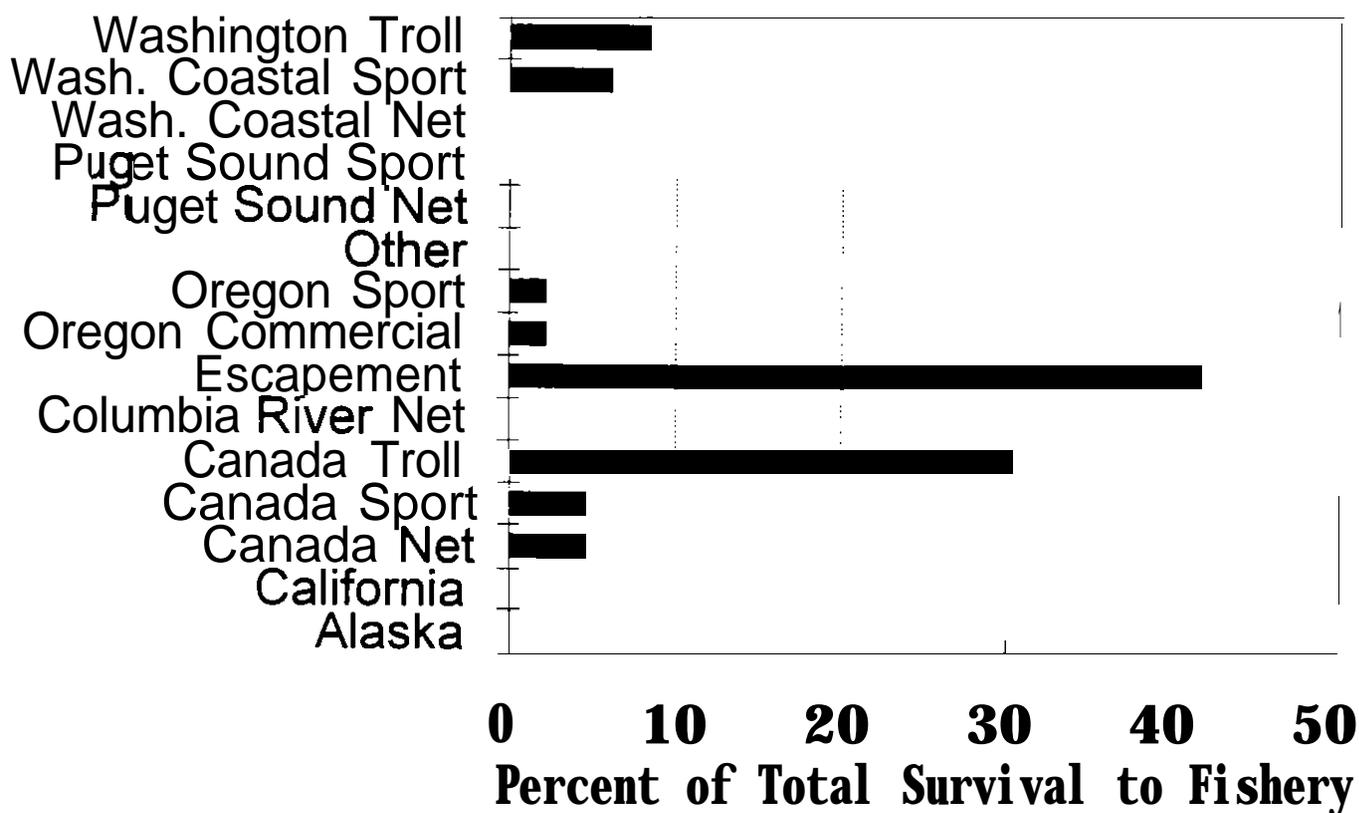


Figure 6. Percent of total survival to fisheries and escapement of Elochoman Hatchery 1988 brood fall chinook.

## Columbia River Type N Coho Elochoman Hatchery

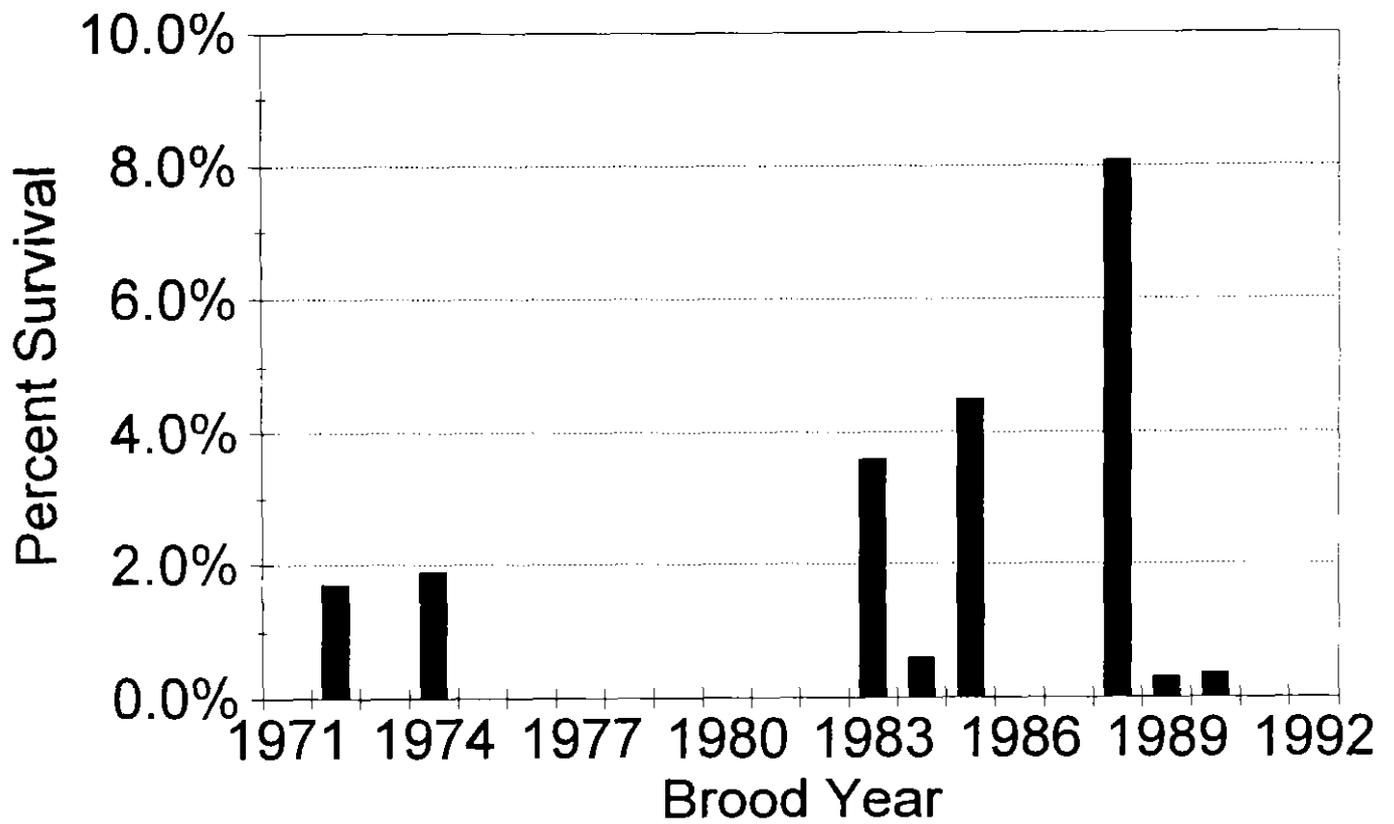


Figure 7. Survival by brood of Elochoman Hatchery Type N coho.

# Columbia River Type N Coho Elochoman Hatchery

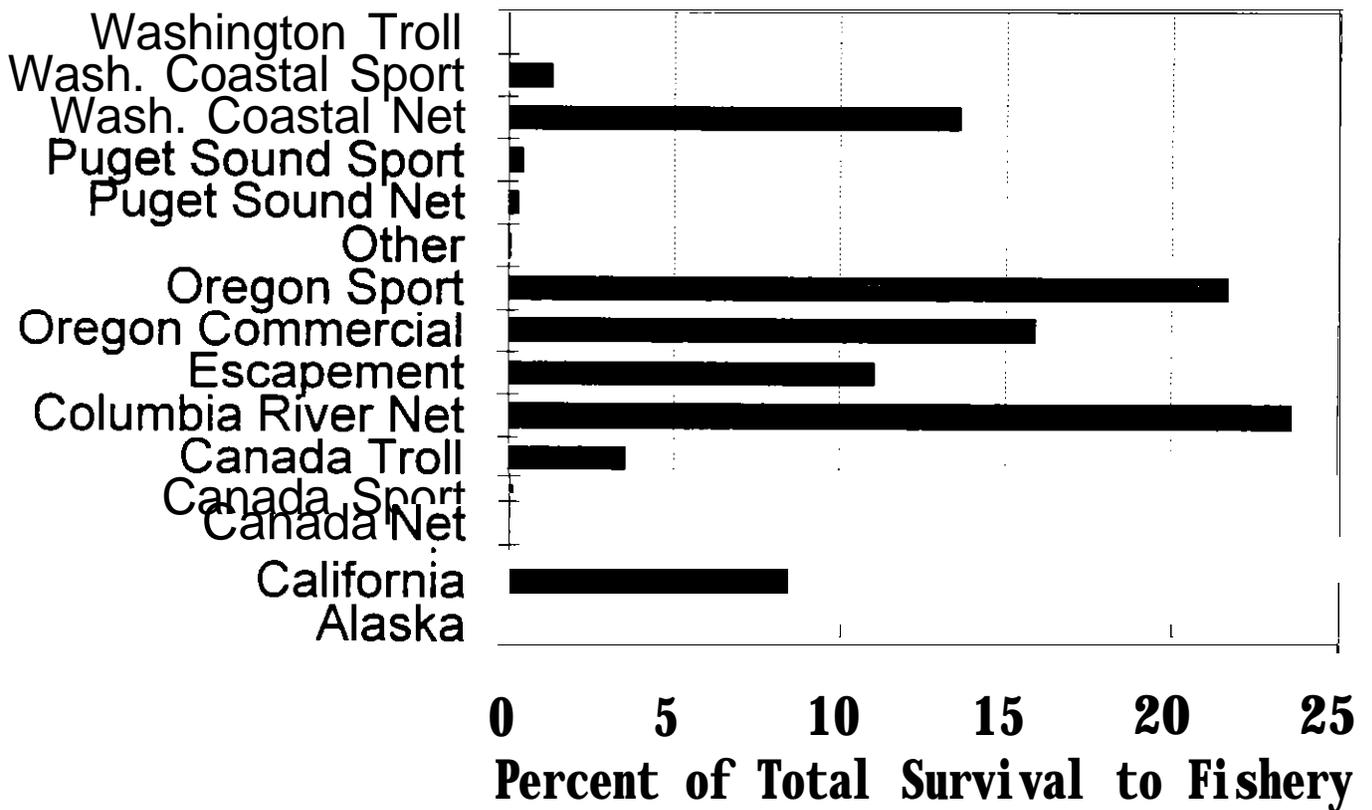


Figure 8. Percent of total survival to fisheries and escapement of Elochoman Hatchery 1988-1992 broods Type N coho.

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## Columbia River Type S Coho Elochoman Hatchery

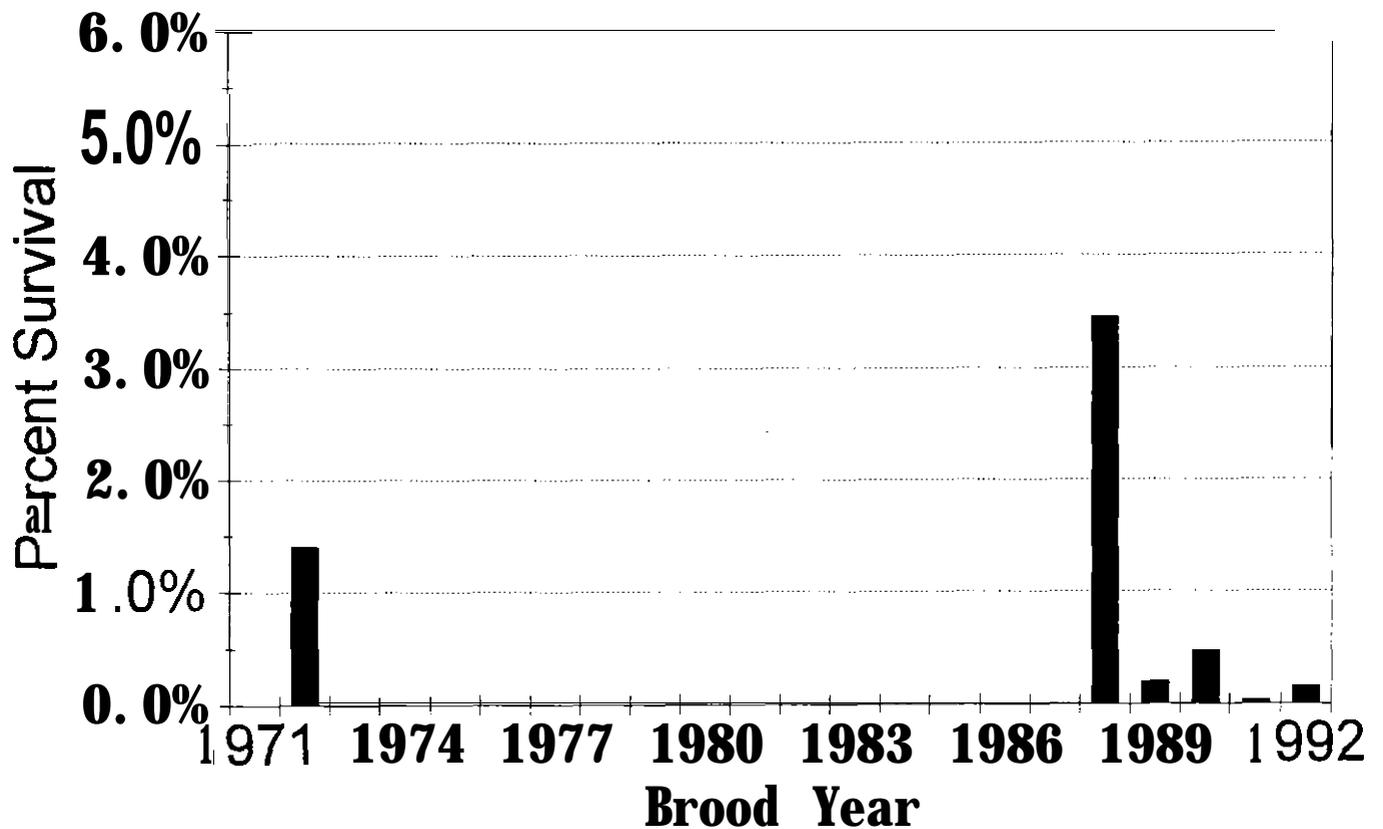


Figure 9. Survival by brood of Elochoman Hatchery Type S coho.

## Columbia River Fall Chinook Cowlitz Salmon Hatchery, Subyearlings

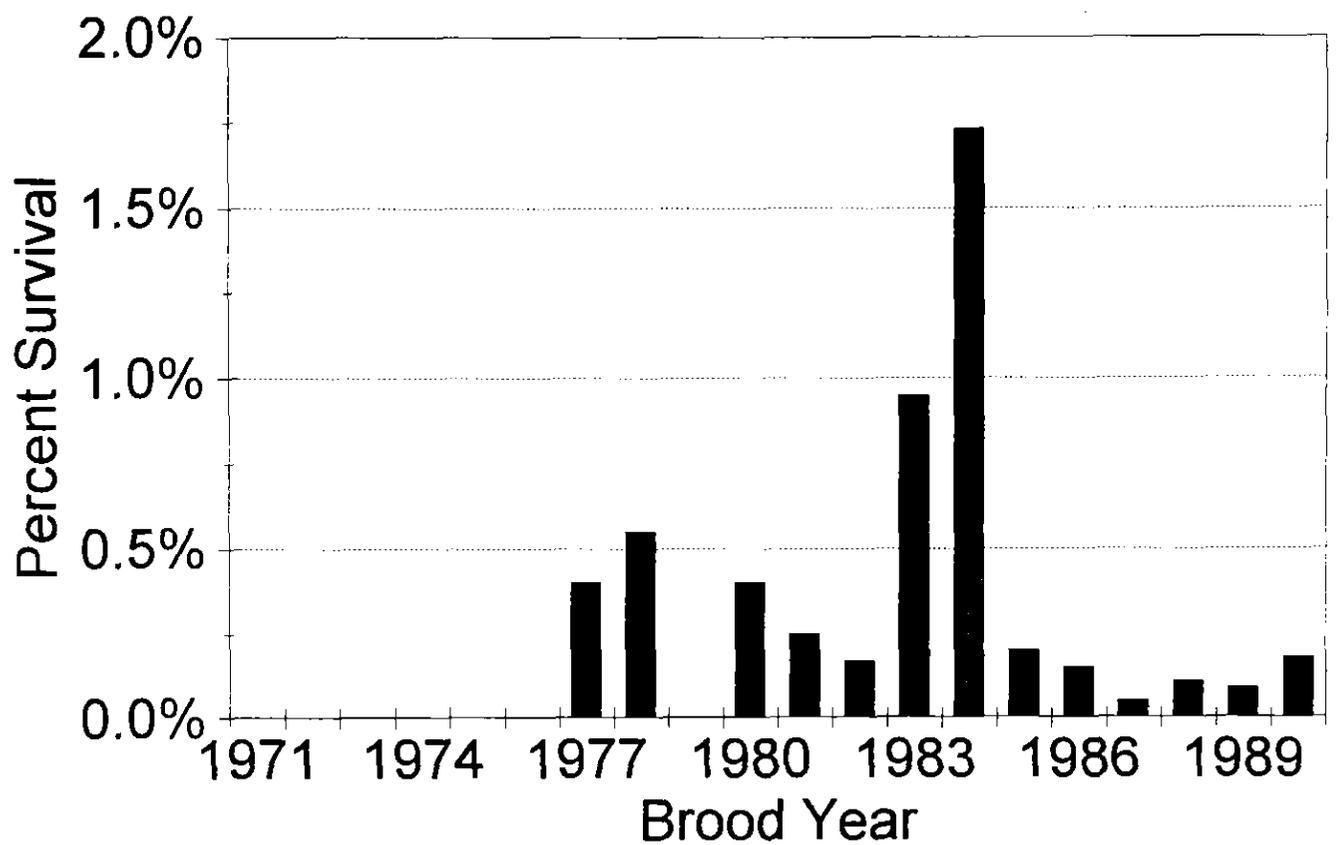


Figure 11. Survival by brood of Cowlitz Hatchery fall chinook.

## Columbia River Fall Chinook Cowlitz Salmon Hatchery, Subyearlings

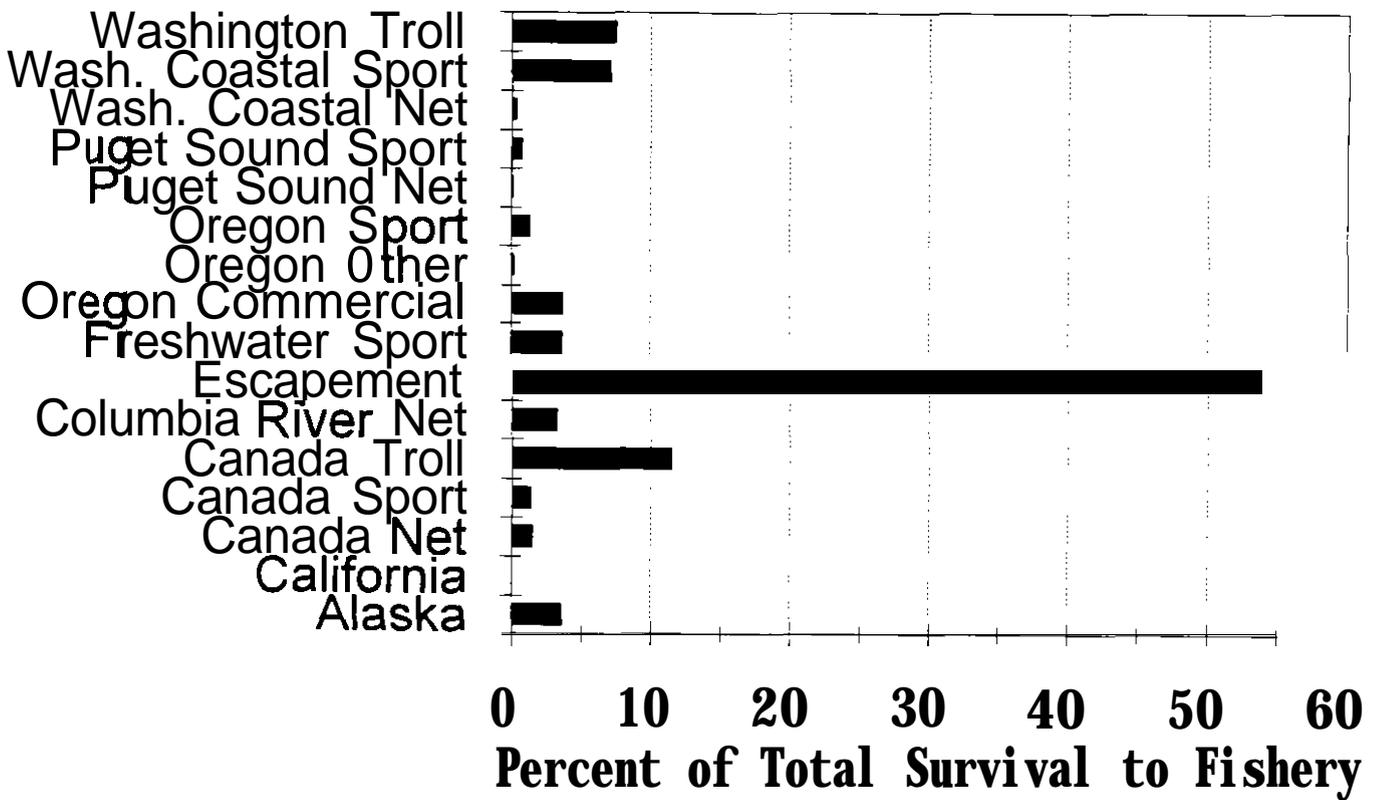


Figure 12. Percent of total survival to fisheries and escapement of Cowlitz Hatchery 1966-1990 broods fall chinook.

# Columbia River Spring Chinook Cowlitz Salmon Hatchery, Yearlings

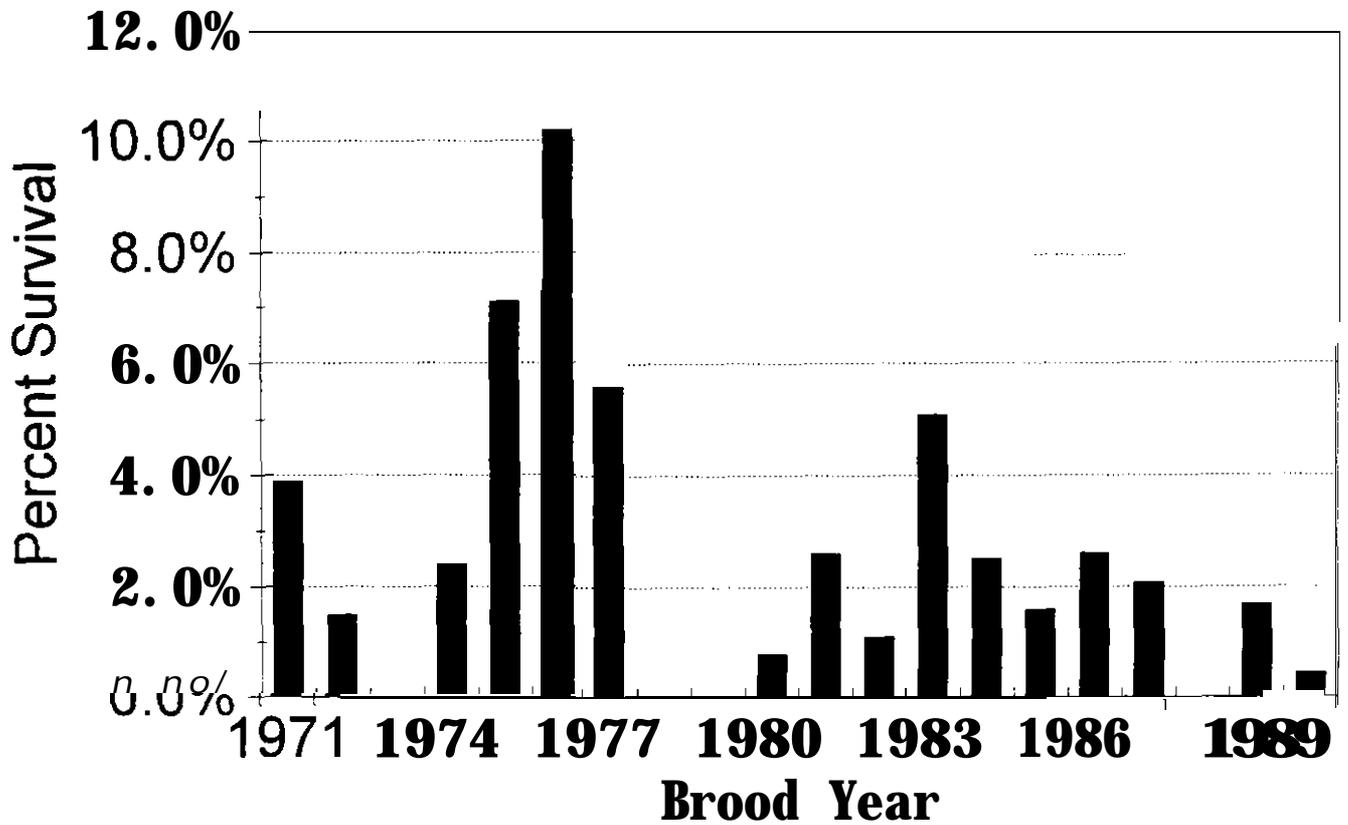


Figure 13. Survival by brood of Cowlitz Hatchery yearling spring chinook.

# Columbia River Spring Chinook Cowlitz Salmon Hatchery, Yearlings

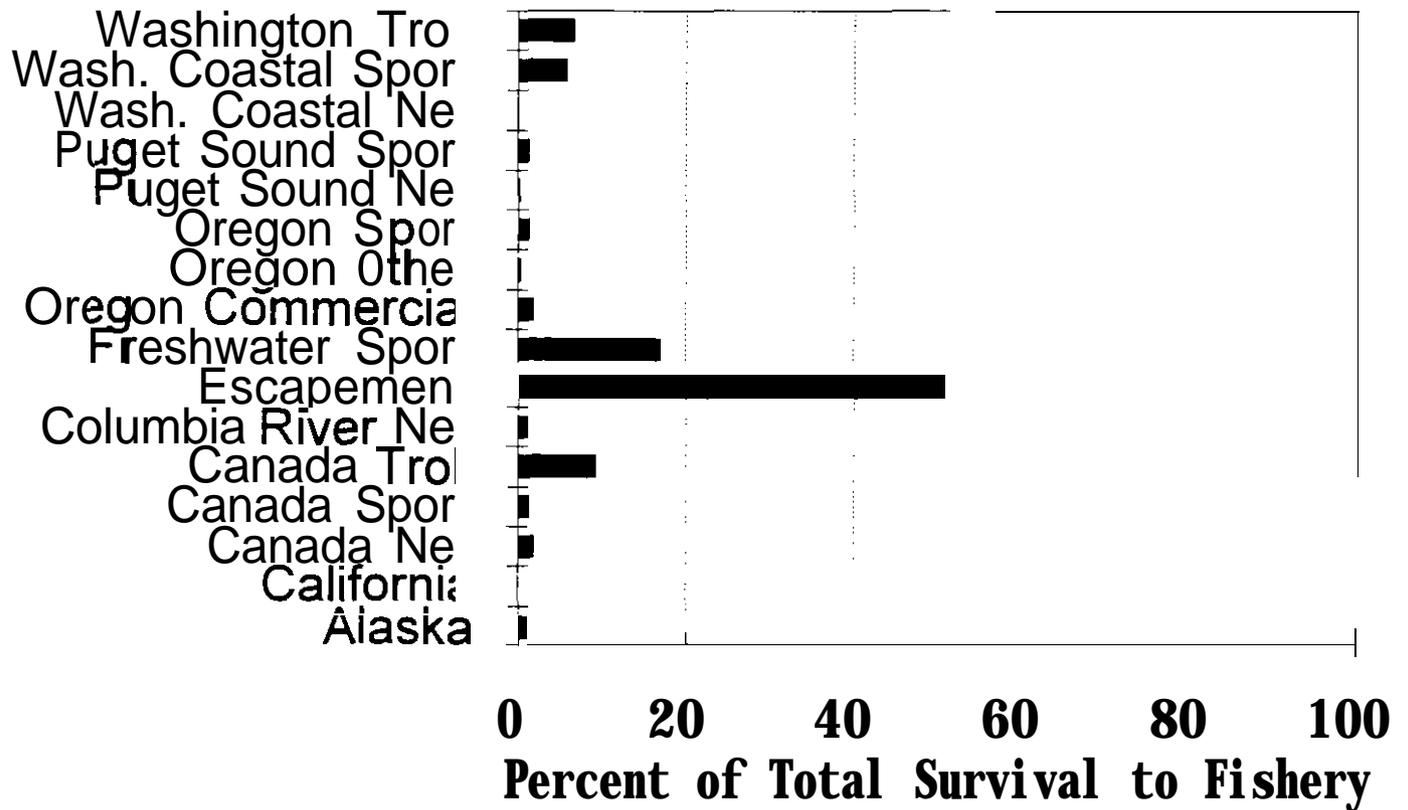


Figure 14. Percent of total survival to fisheries and escapement of Cowlitz Hatchery 1986, 1987, 1989 and 1990 brood yearling spring chinook.

## Columbia River Spring Chinook Cowlitz Salmon Hatchery, Subyearlings

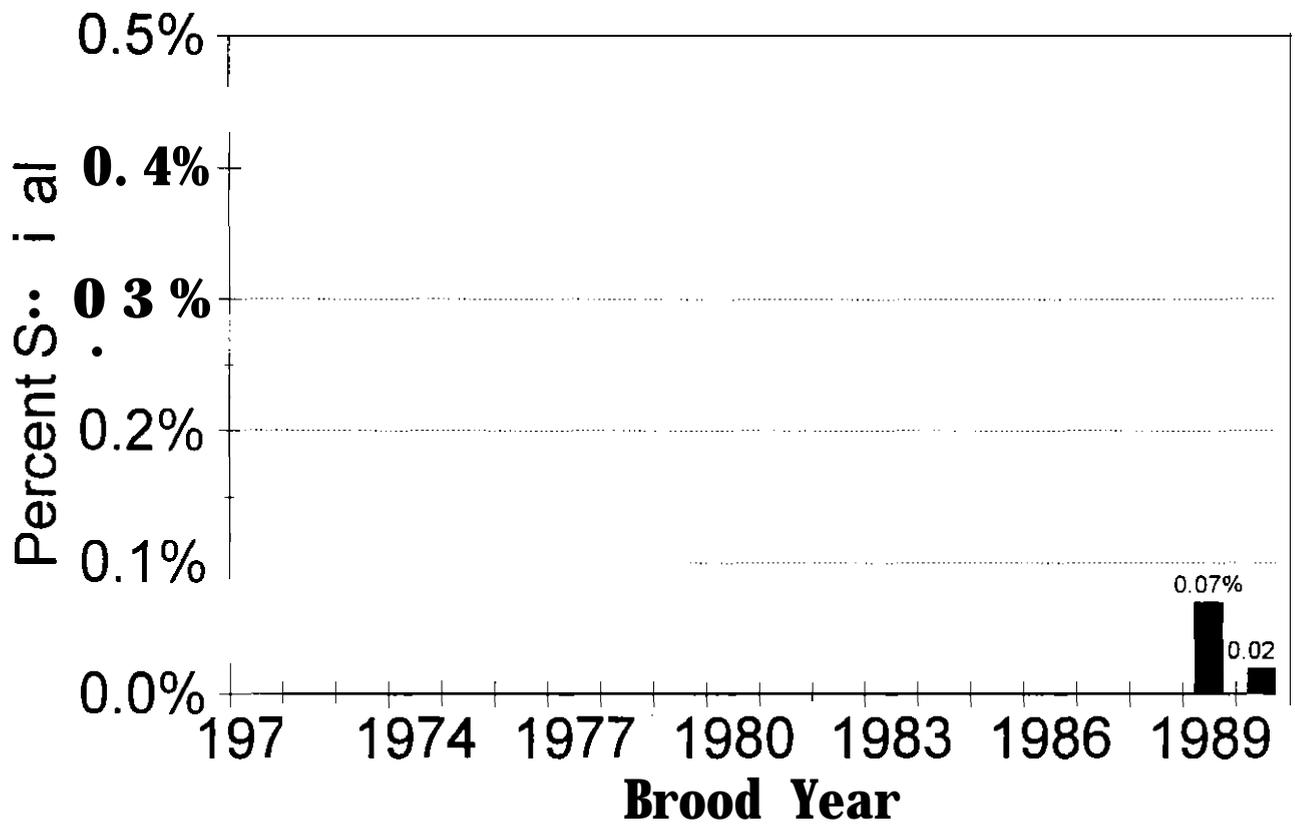


Figure 15. Survival by brood of Cowlitz Hatchery subyearling spring chinook.

## Columbia River Spring Chinook Cowlitz Salmon Hatchery, Subyearlings

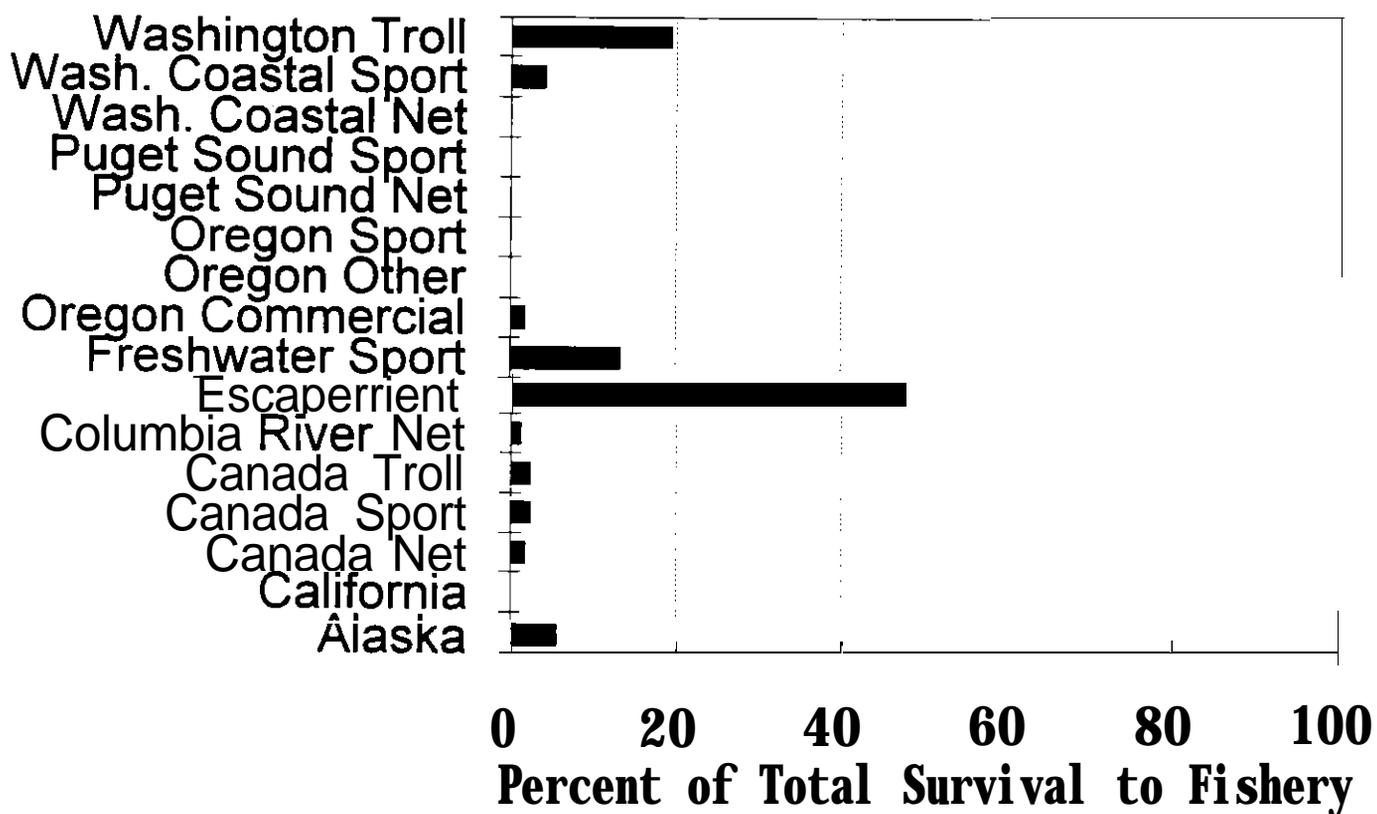


Figure 16. Percent of total survival to fisheries and escapement of Cowlitz Hatchery 1989 and 1990 brood subyearling spring chinook.

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## Columbia River Type N Coho Cowlitz Salmon Hatchery

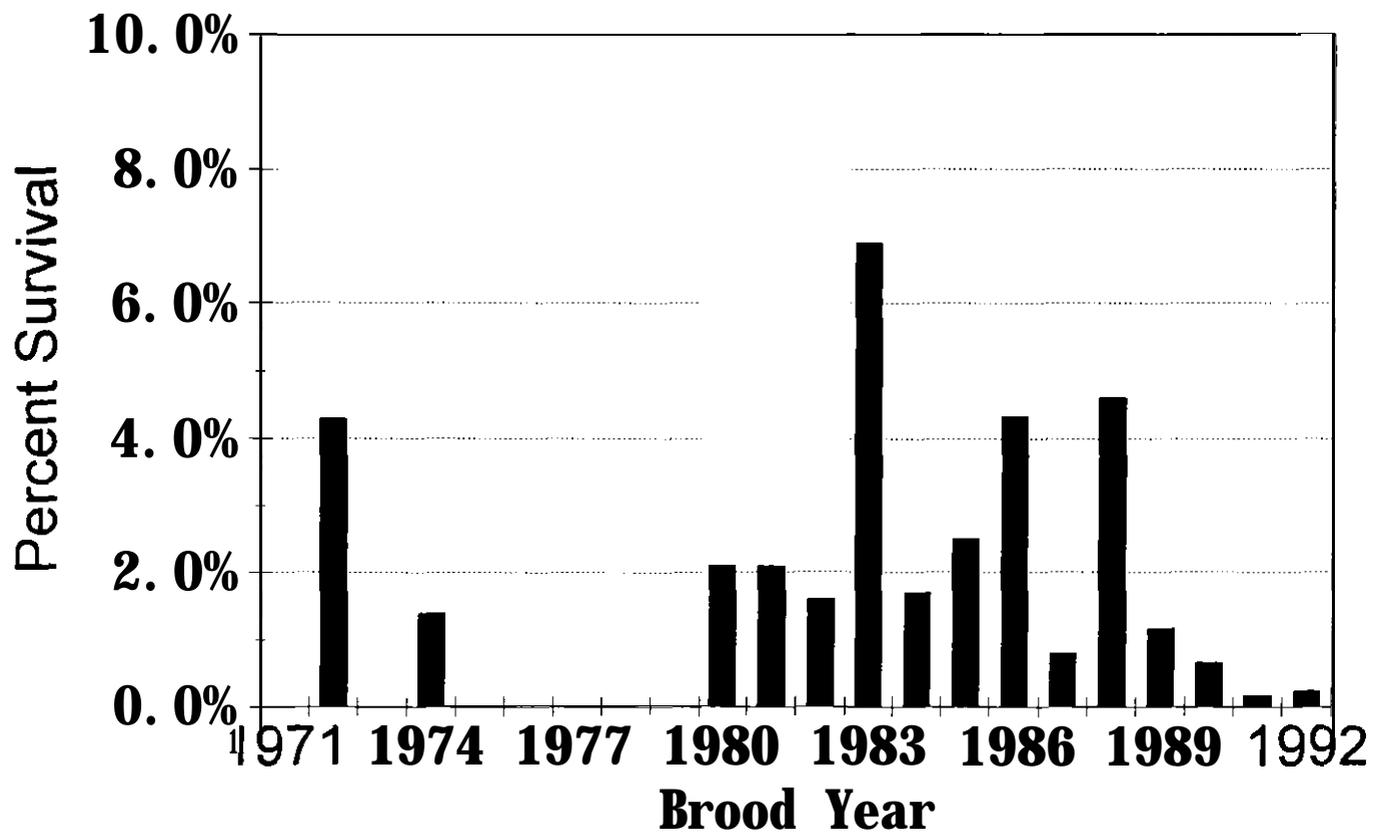


Figure 17. Survival by brood of Cowlitz Hatchery Type N coho

## Columbia River Type N Coho Cowlitz Salmon Hatchery

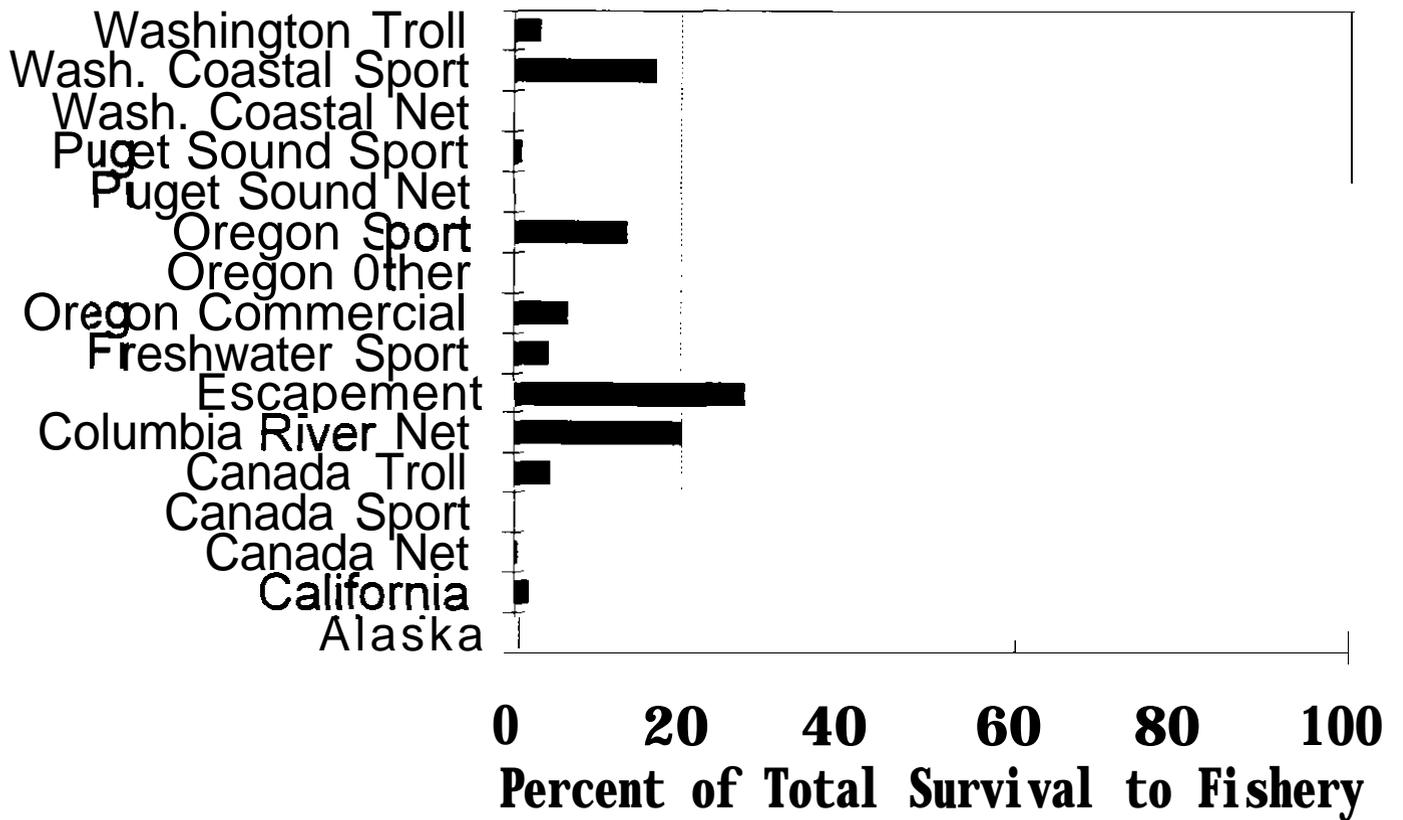


Figure 18. Percent of total survival to fisheries and escapement of Cowlitz Hatchery 1988-1992 broods Type N coho.

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## Columbia River Fall Chinook North Toutle Hatchery, Subyearling

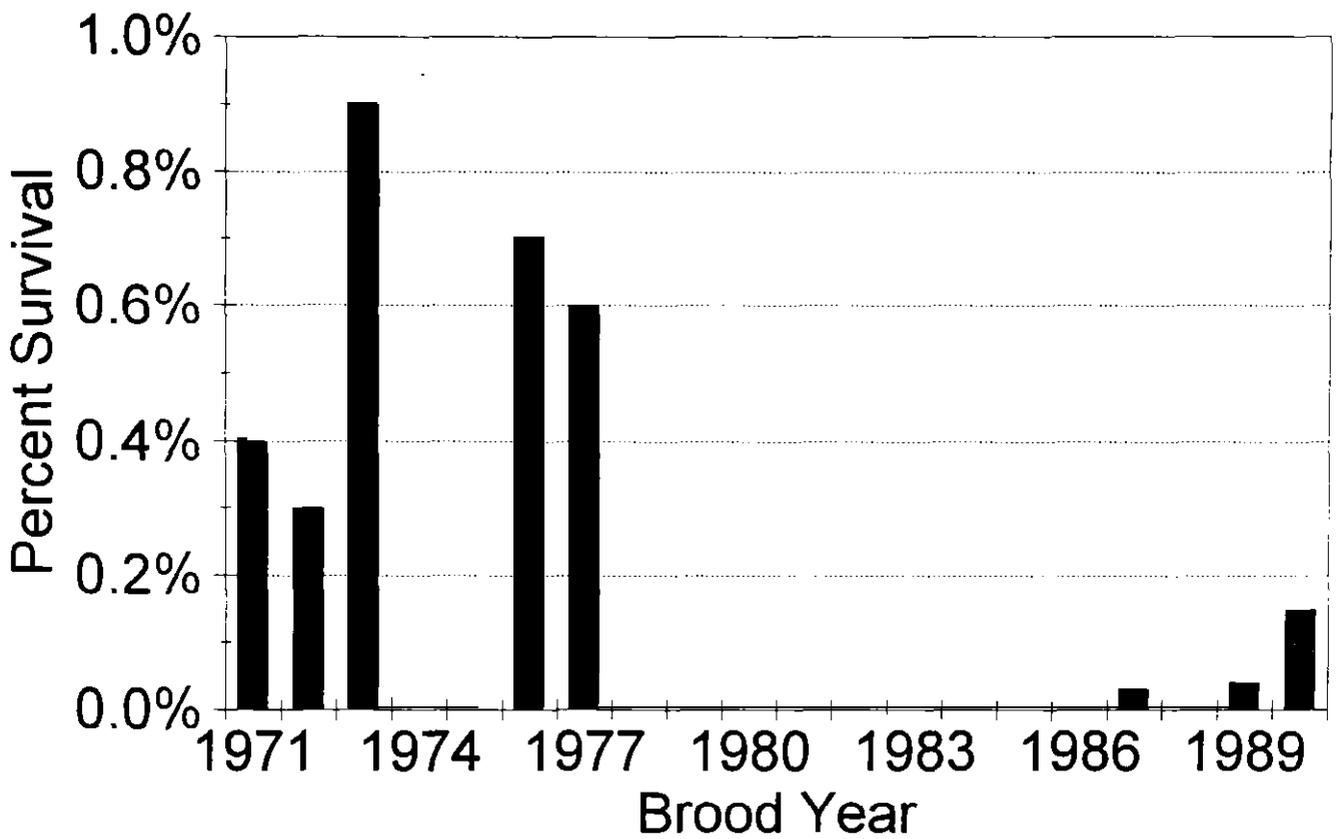


Figure 19. Survival by brood of North Toutle Hatchery fall chinook.

# Columbia River Fall Chinook

## North Toutle Hatchery

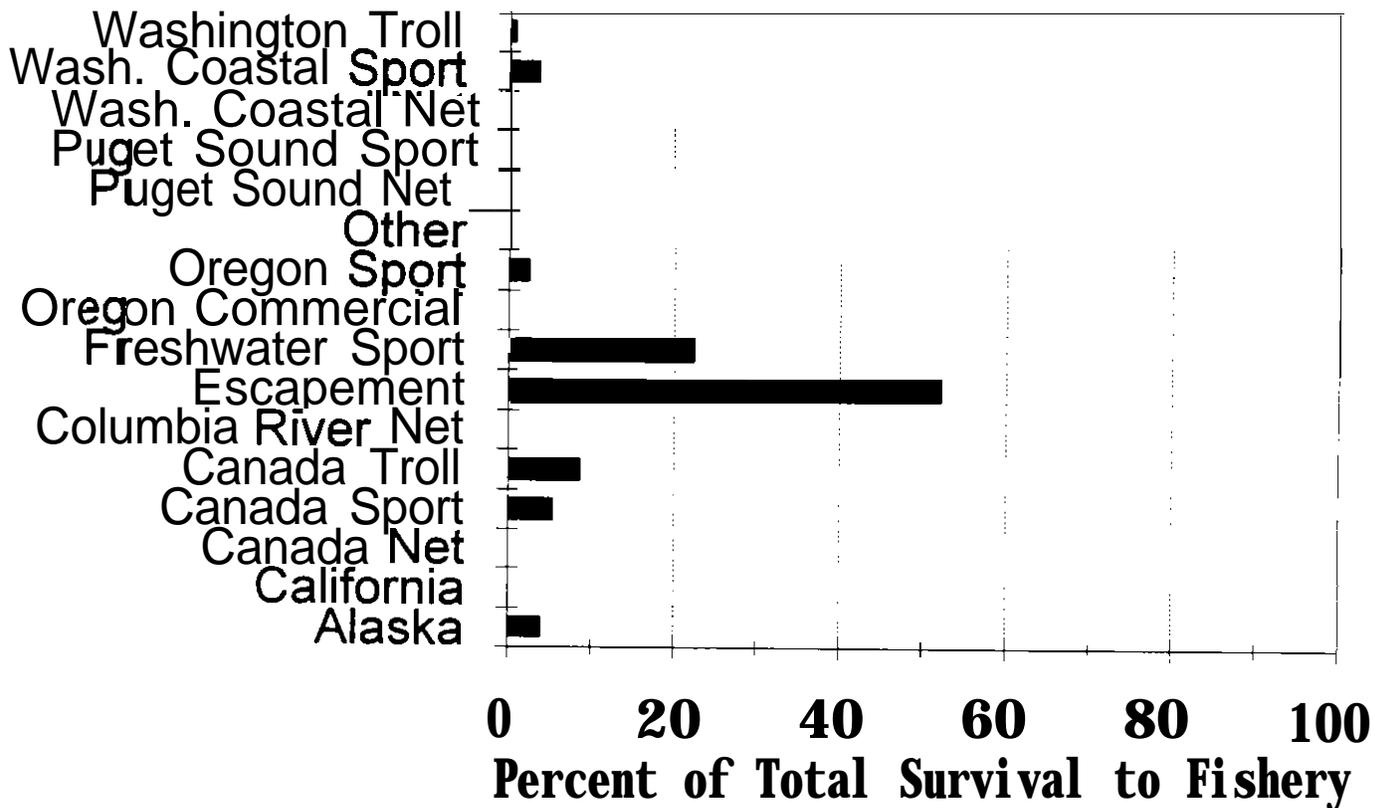


Figure 20. Percent of total survival to fisheries and escapement of North Toutle Hatchery 1987, 1989 and 1990 brood fall chinook.

## Columbia River Type S Coho North Toutle Hatchery

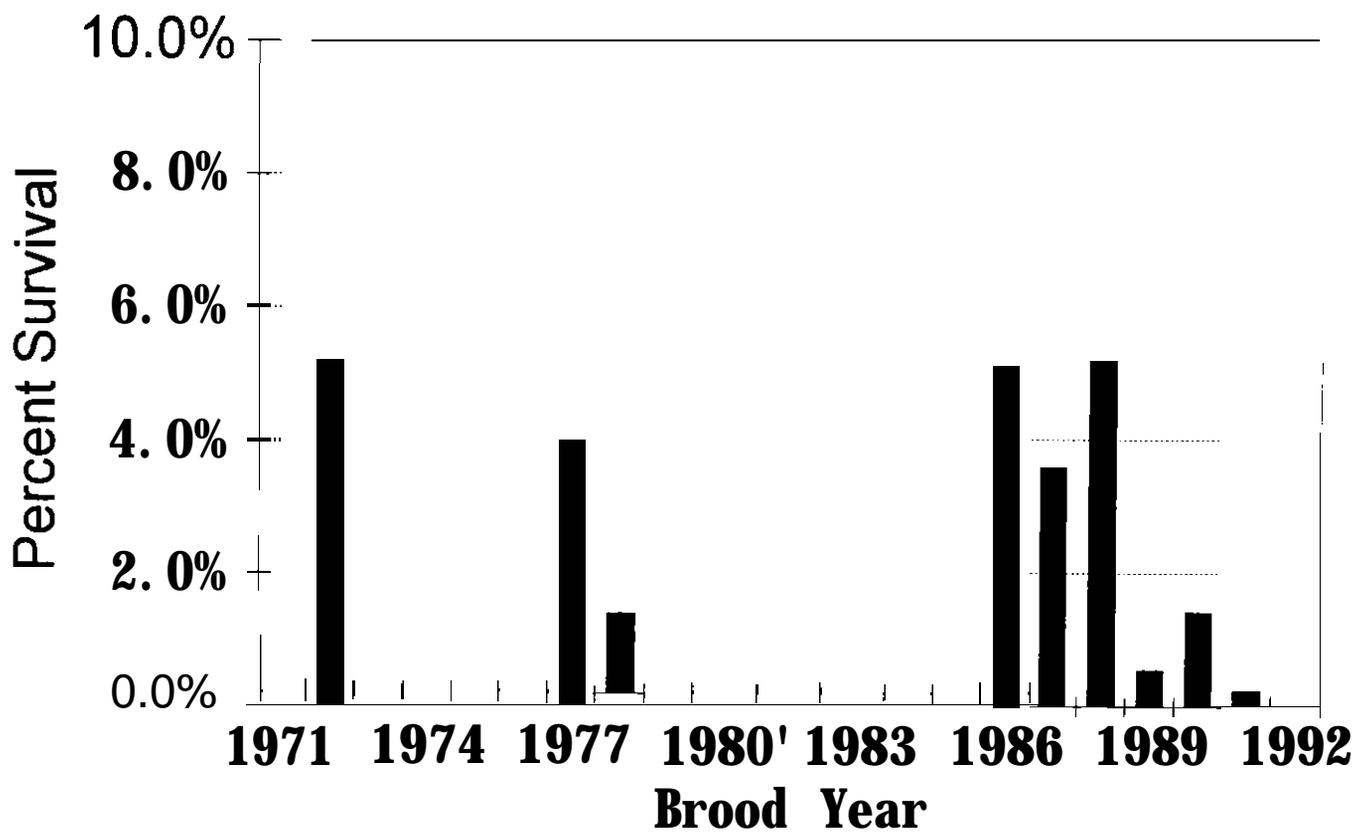


Figure 21. Survival by brood of North Toutle Hatchery Type S coho.

## Columbia River Type S Coho North Toutle Hatchery

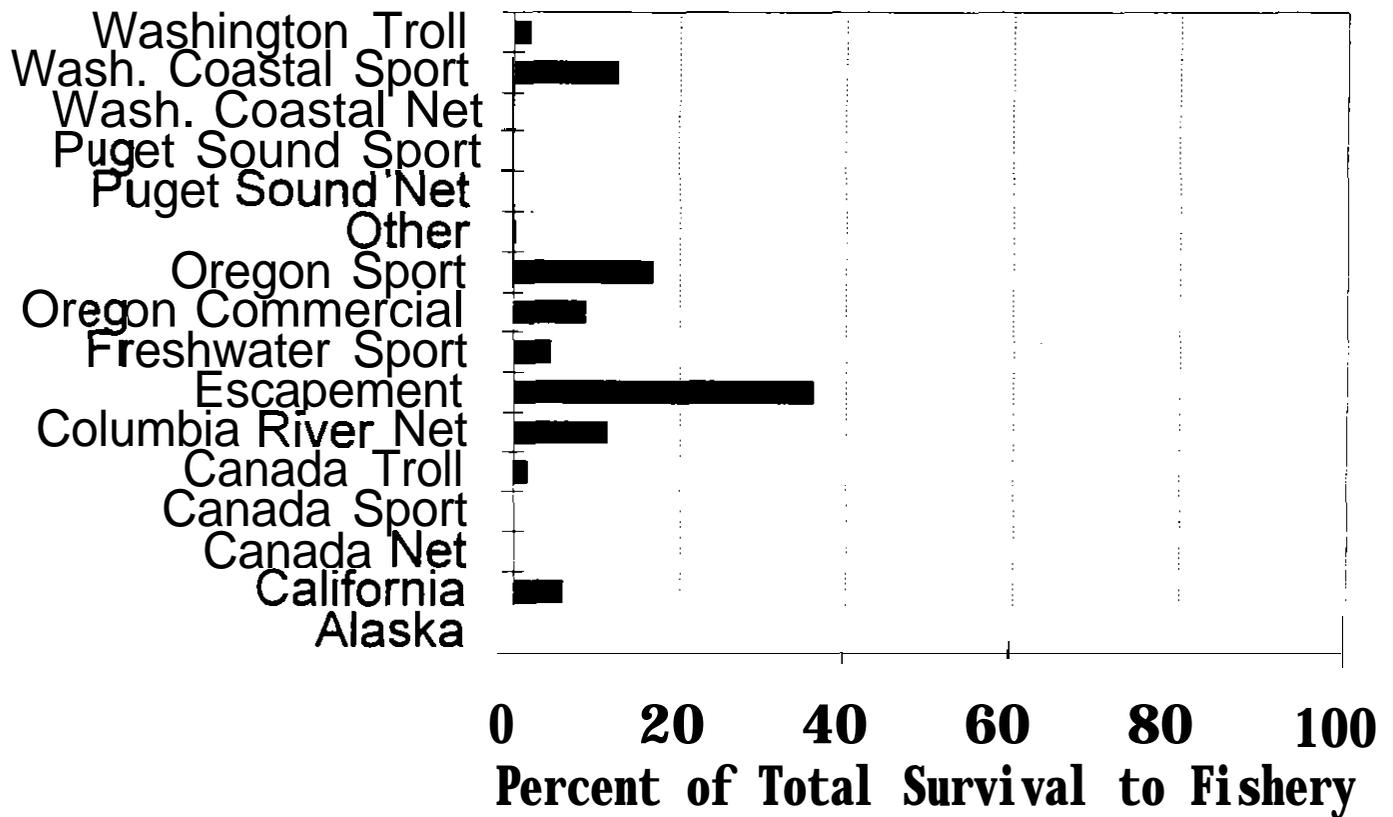


Figure 22. Percent of total survival to fisheries and escapement of North Toutle Hatchery 1988-1992 broods Type S coho.

# Columbia River Fall Chinook Fallert Creek Hatchery

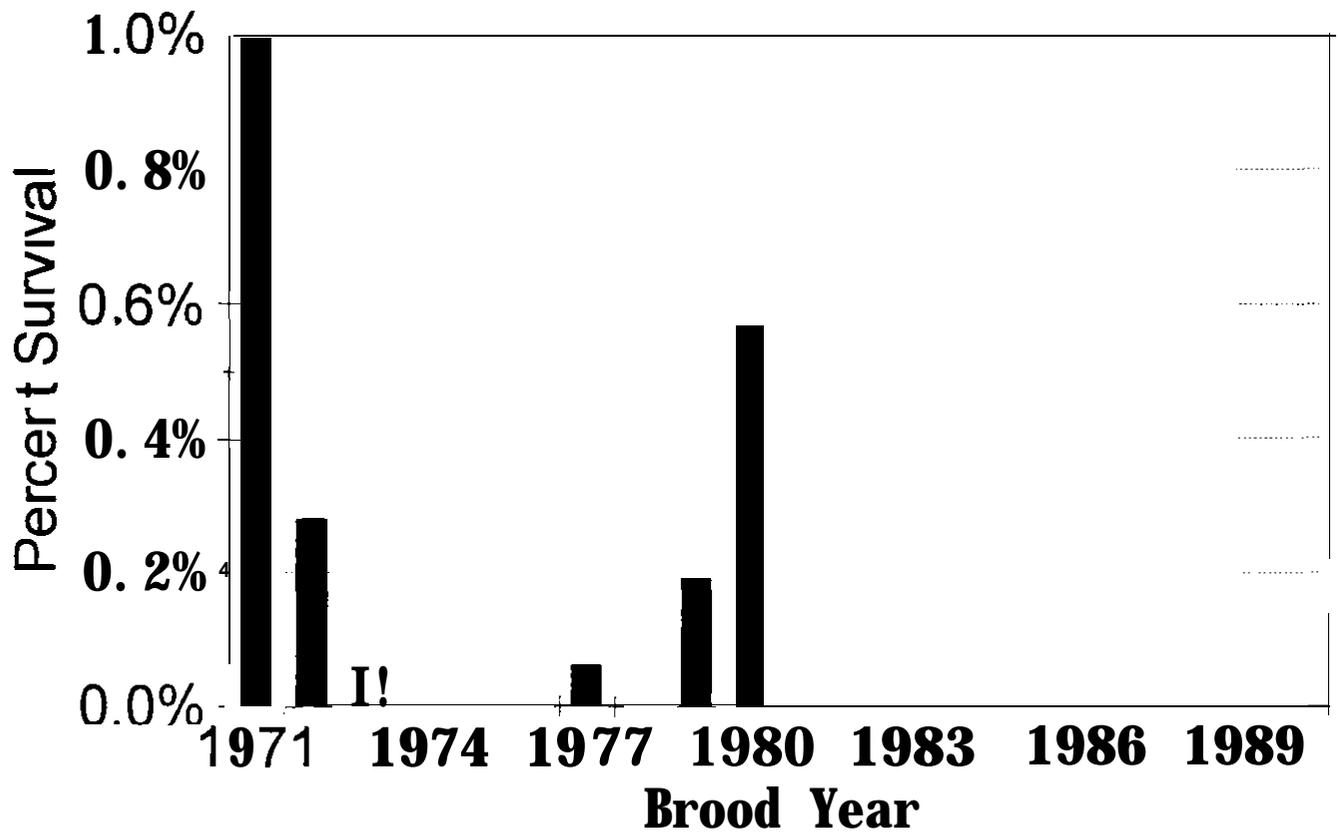


Figure 23. Survival by brood of Fallert Creek Hatchery fall chinook.

## Columbia River Spring Chinook Fallert Creek Hatchery, Yearlings

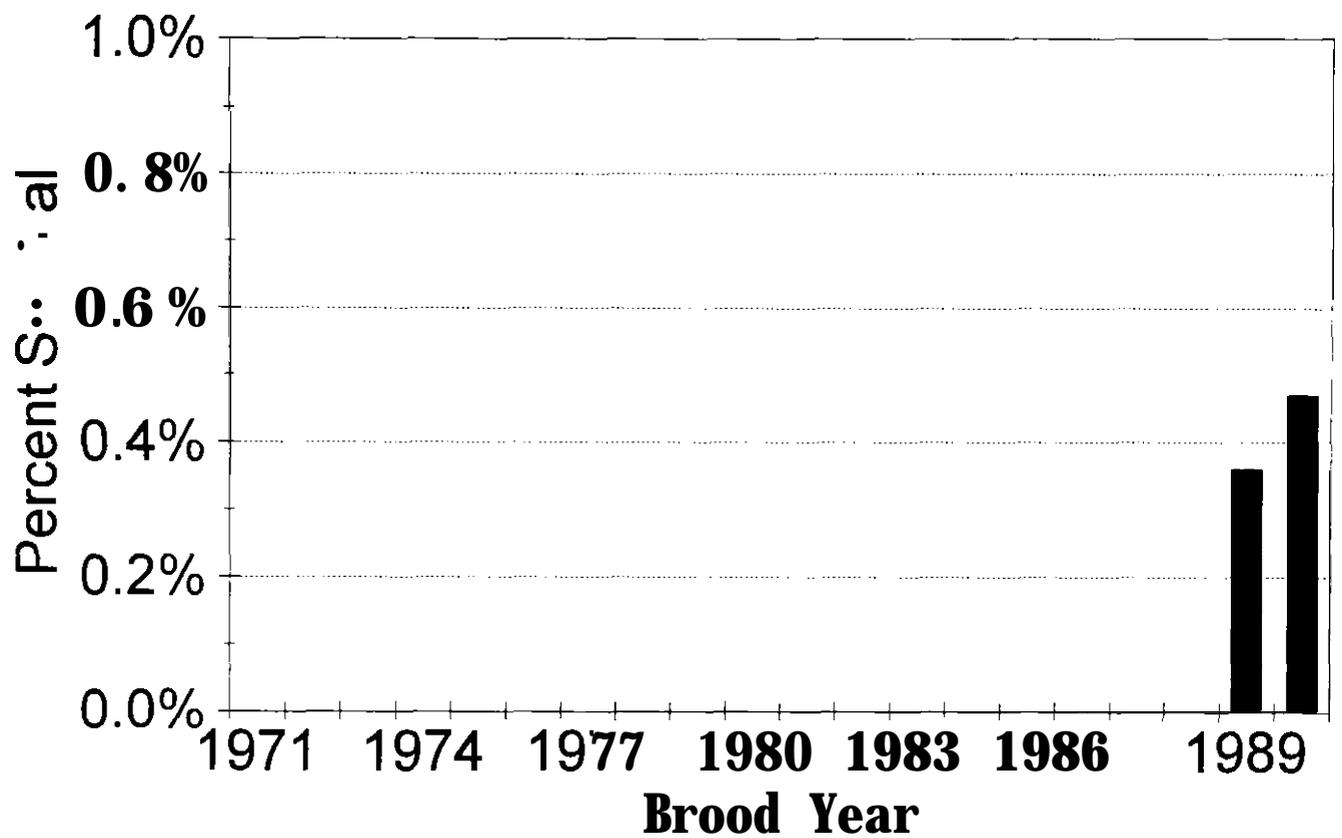


Figure 24. Survival by brood of Fallert Creek Hatchery yearling spring chinook.

# Columbia River Spring Chinook

## Fallert Creek Hatchery

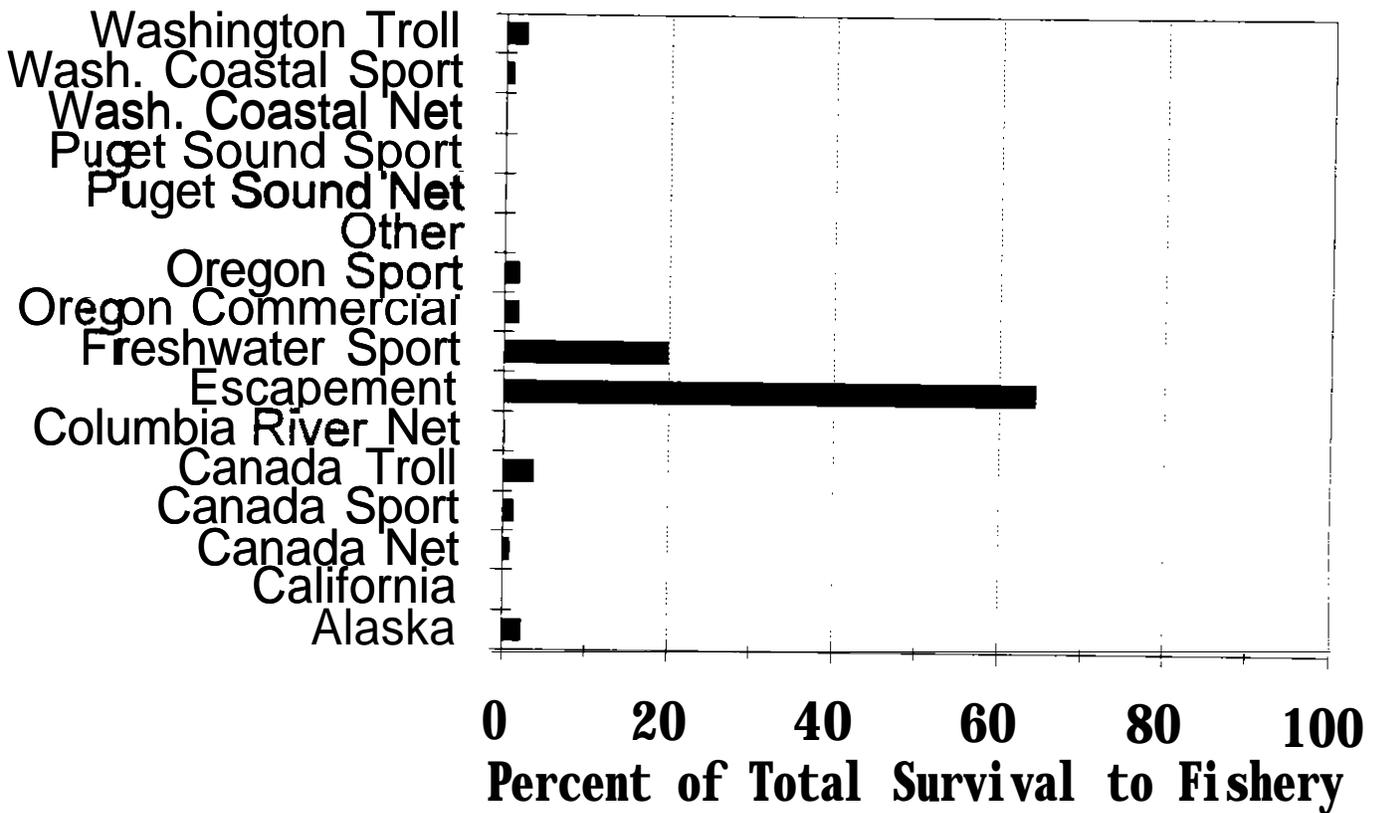


Figure 25. Percent of total survival to fisheries and escapement of Fallert Creek Hatchery 1989 and 1990 brood yearling spring chinook.

## Columbia River Type S Coho Fallert Creek Hatchery

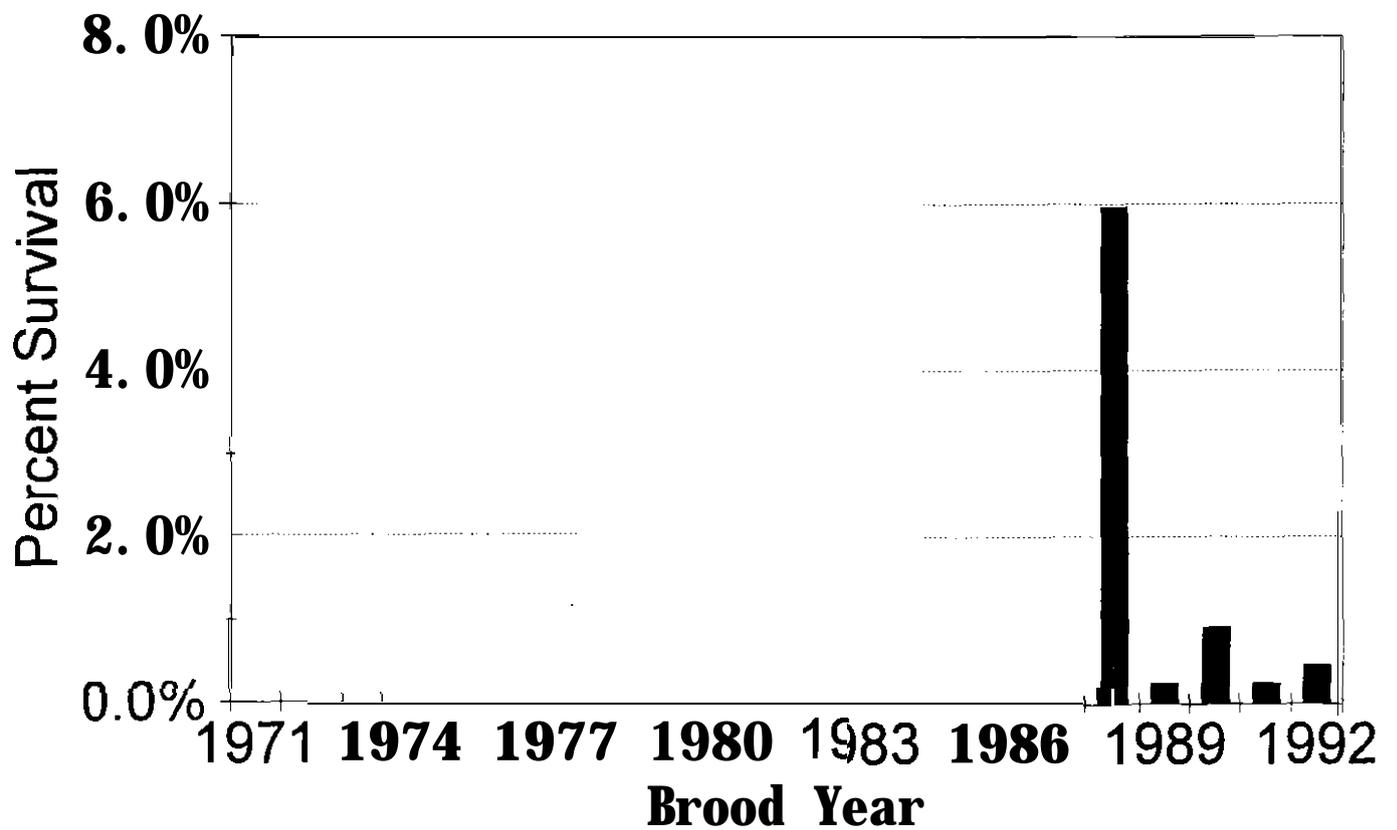


Figure 26. Survival by brood of Fallert Creek Hatchery Type S coho.

## Columbia River Type S Coho Fallert Creek Hatchery

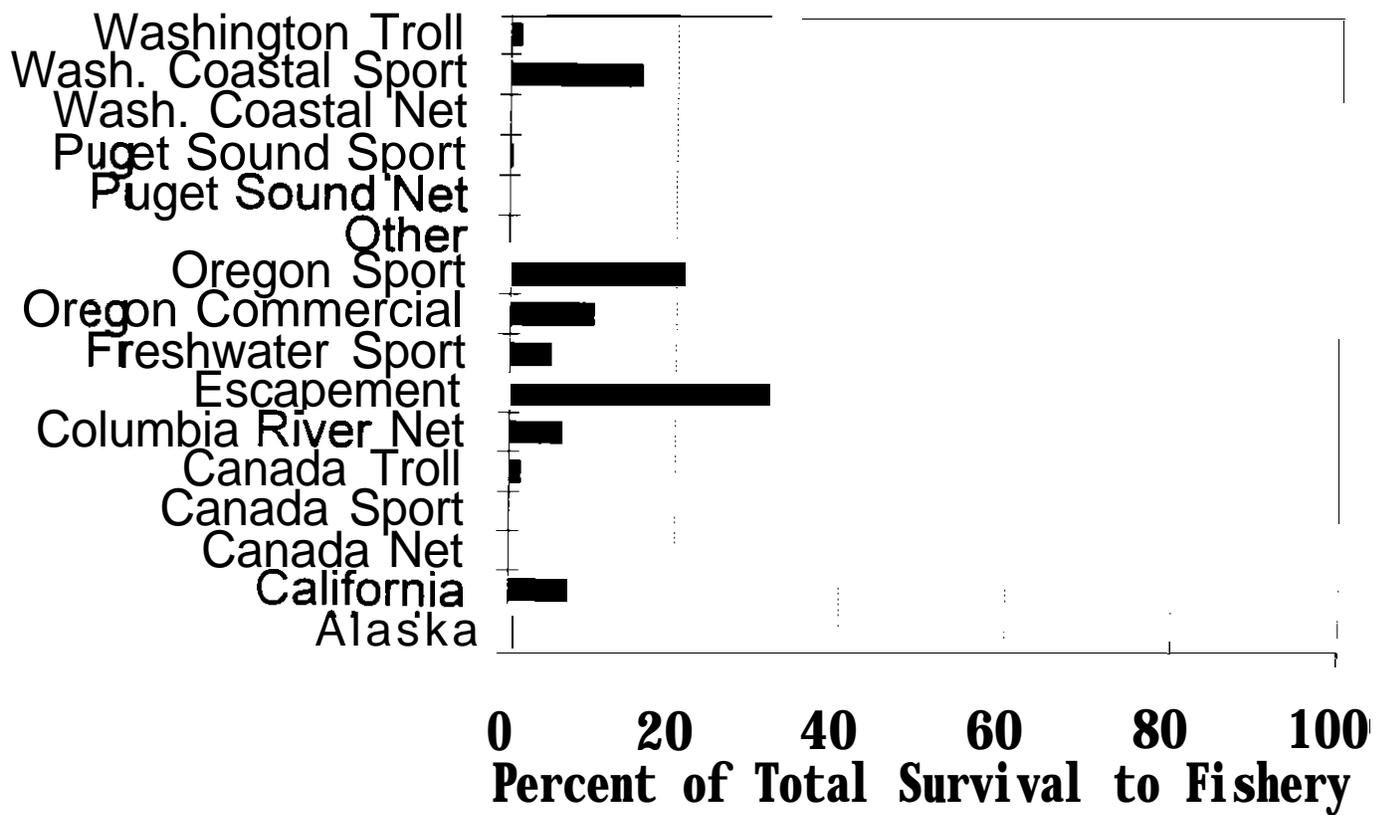


Figure 27. Percent of total survival to fisheries and escapement of Fallert Creek Hatchery 1988-1992 broods Type S coho.

## Columbia River Fall Chinook Kalama Falls Hatchery, Subyearlings

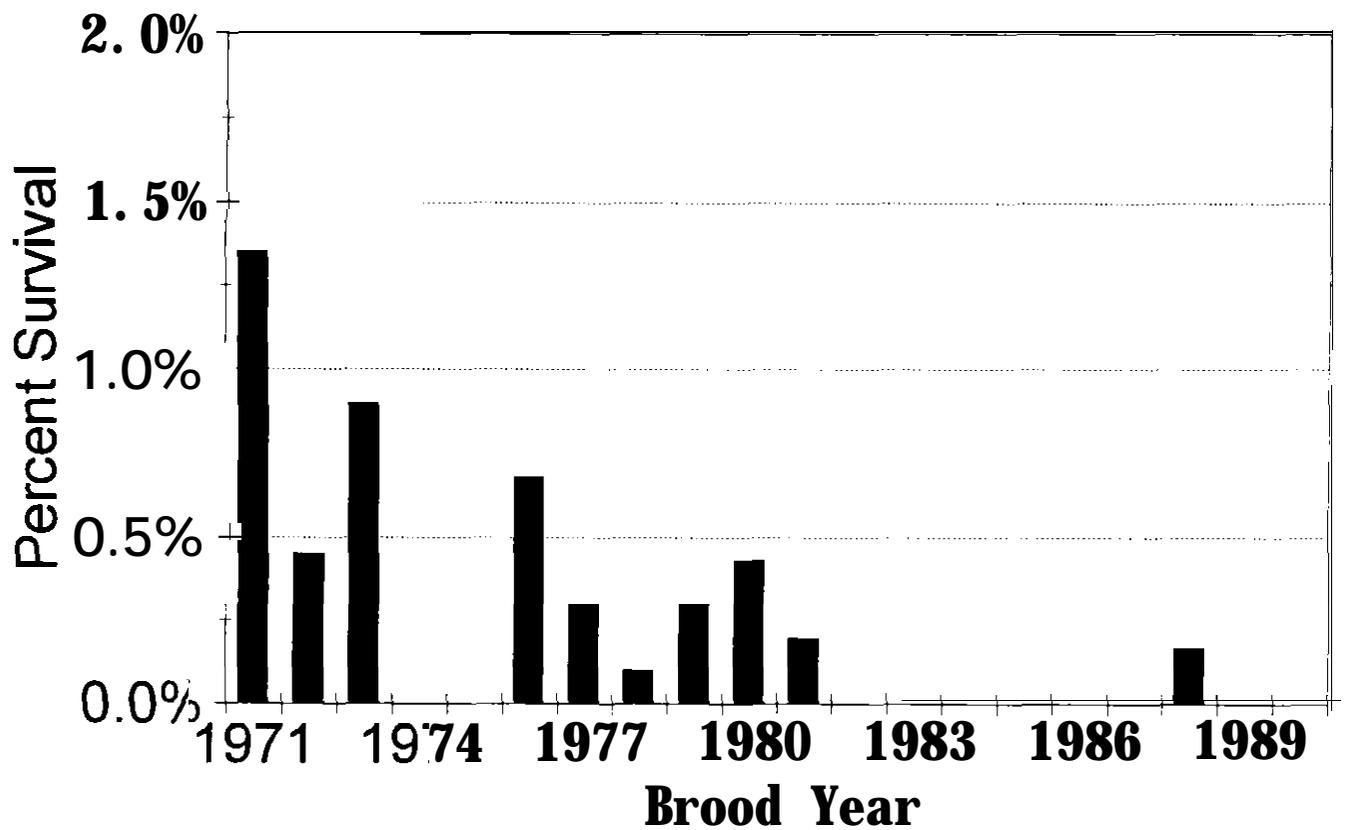
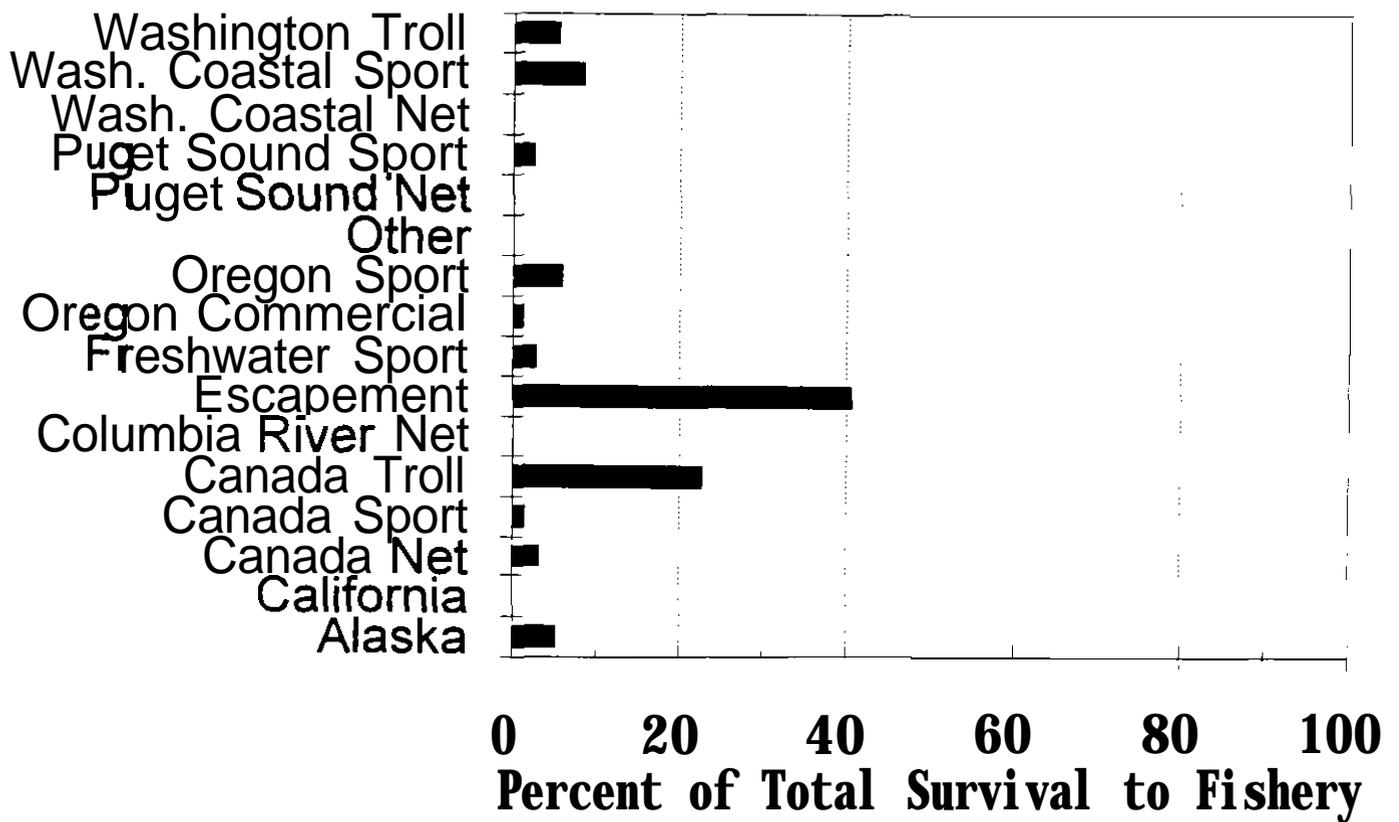


Figure 28. Survival by brood of Kalama Falls Hatchery fall chinook.

# Columbia River Fall Chinook

## Kalama Falls Hatchery



**Figure 29.** Percent of total survival to fisheries and escapement of Kalama Falls Hatchery 1988 brood fall chinook.

## Columbia River Type N Coho Kalama Falls Hatchery

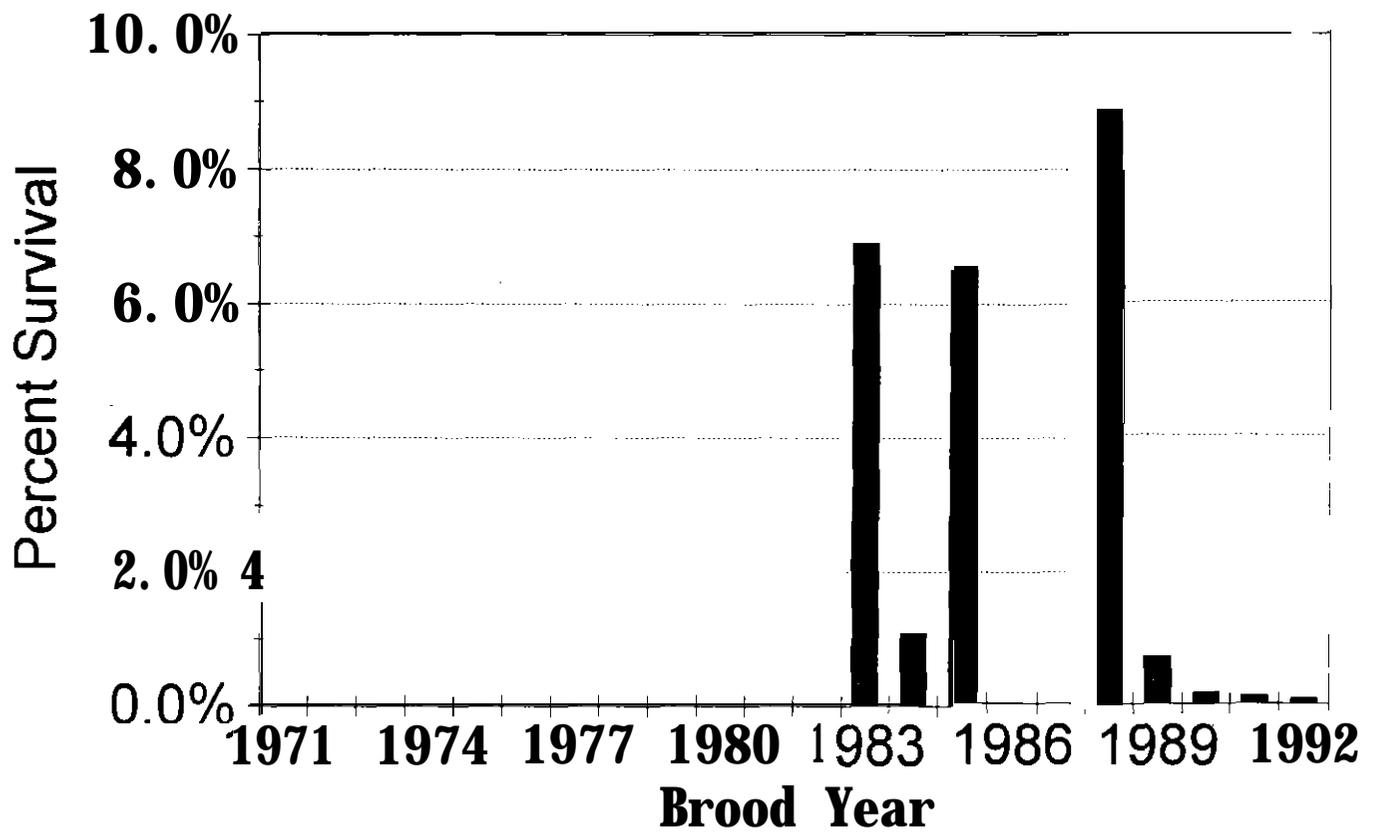


Figure 30. Survival by brood of Kalama Falls Hatchery Type N coho.

# Columbia River Type N Coho

## Kalama Falls Hatchery

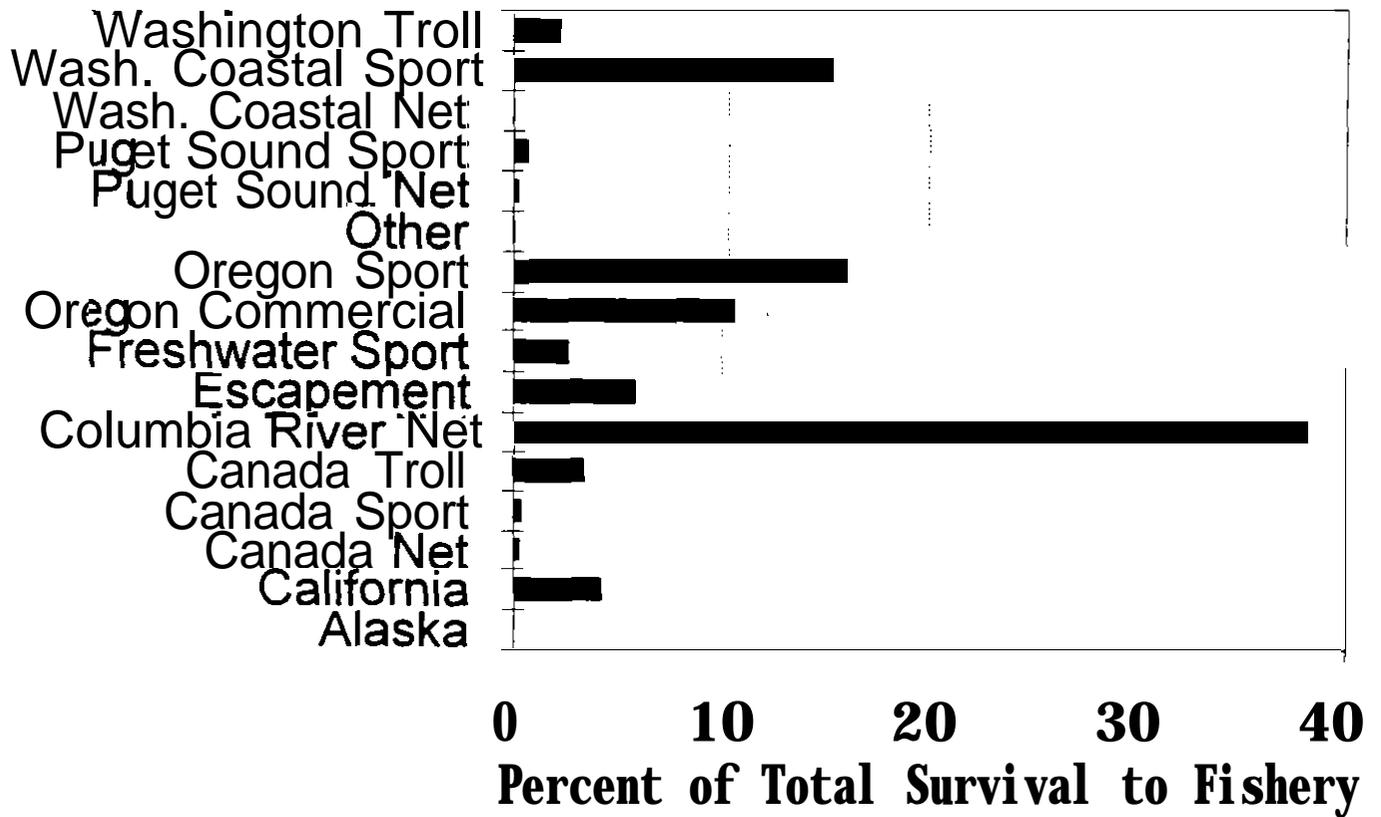


Figure 31. Percent of total survival to fisheries and escapement of Kalama Falls Hatchery 1988-1992 broods Type N coho.

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## Columbia River Spring Chinook Lewis River Hatchery, Yearlings

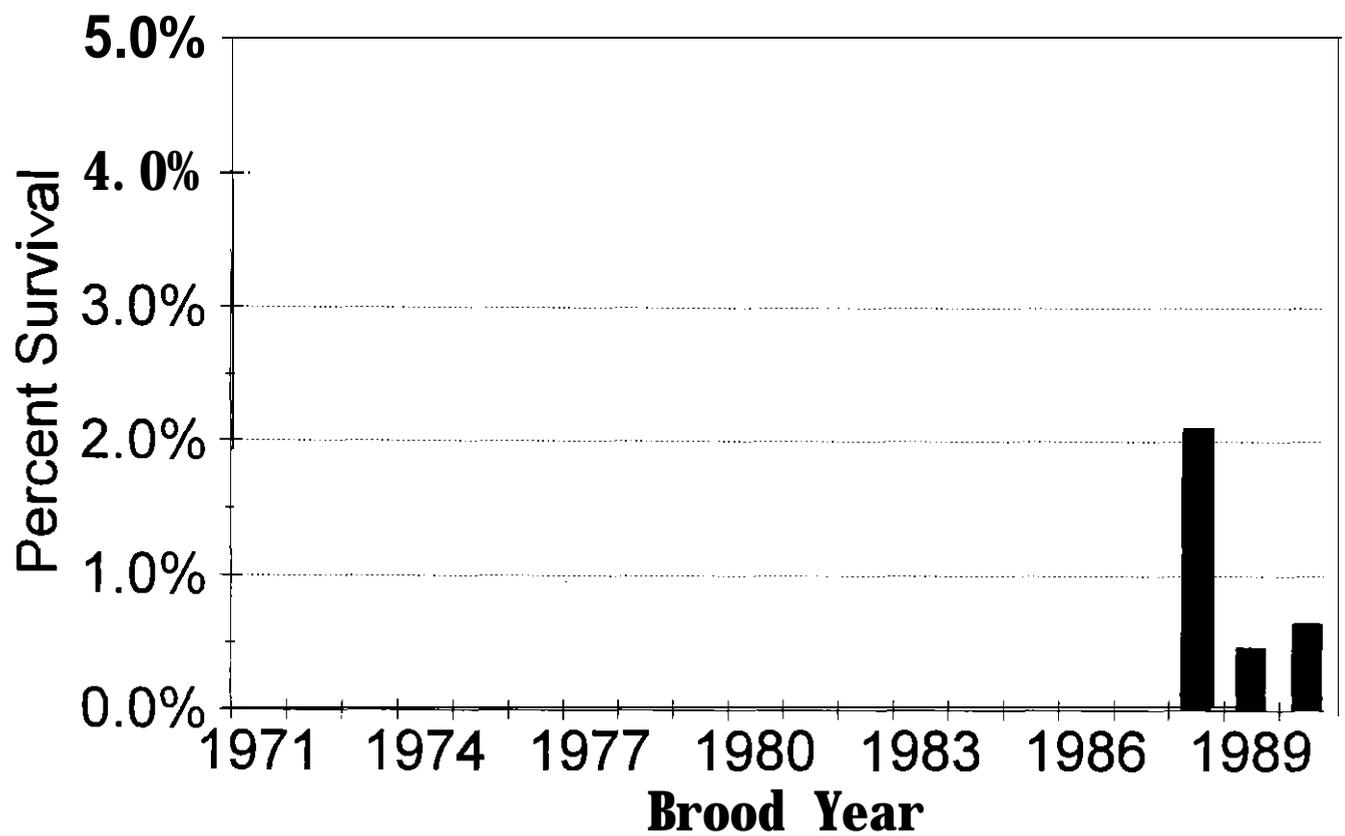
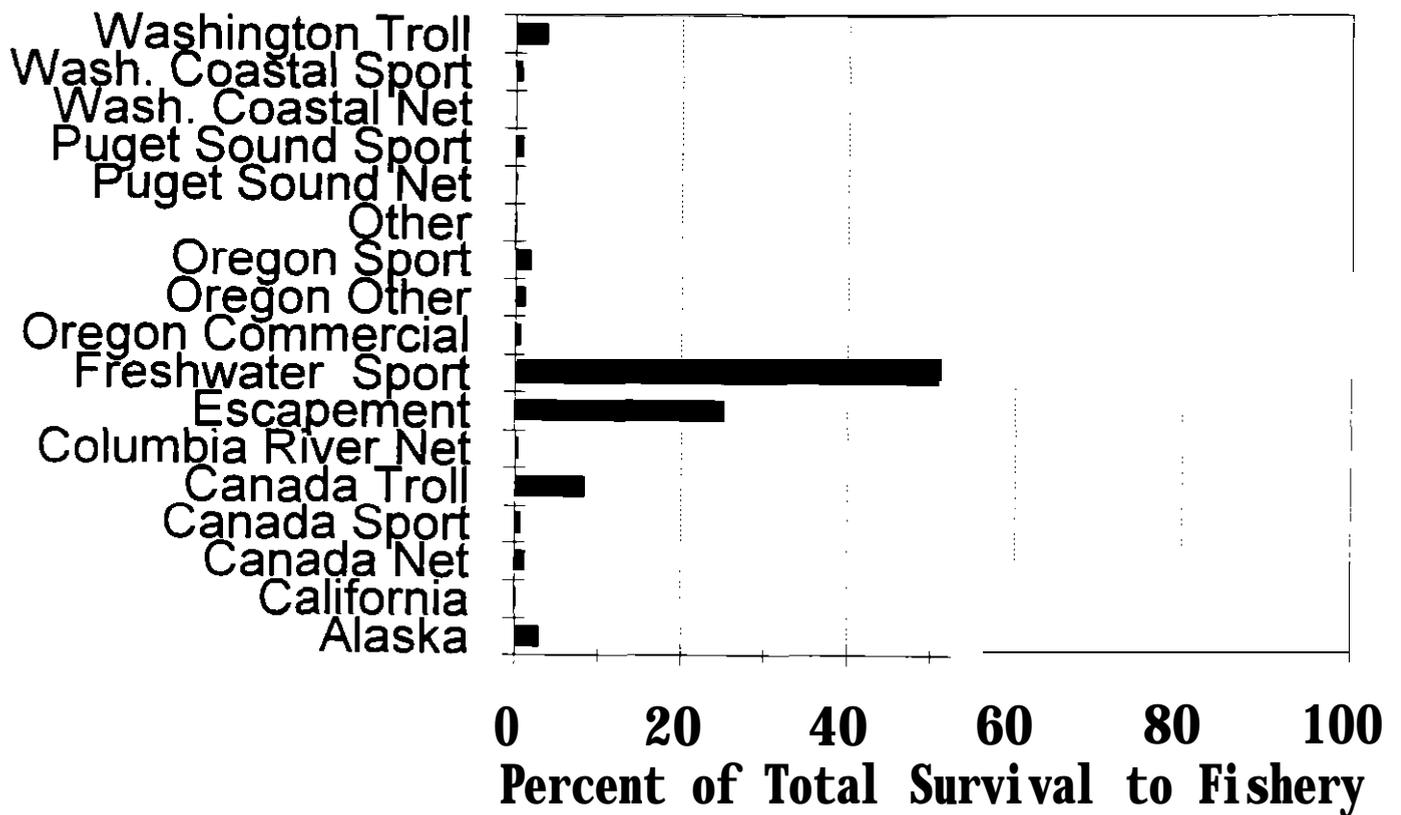


Figure 32. Survival by brood of Lewis River Hatchery yearling spring chinook.

# Columbia River Spring Chinook

## Lewis River Hatchery, Yearlings



**Figure 33.** Percent of total survival to fisheries and escapement of Lewis River Hatchery 1988, 1989 and 1990 yearling spring chinook.

# Columbia River Type N Coho

## Lewis River Hatchery

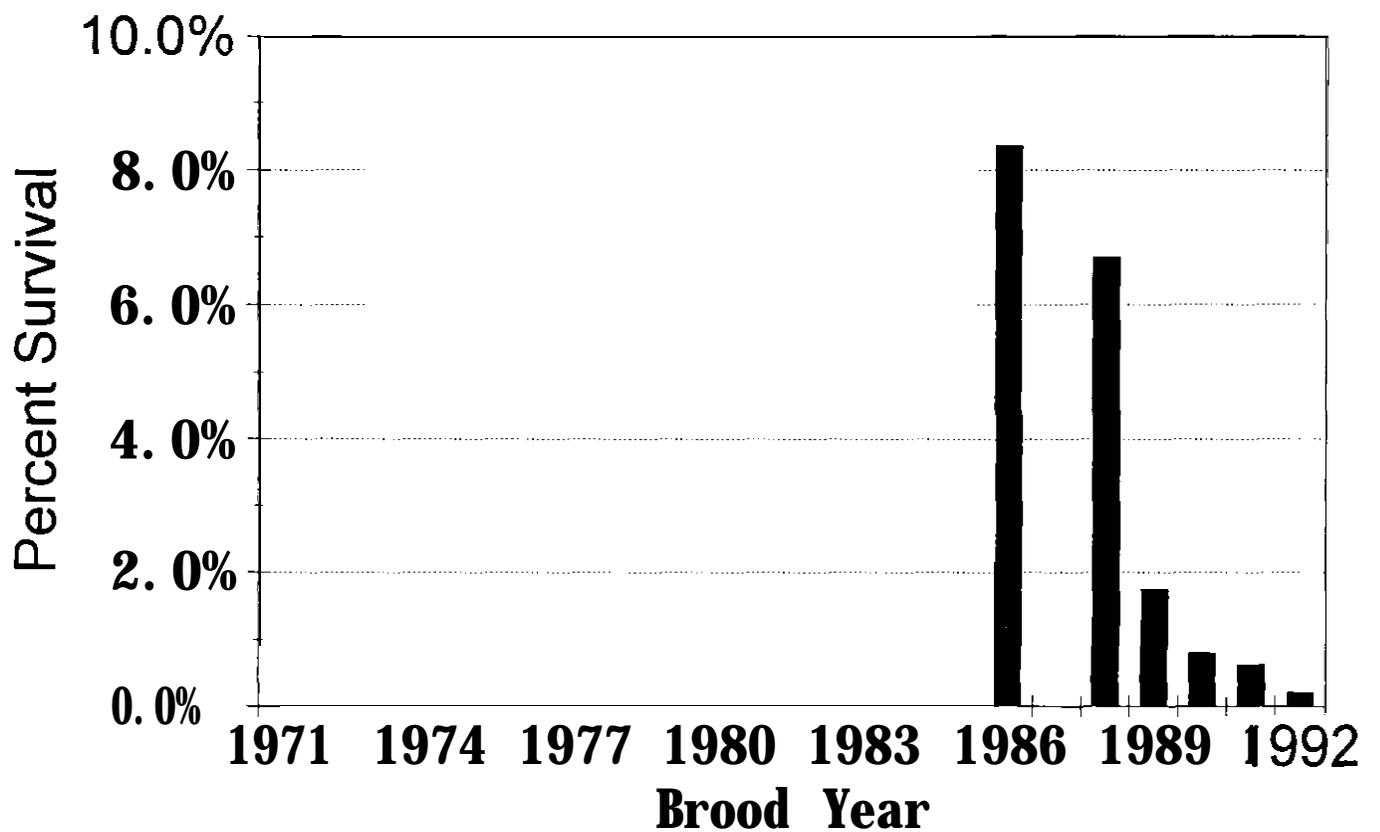


Figure 34. Survival by brood of Lewis River Hatchery Type N coho.

# Columbia River Type N Coho

## Lewis River Hatchery

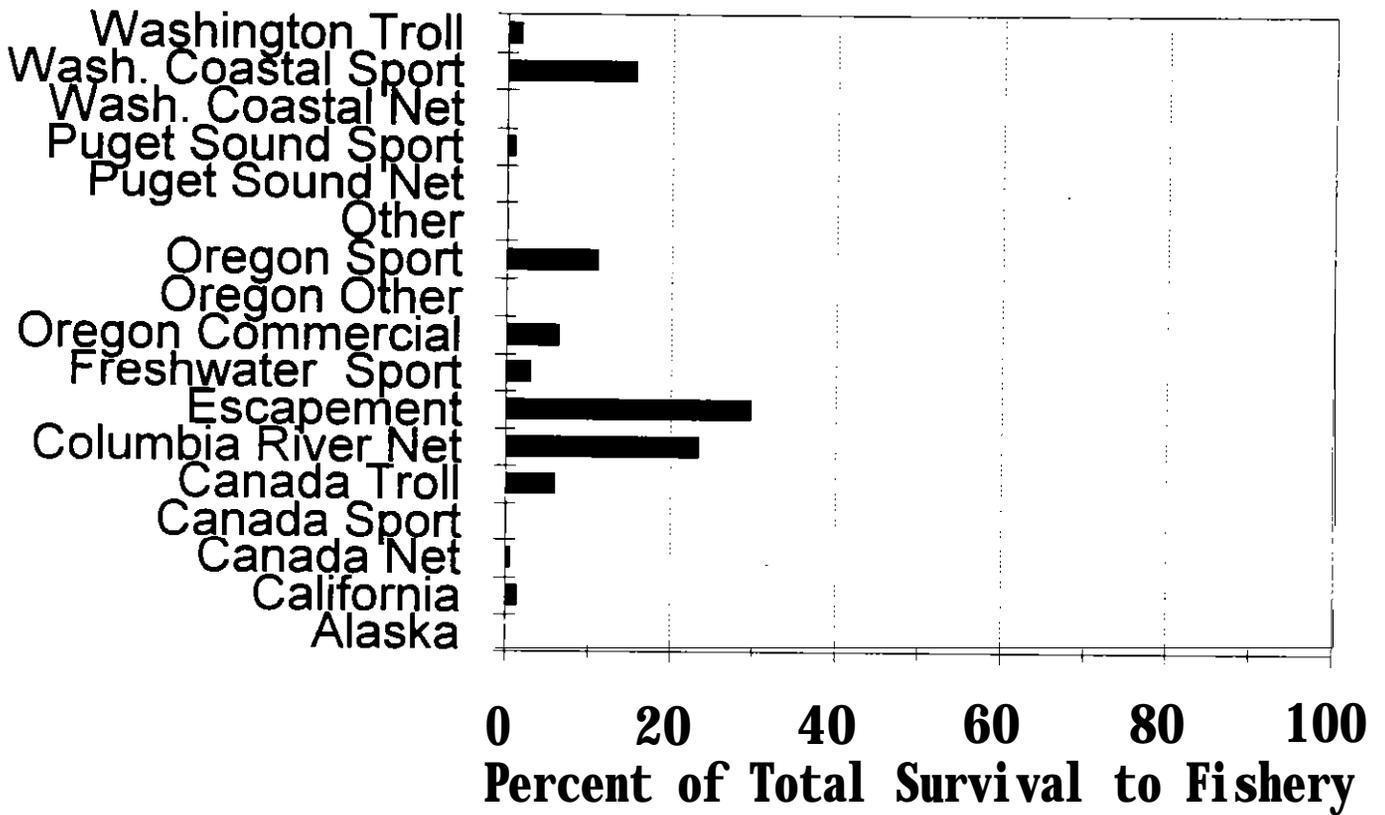


Figure 35. Percent of total survival to fisheries and escapement of Lewis River Hatchery 1988-1992 broods Type N coho.

# Columbia River Type S Coho Lewis River Hatchery

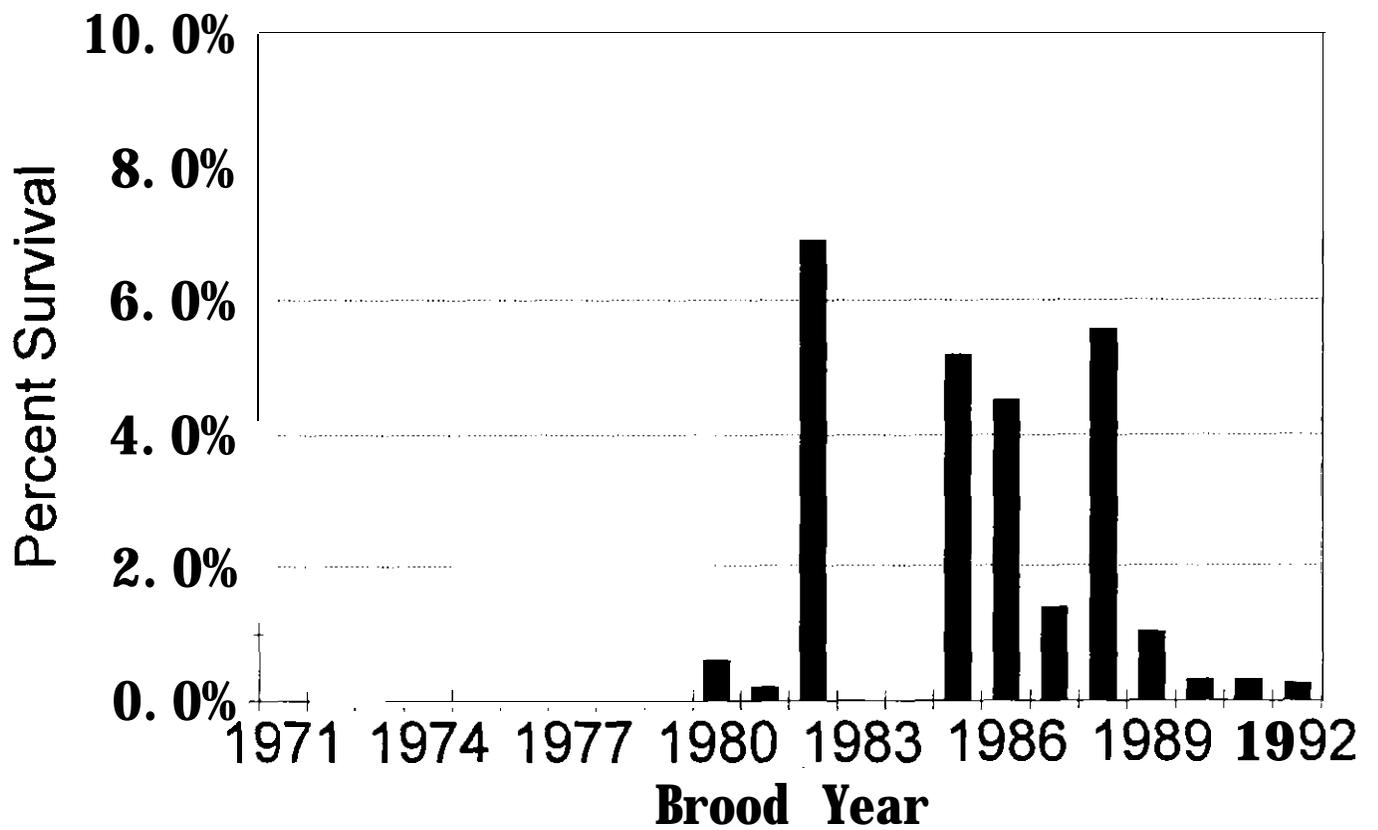


Figure 36. Survival by brood of Lewis River Hatchery Type S coho.

# Columbia River Type S Coho

## Lewis River Hatchery

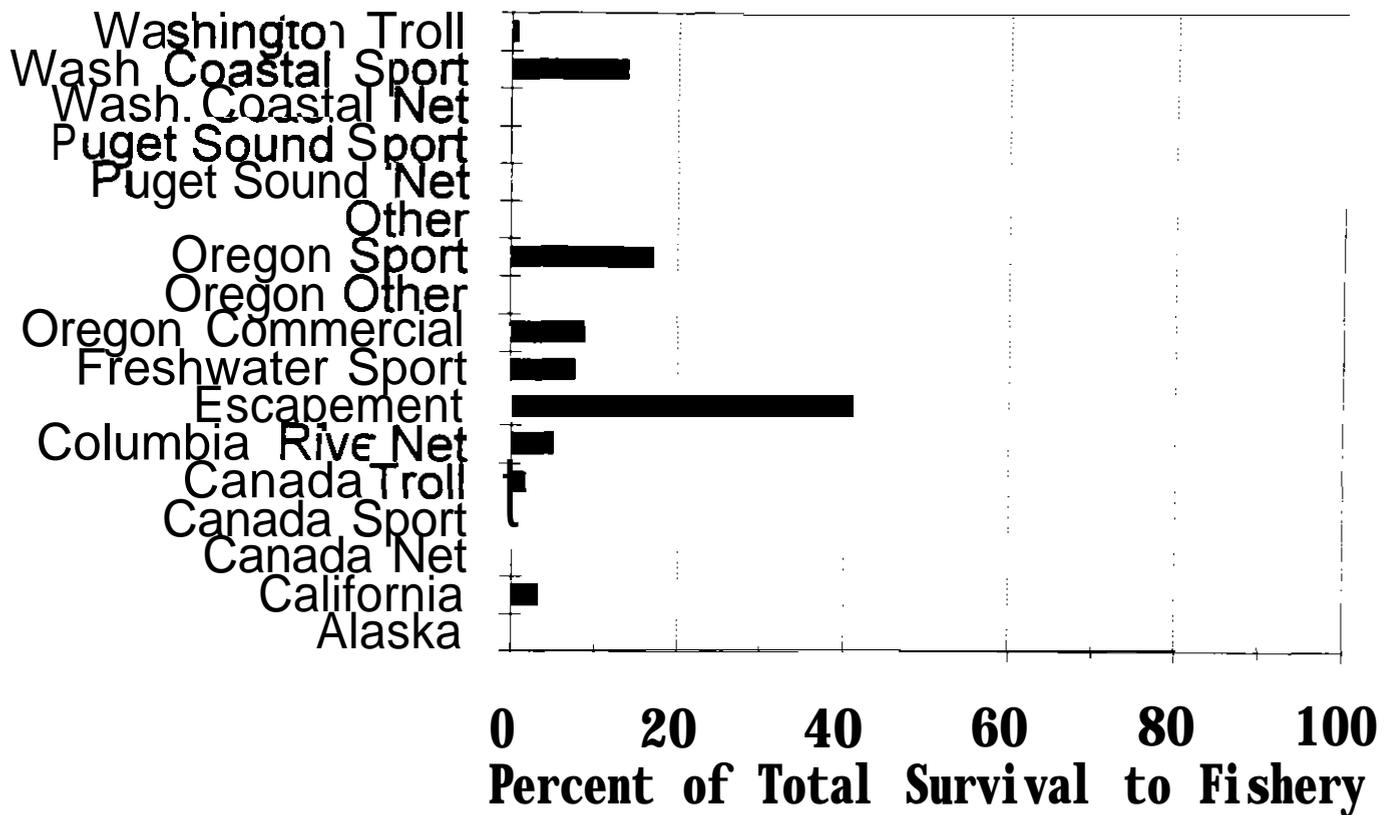


Figure 37. Percent of total survival to fisheries and escapement of Lewis River Hatchery 1988-1992 broods Type S coho.

# Columbia River Fall Chinook

## Lewis River Wild

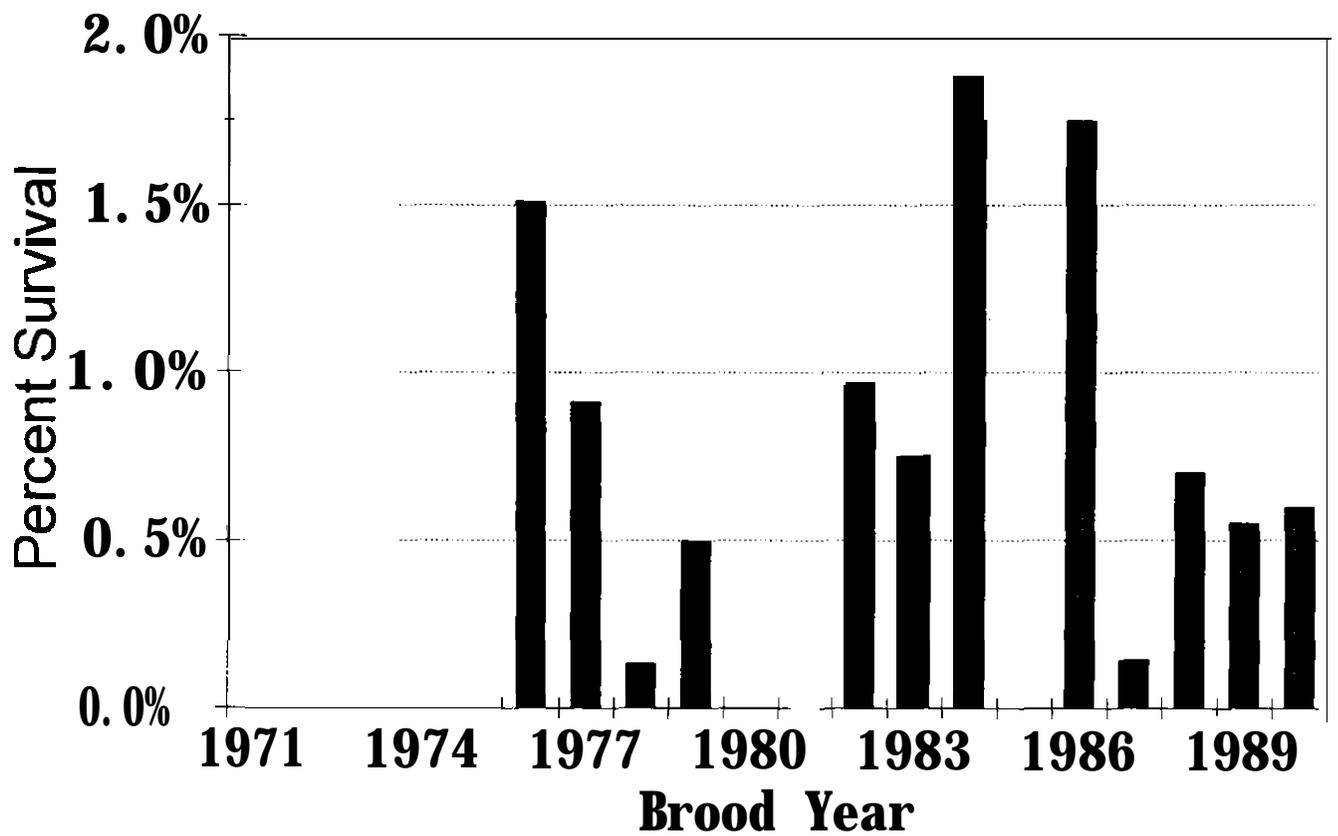


Figure 36. Survival by brood of Lewis River wild fall chinook.

# Columbia River Fall Chinook

## Lewis River Wild

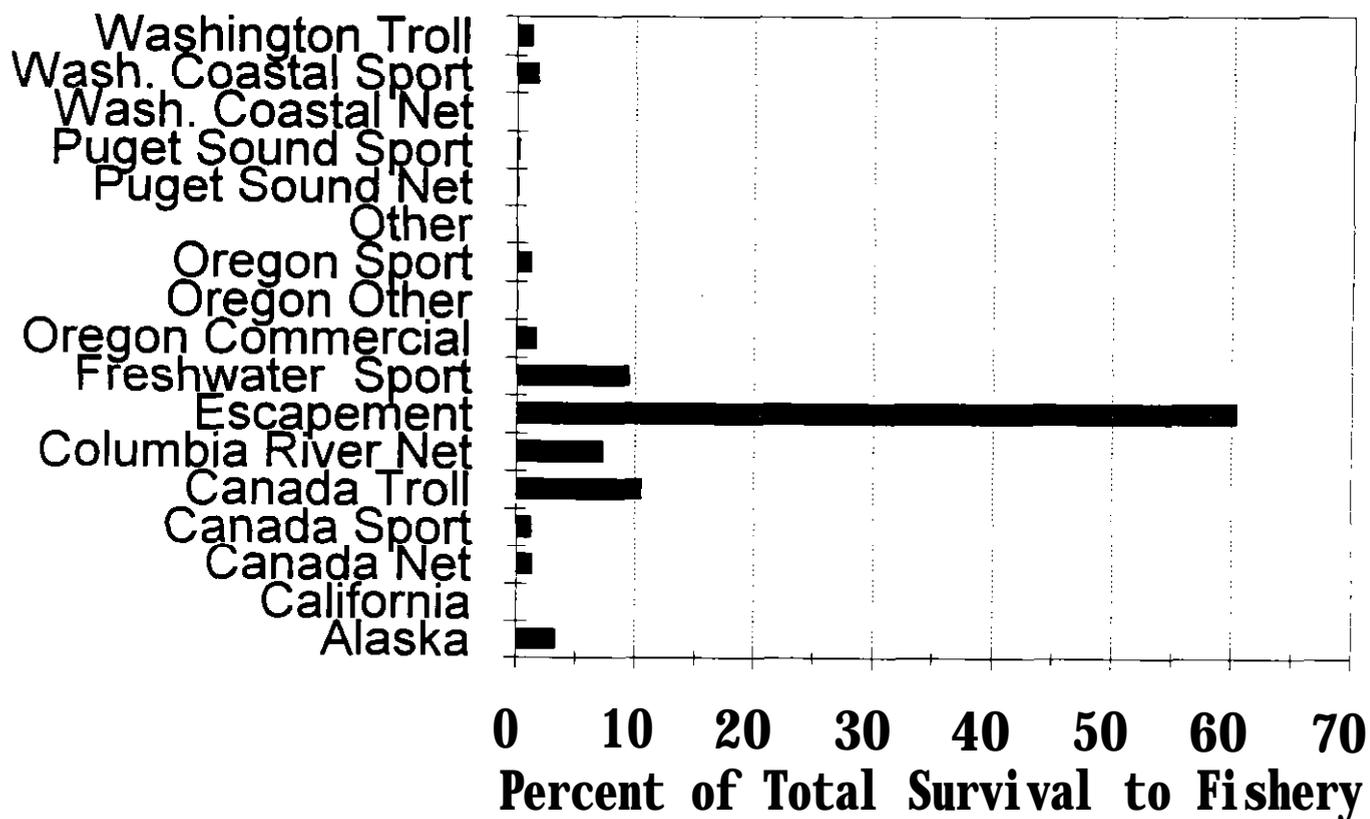


Figure 39. Percent of total survival to fisheries and escapement of Lewis River wild fall chinook. Broods: 1986-1 990.

## Columbia River Fall Chinook Washougal Hatchery, Subyearlings

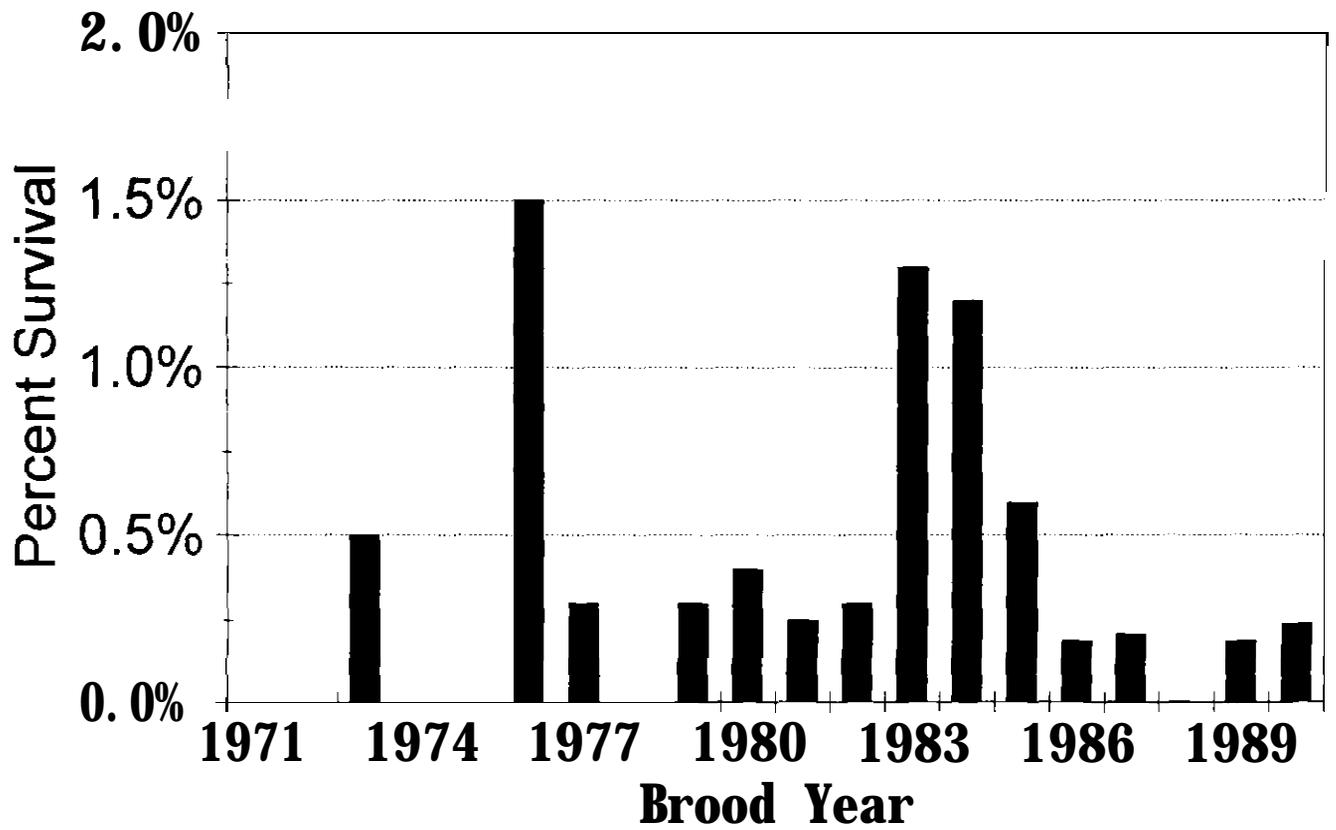
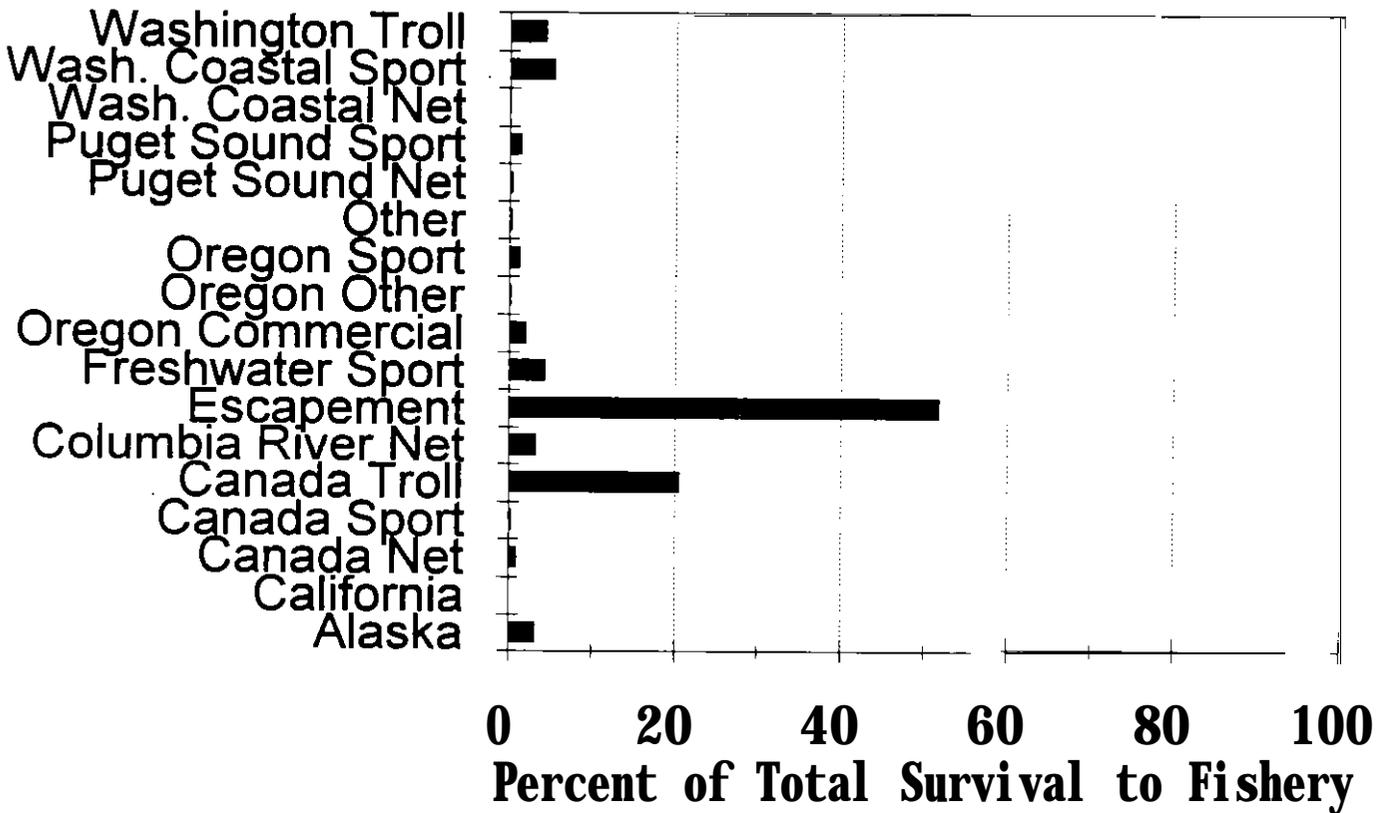


Figure 40. Survival by brood of Washougal Hatchery fall chinook.

# Columbia River Fall Chinook

## Washougal Hatchery, Subyearlings



**Figure 41.** Percent of total survival to fisheries and escapement of Washougal Hatchery 1986, 1987, 1989 and 1990 fall chinook.

## Columbia River Type N Coho Washougal Hatchery, On-Station Release

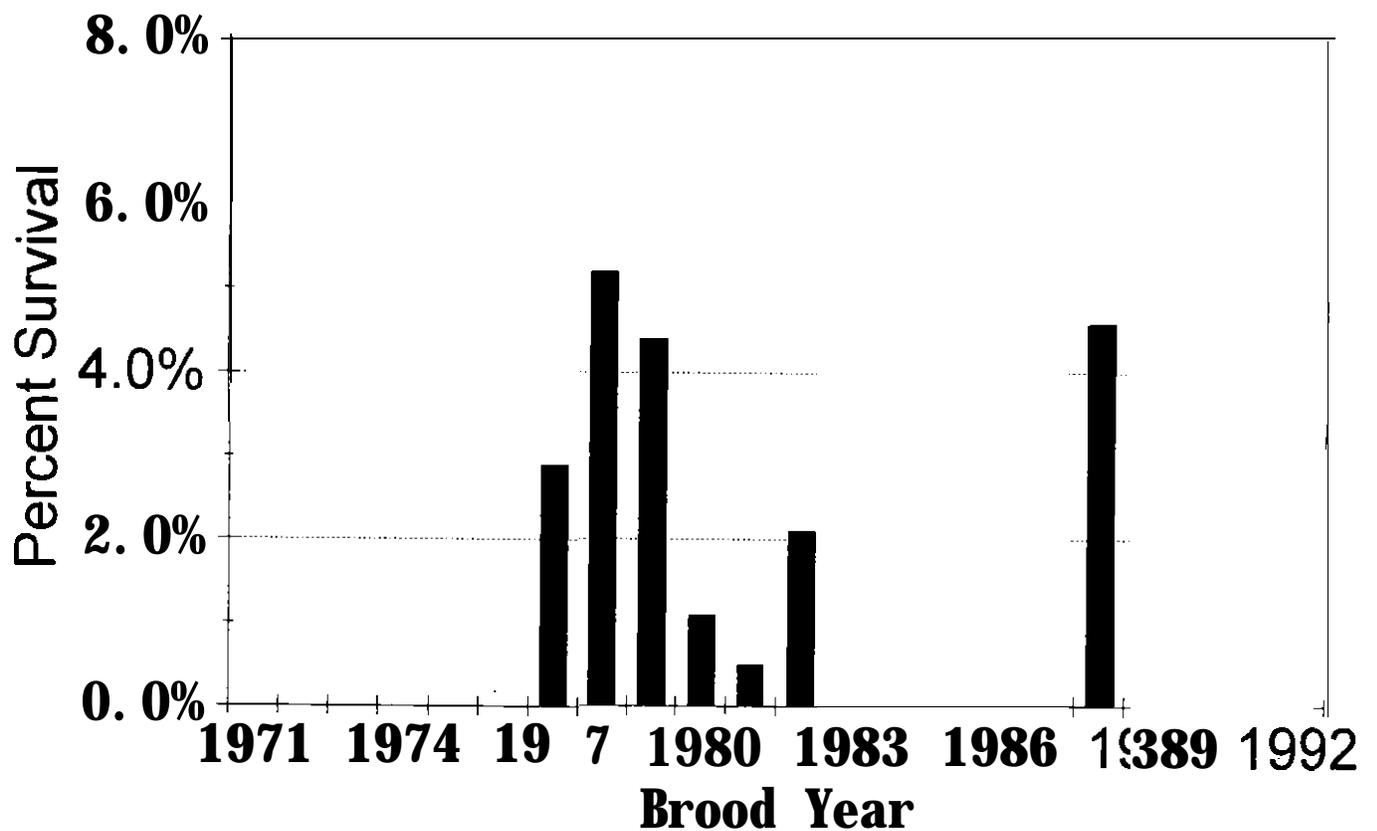


Figure 42. Survival by brood of Washougal Hatchery Type N coho released on-station

# Columbia River Type N Coho

## Washougal Hatchery, On-station Release

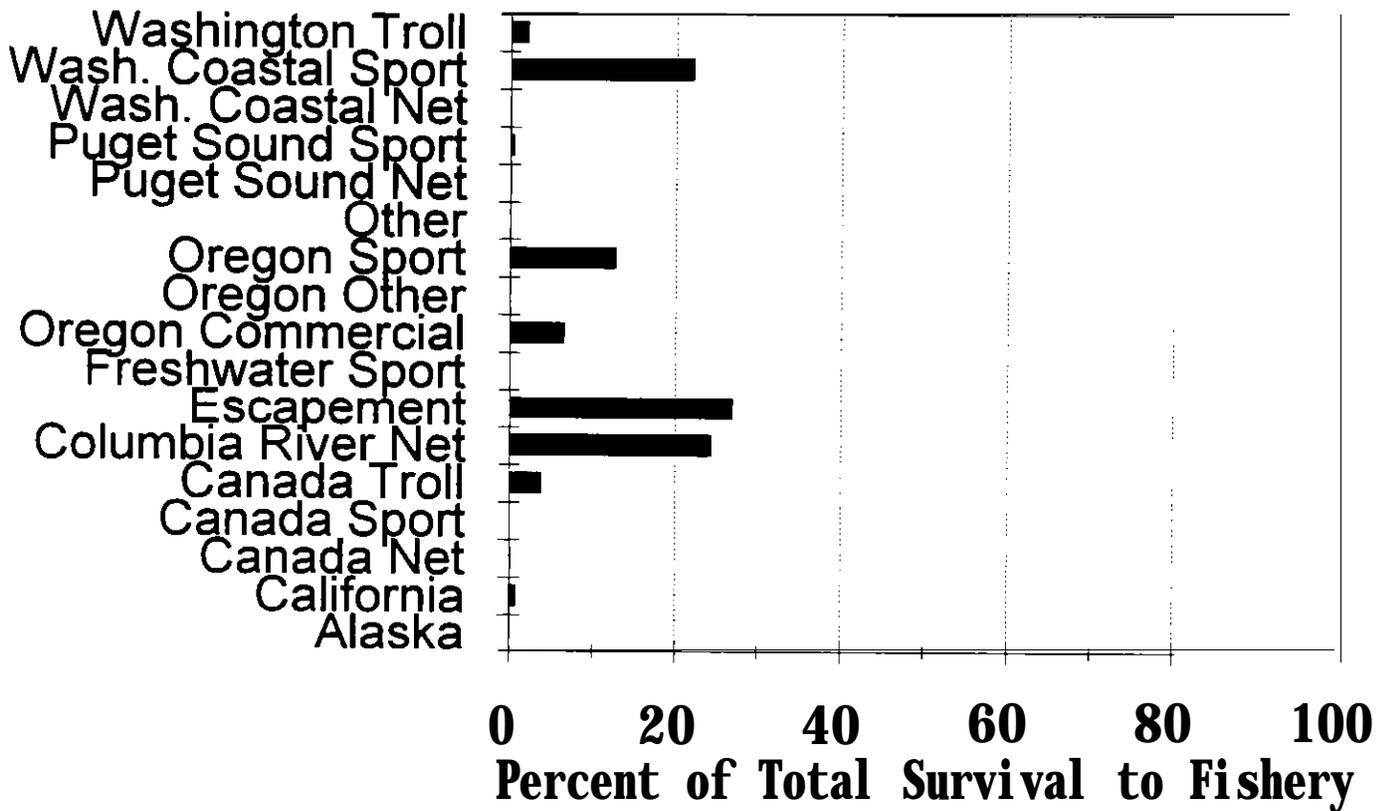


Figure 43. Percent of total survival to fisheries and escapement of Washougal Hatchery 1988-1992 broods Type N coho released on-station.

## Columbia River Type N Coho Washougal Hatchery, Klickitat River

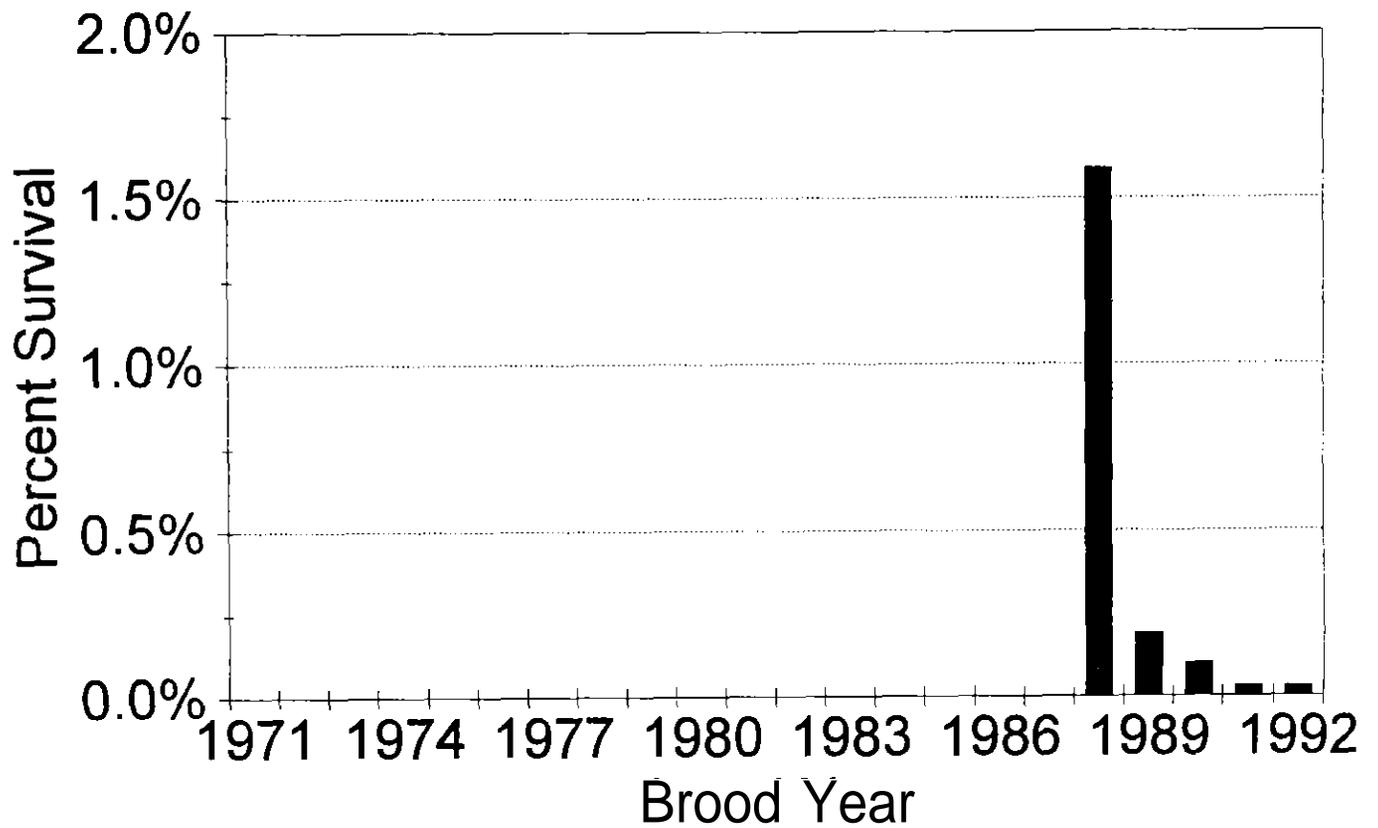


Figure 44. Survival by brood of Washougal Hatchery Type N coho released into the Klickitat River.

## Columbia River Type N Coho Washougal Hatchery, Klickitat River

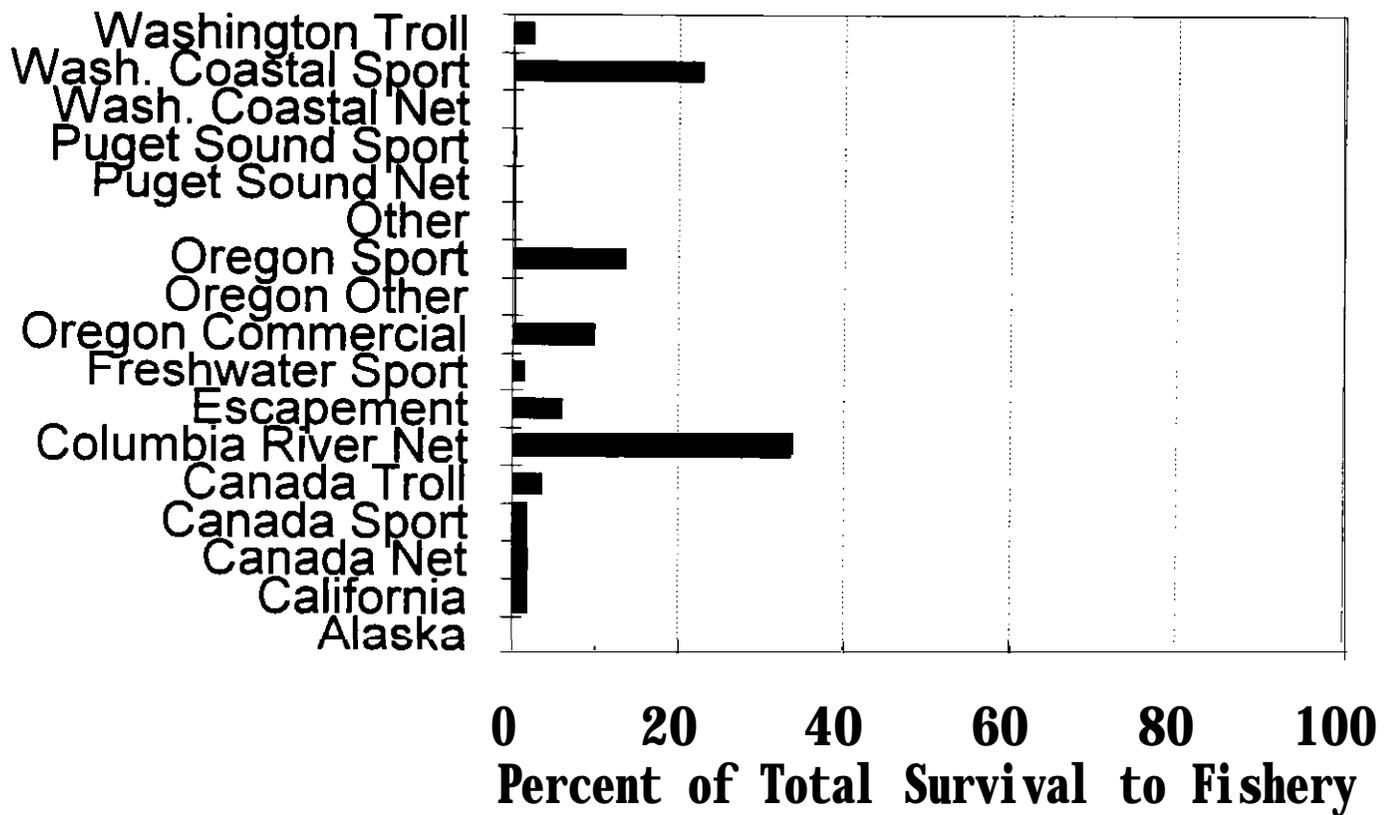


Figure 45. Percent of total survival to fisheries and escapement of Washougal Hatchery 1988-1992 brood Type N coho released into the Klickitat River.

# Columbia River Fall Chinook Klickitat Hatchery, Subyearlings

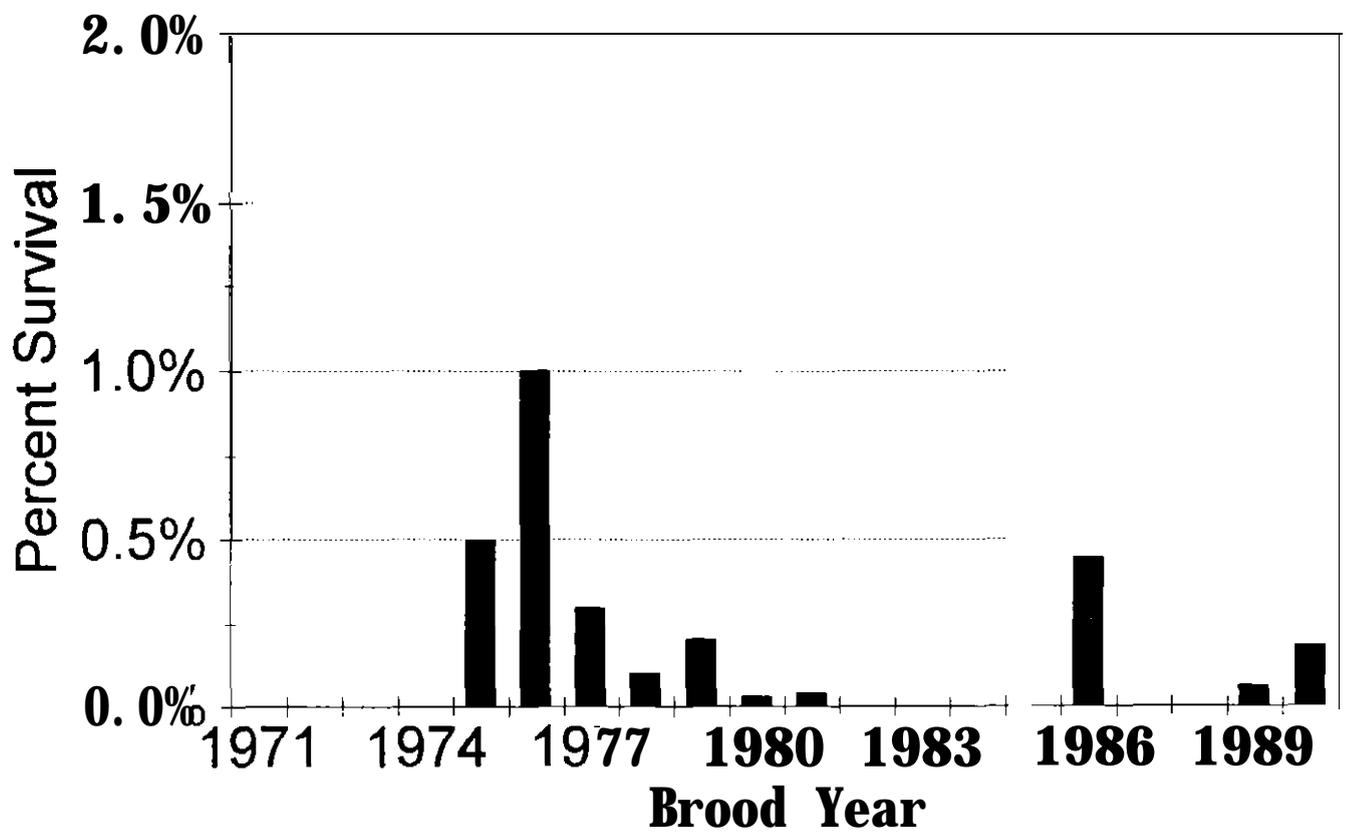


Figure 46. Survival by brood of Klickitat Hatchery fall chinook

# Columbia River Fall Chinook

## Klickitat Hatchery

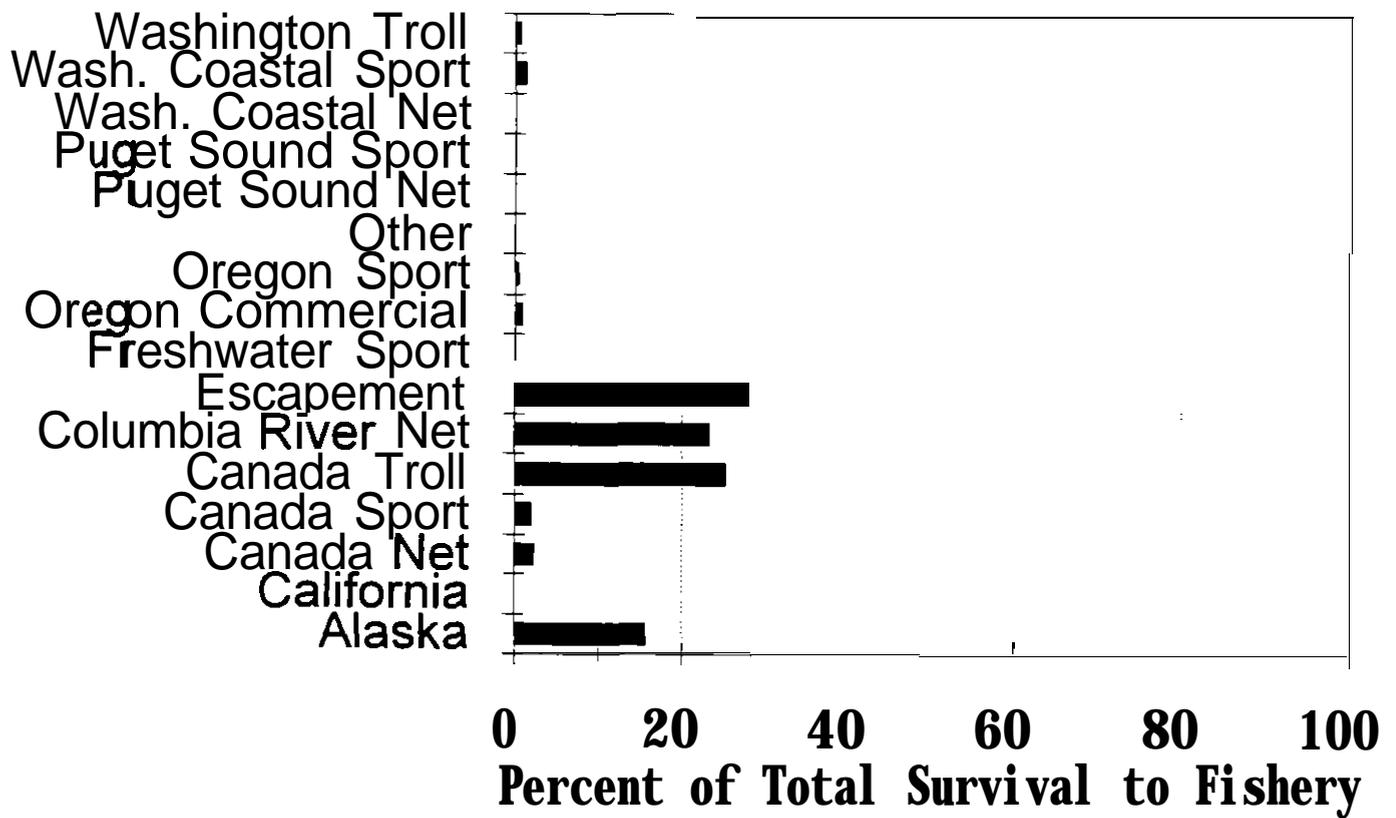


Figure 47. Percent of total survival to fisheries and escapement of Klickitat Hatchery 1986, 1989 and 1990 brood fall chinook.

## Columbia River Spring Chinook Klickitat Hatchery, Yearlings

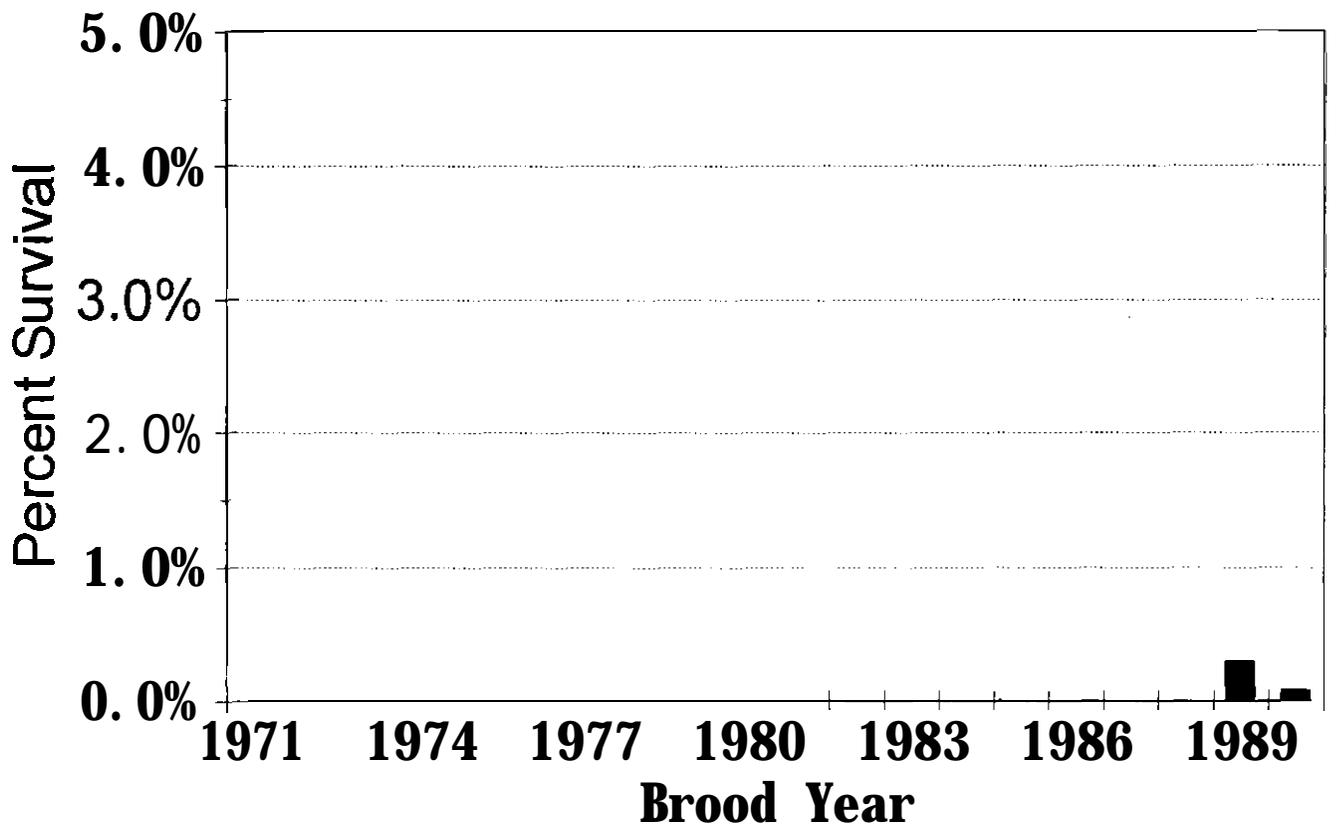


Figure 48. Survival by brood of Klickitat Hatchery yearling spring chinook.

# Columbia River Spring Chinook Klickitat Hatchery

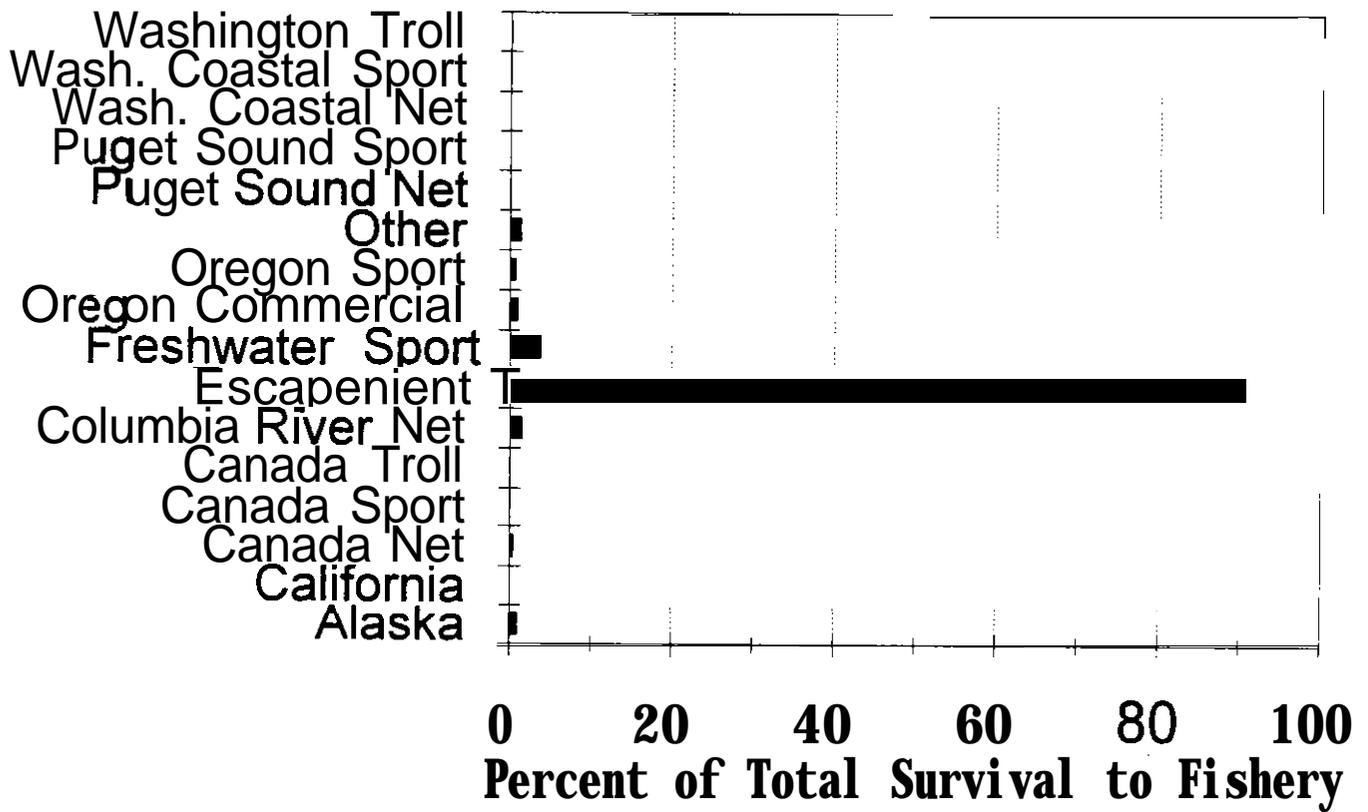


Figure 49. Percent of total survival to fisheries and escapement of Klickitat Hatchery 1989 brood yearling spring chinook.

## Columbia River Type N Coho Klickitat Hatchery, On-Station Release

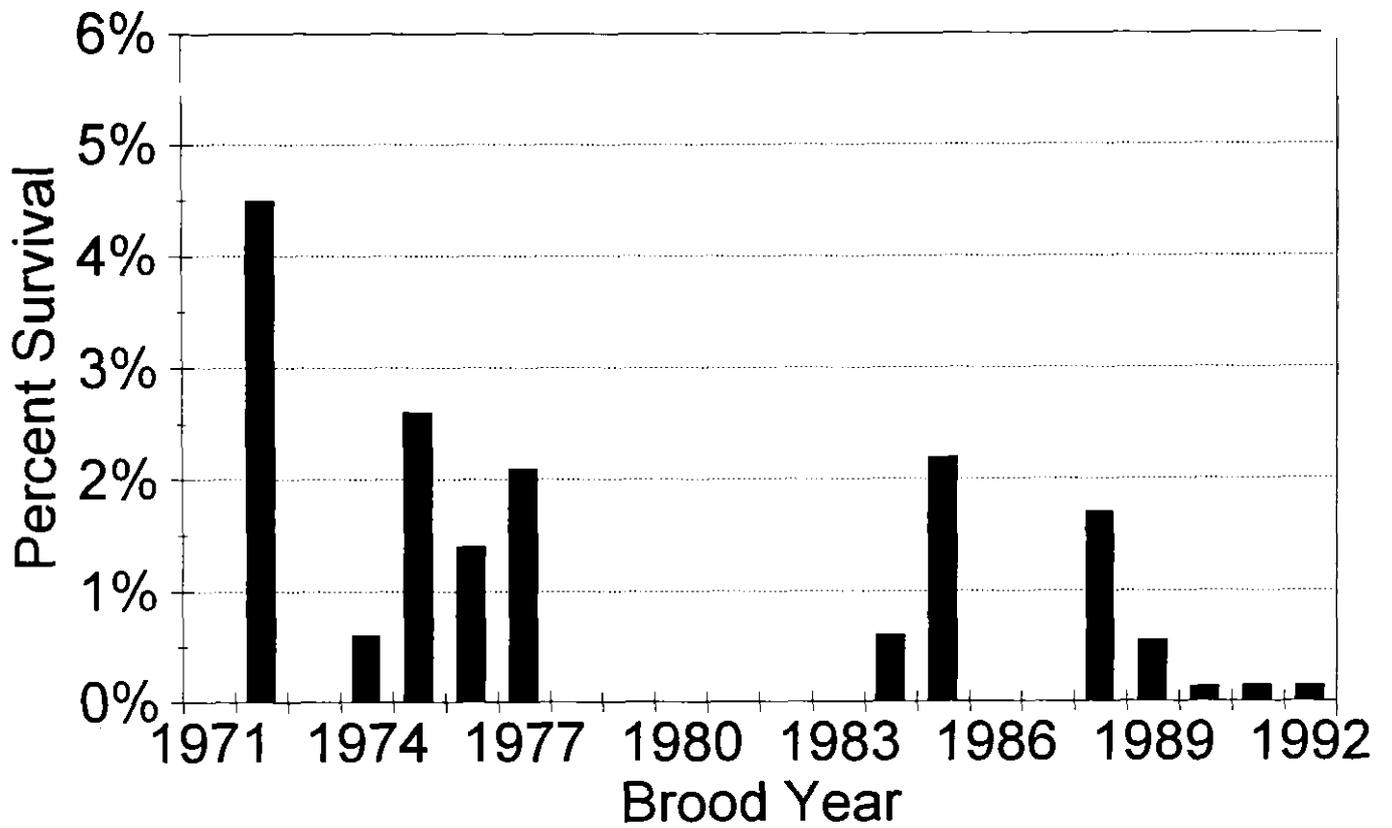


Figure 50. Survival by brood of Klickitat Hatchery Type N coho.

## Columbia River Type N Coho Klickitat Hatchery

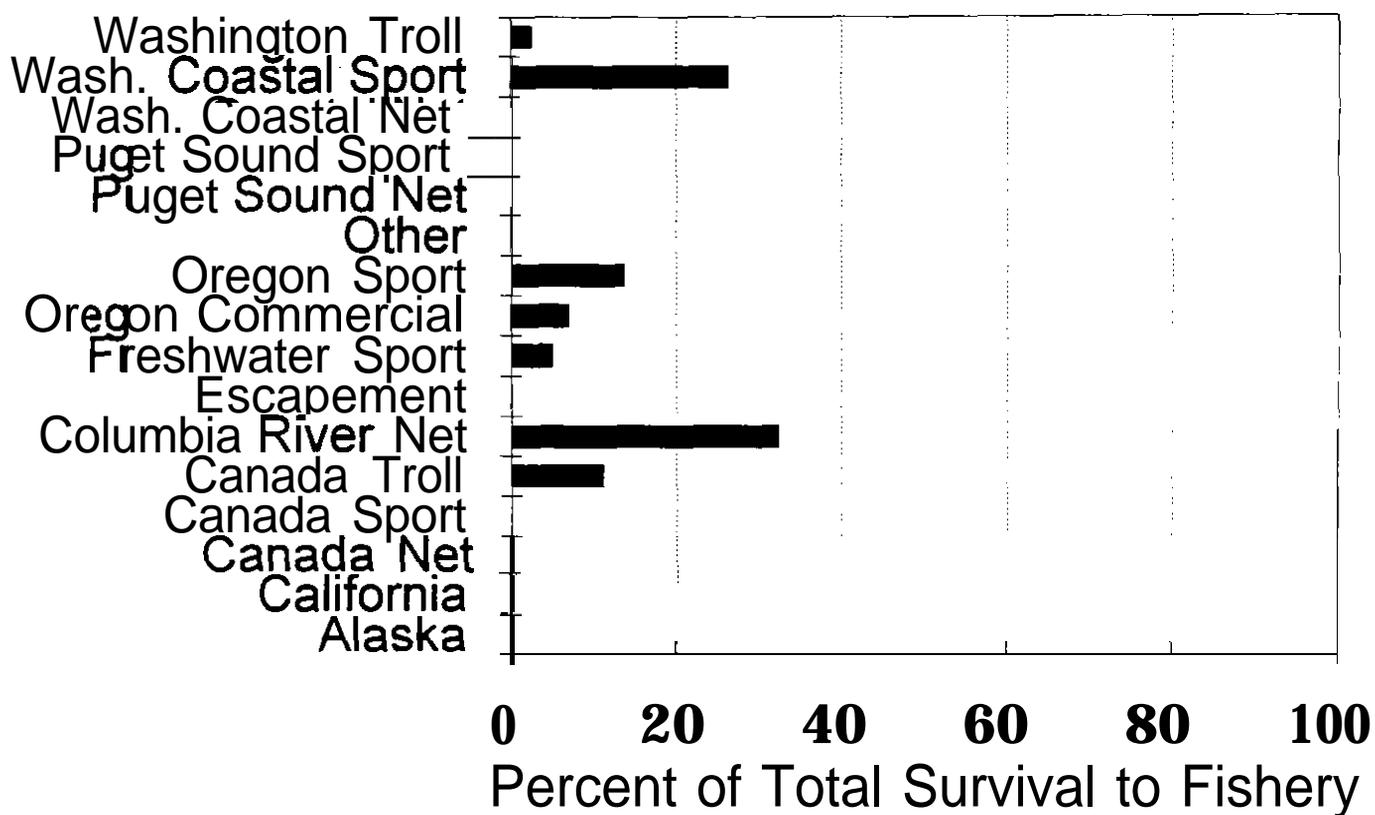


Figure 51. Percent of total survival to fisheries and escapement of Klickitat Hatchery 1988-1992 broods Type N coho.

## Columbia River Fall Chinook Lyons Ferry Hatchery, Subyearlings

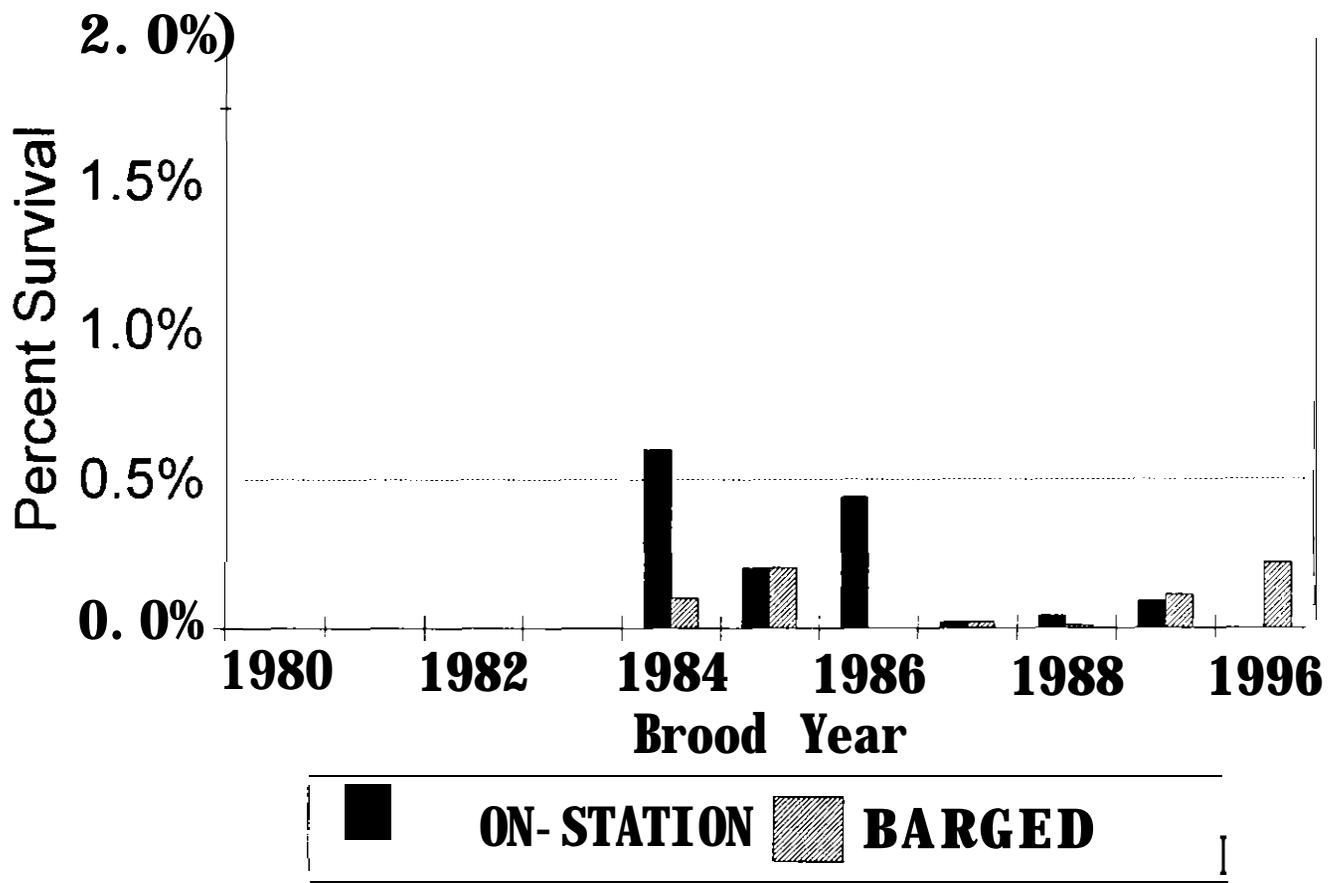


Figure 52. Survival by brood of Lyons Ferry Hatchery subyearling fall chinook released on-station or barged downstream.

# Columbia River Fall Chinook Lyons Ferry Hatchery, Yearlings

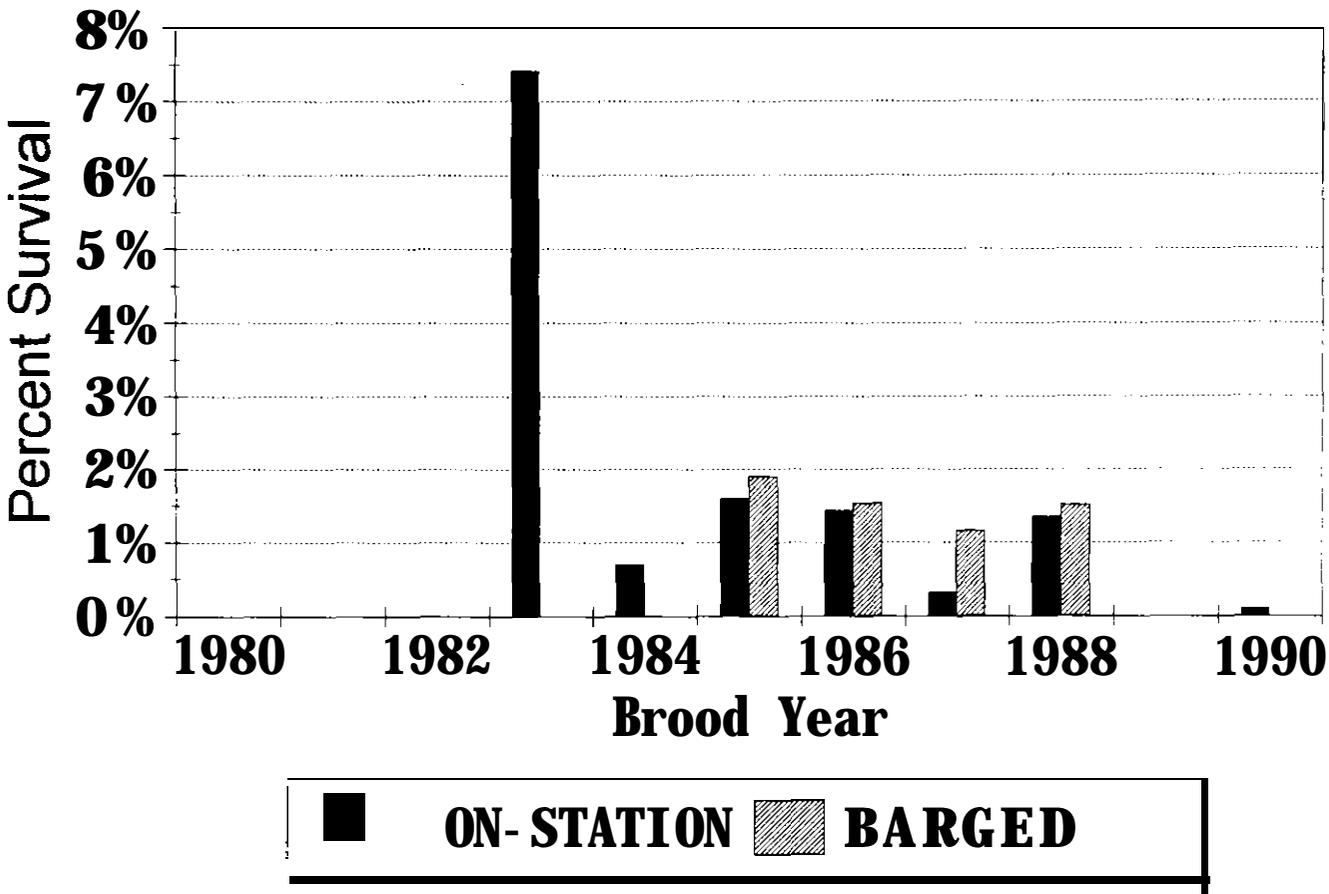


Figure 53. Survival by brood of Lyons Ferry Hatchery yearling fall chinook released on-station or barged downstream.

# Columbia River Fall Chinook

## Lyons Ferry Hatchery, SY, On-station

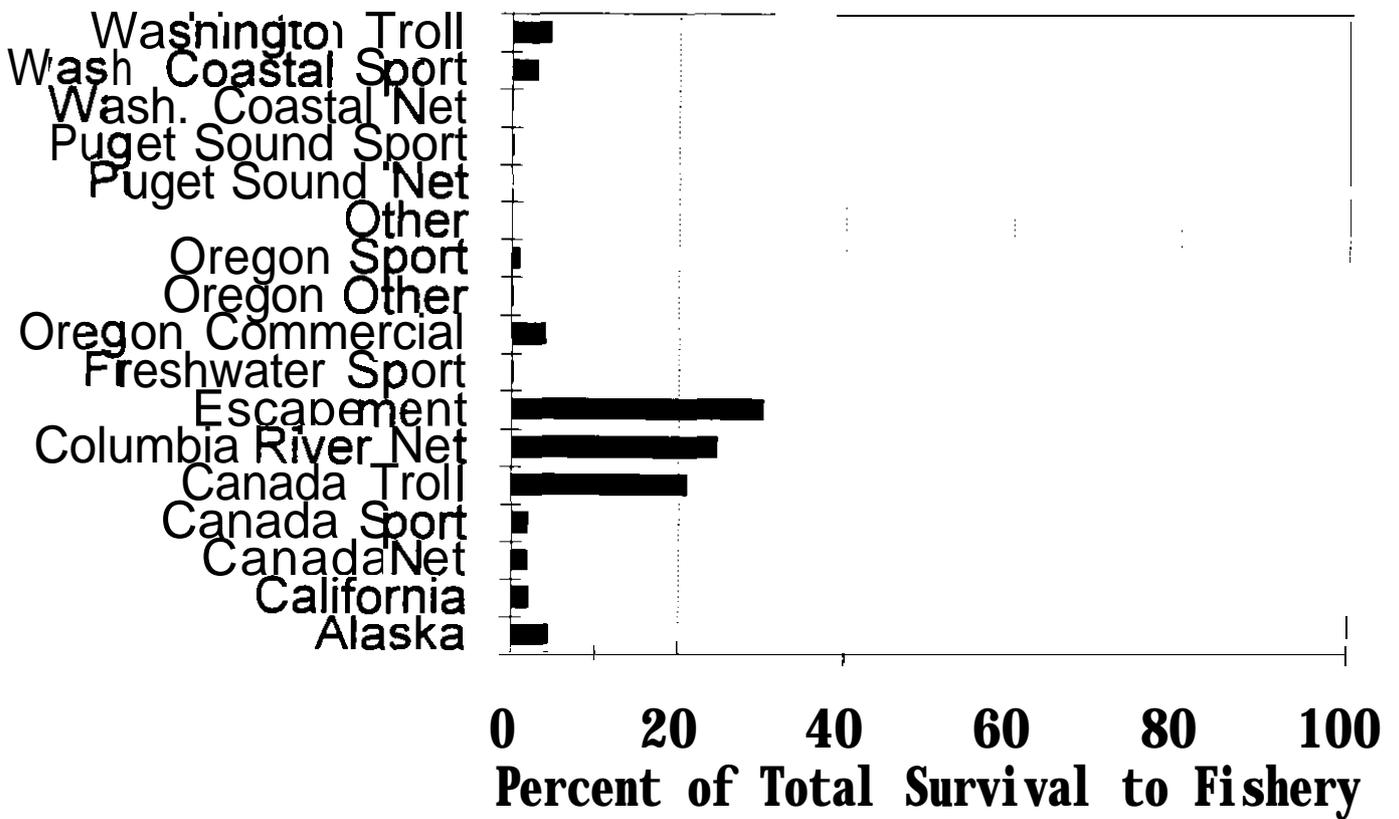


Figure 54. Percent of total survival to fisheries and escapement of Lyons Ferry Hatchery 1966-1990 broods subyearling fall chinook released on-station.

# Columbia River Fall Chinook Lyons Ferry Hatchery, SY, Barged

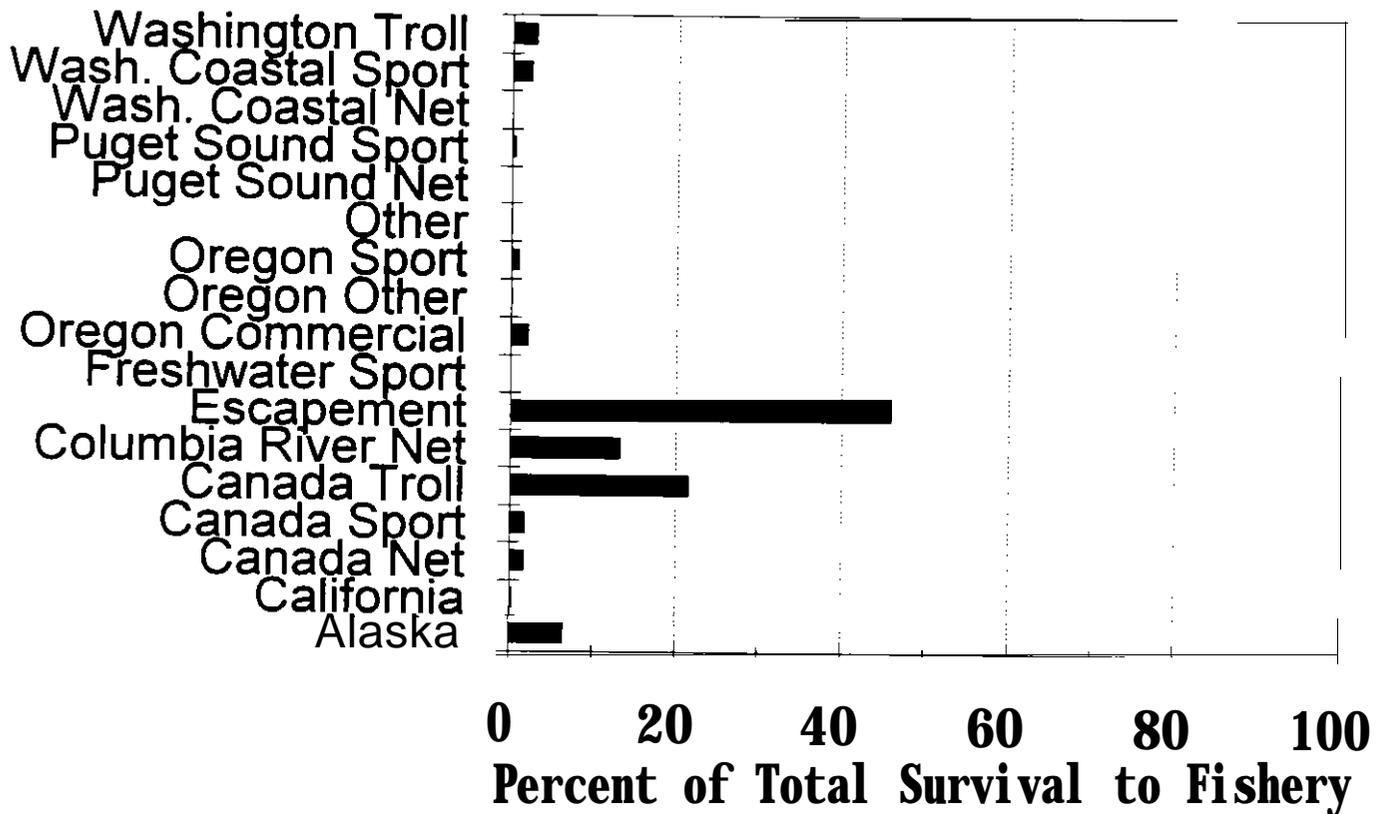


Figure 55. Percent of total survival to fisheries and escapement of Lyons Ferry Hatchery 1986-1990 broods subyearling fall chinook barged downstream.

# Columbia River Fall Chinook

## Lyons Ferry Hatchery, YR, On-station

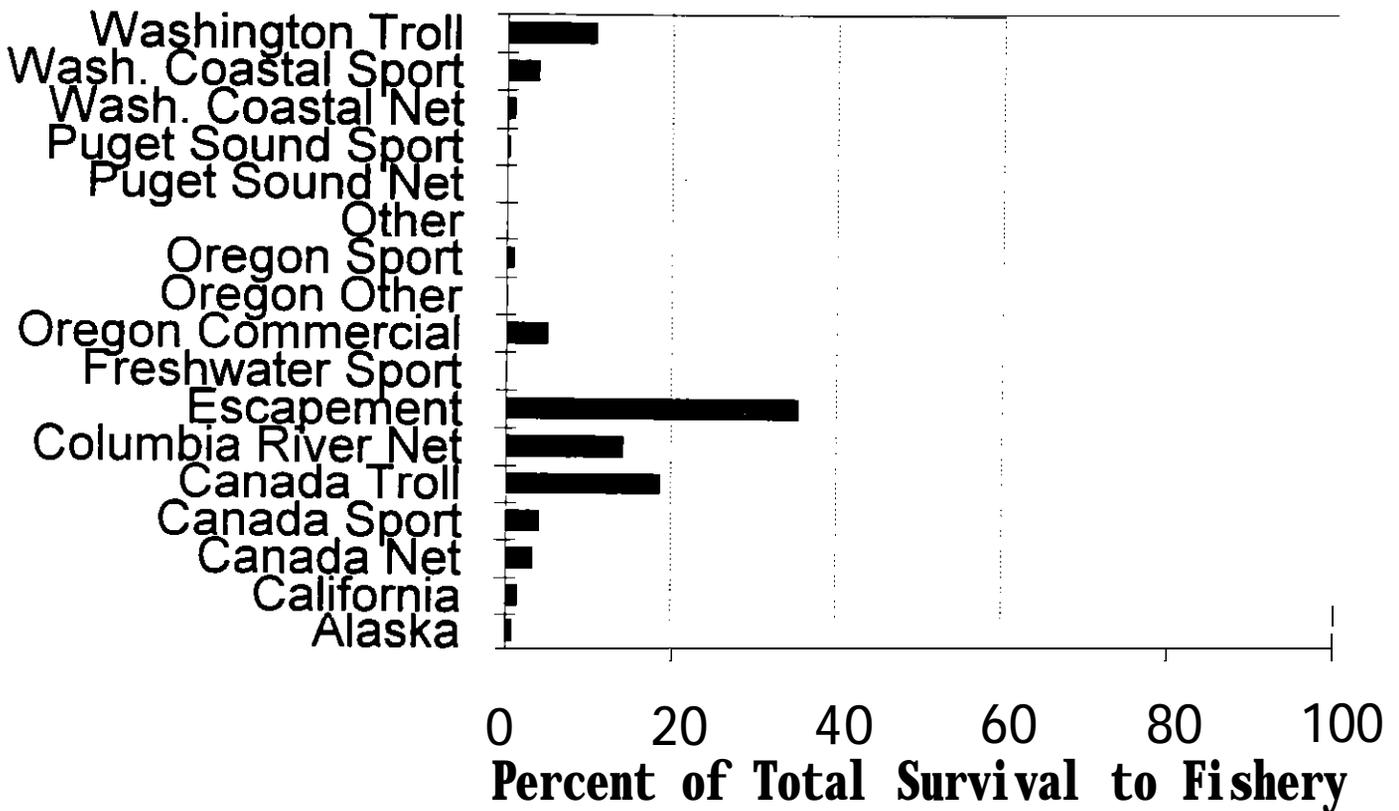


Figure 56. Percent of total survival to fisheries and escapement of Lyons Ferry Hatchery 1986-1988 and 1990 brood yearling fall chinook released on-station.

# Columbia River Fall Chinook

## Lyons Ferry Hatchery, YR, Barged

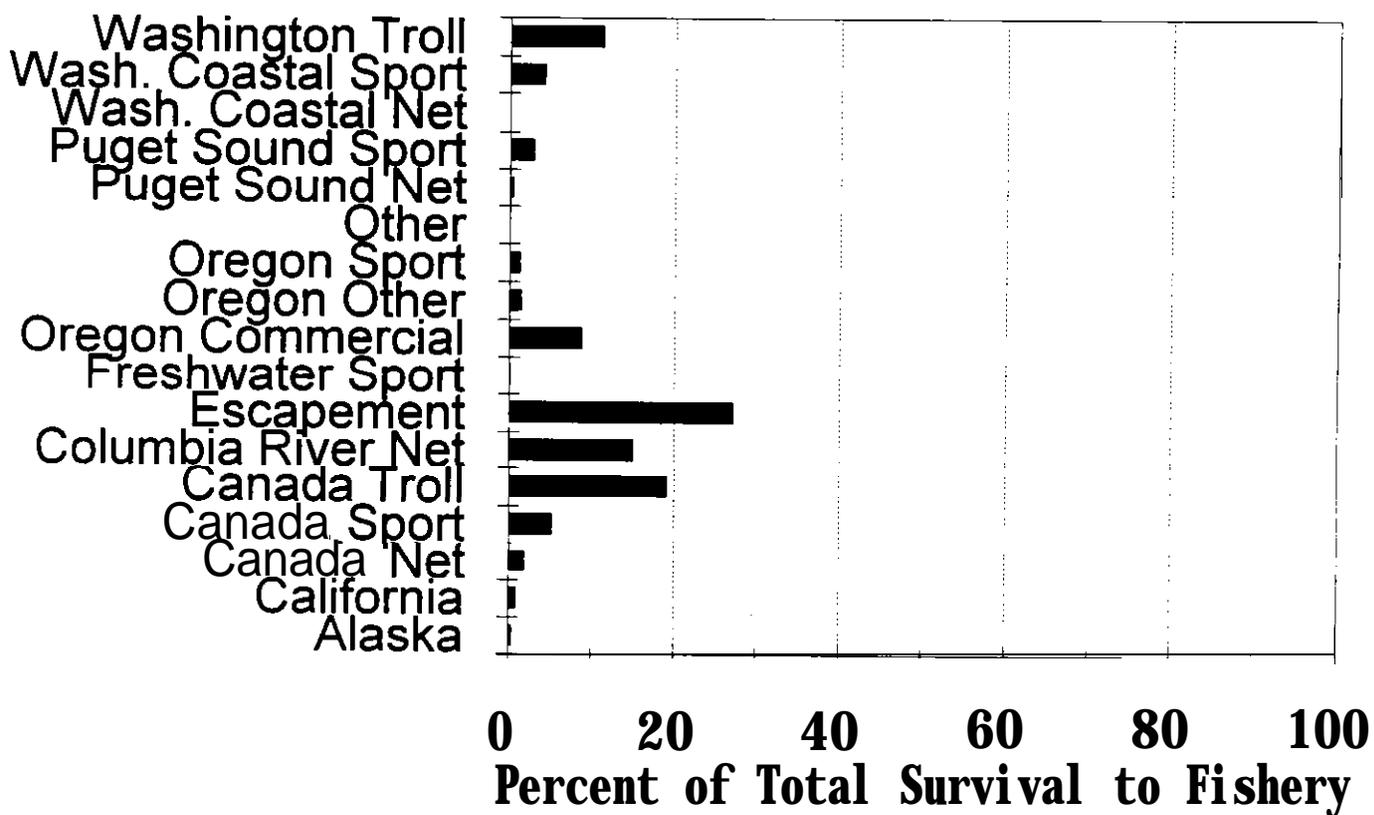


Figure 57. Percent of total survival to fisheries and escapement of Lyons Ferry Hatchery 1986-1988 broods yearling fall chinook barged downstream.

## Columbia River Spring Chinook Tucannon Hatchery, Yearlings

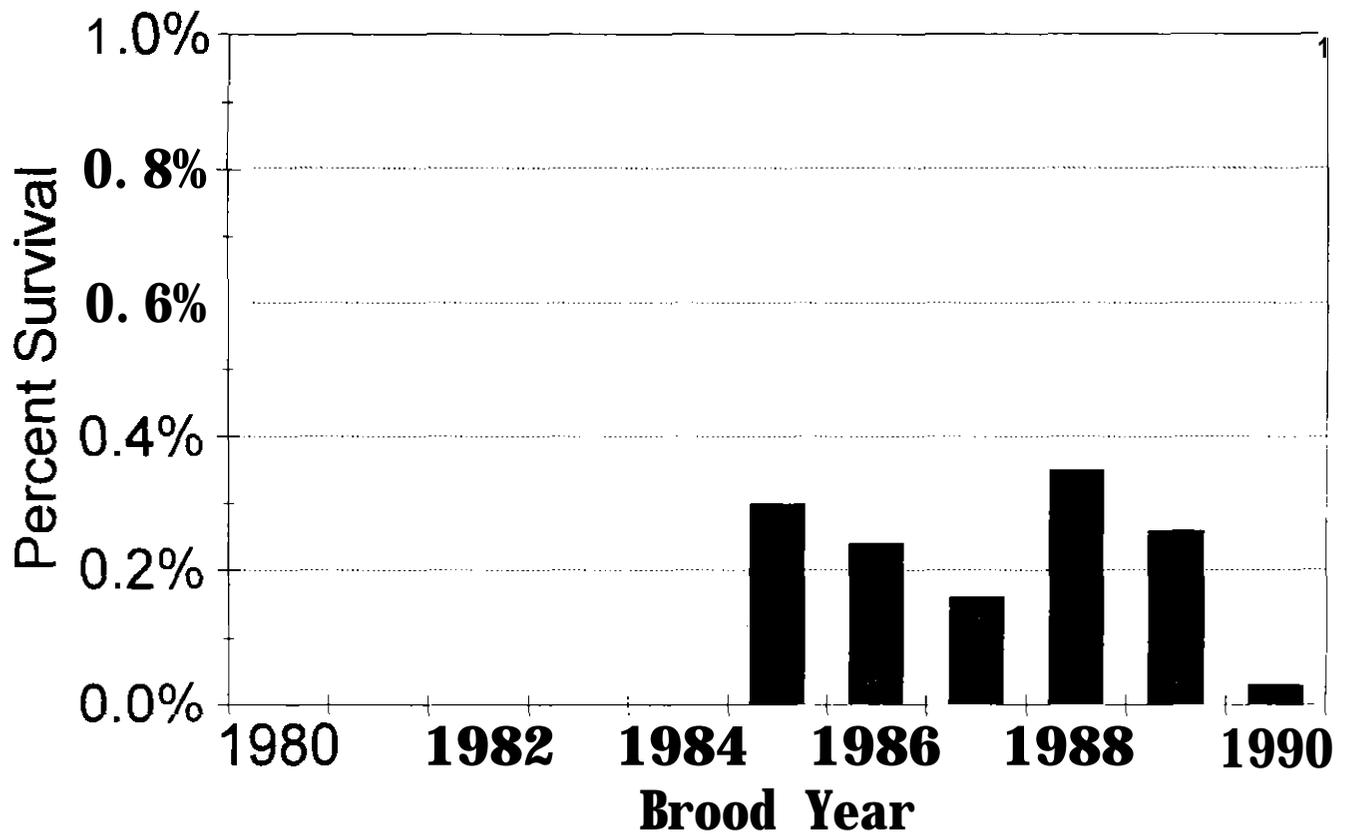


Figure 58. Survival by brood of Tucannon Hatchery spring chinook.

# Columbia River Spring Chinook Tucannon Hatchery

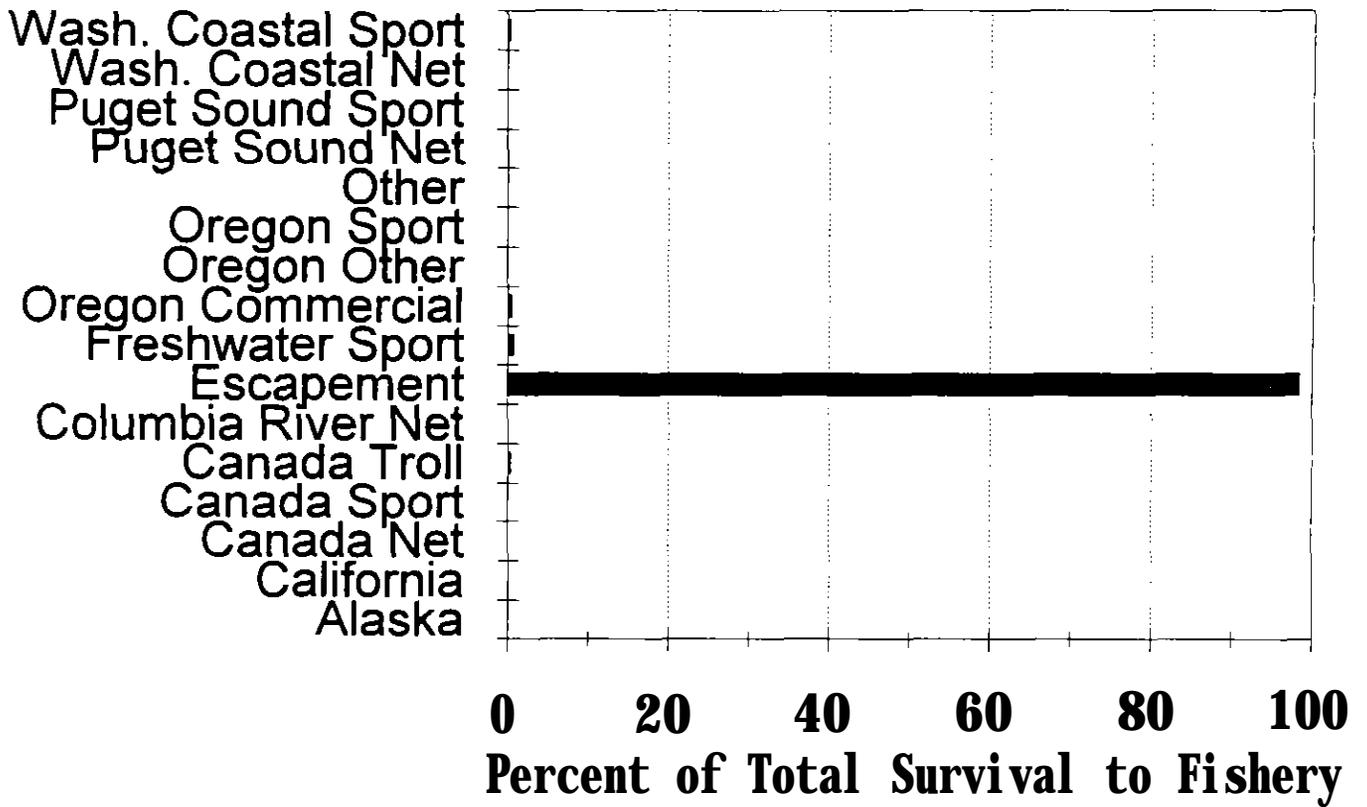


Figure 69. Percent of total survival to fisheries and escapement of Tucannon Hatchery 1986-1990 broods spring chinook.

## Columbia River Spring Chinook Ringold Hatchery, Yearlings

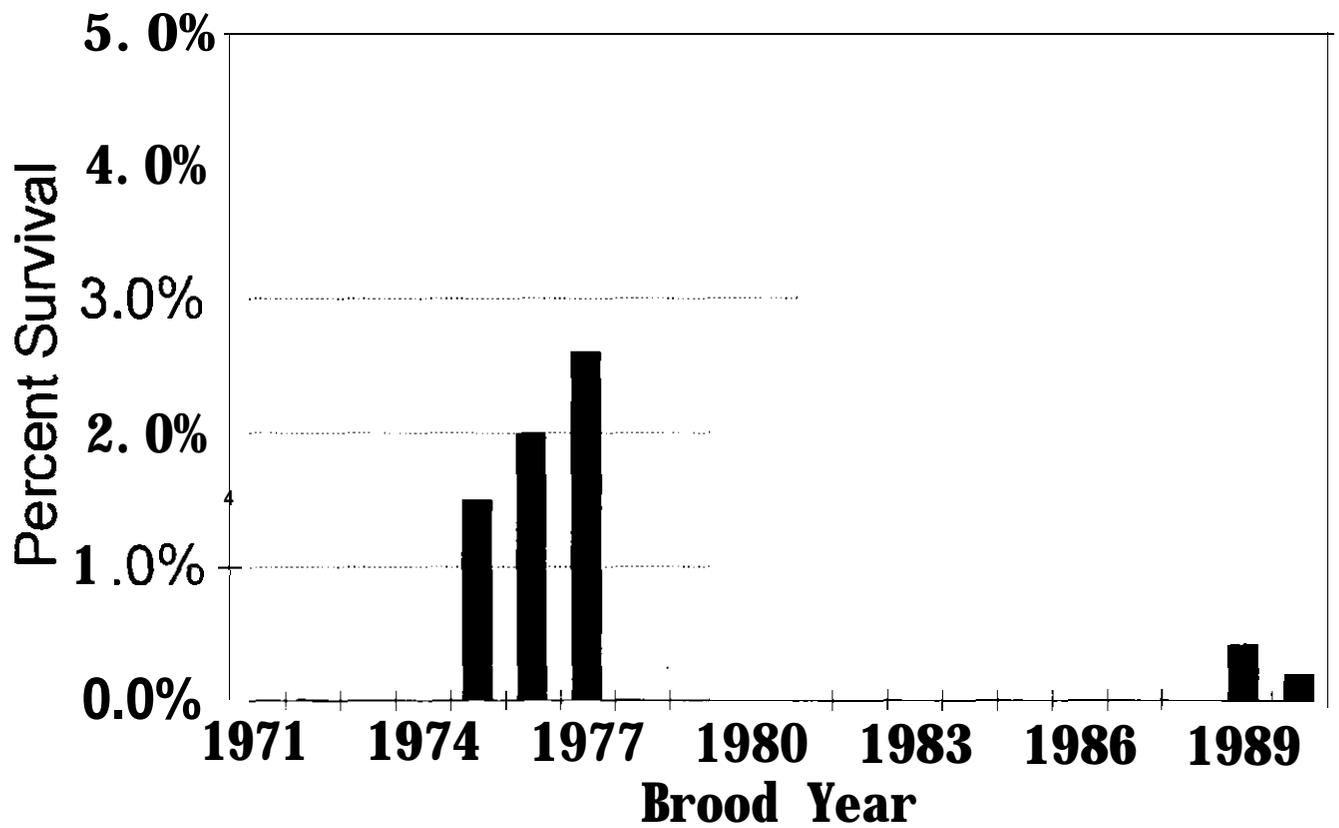


Figure 60. Survival by brood of Ringold Hatchery spring chinook.

# Columbia River Spring Chinook Ringold Hatchery

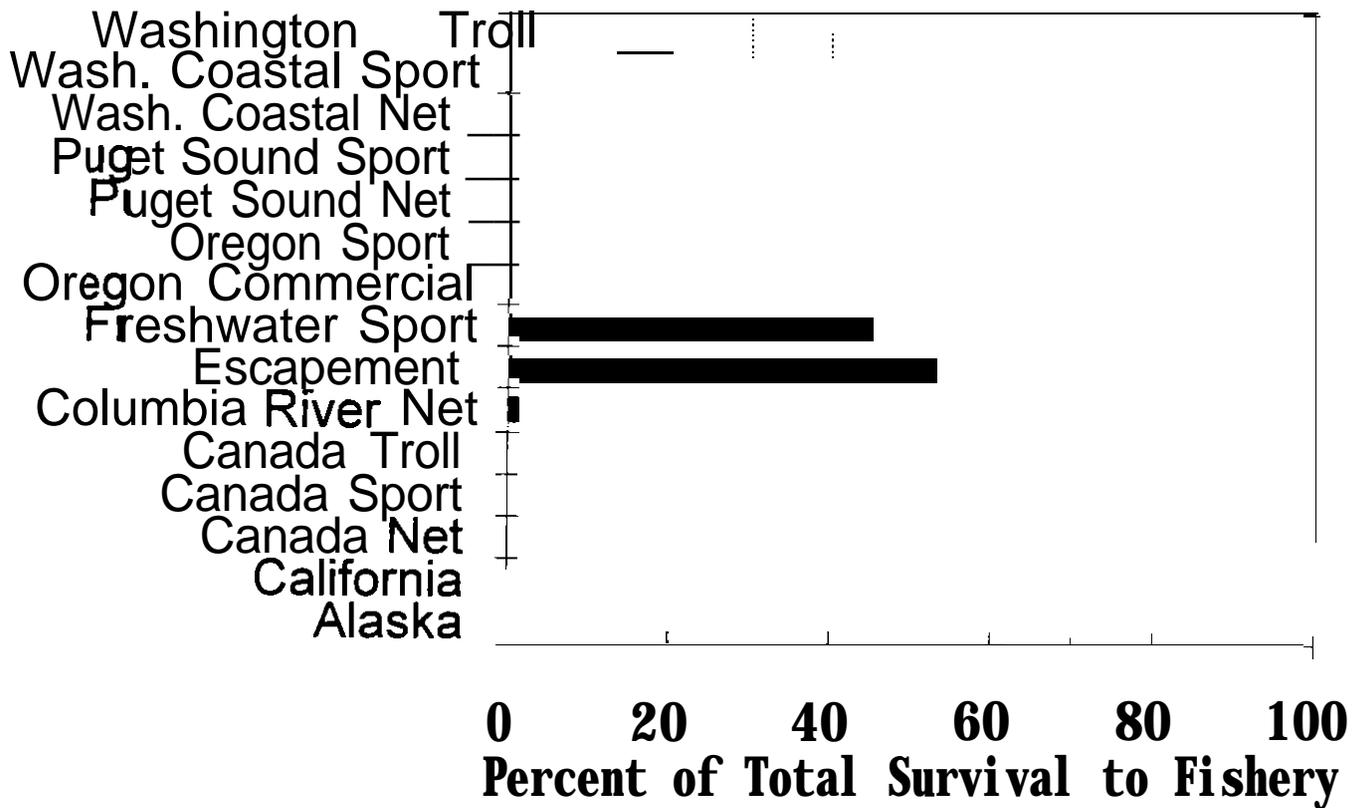
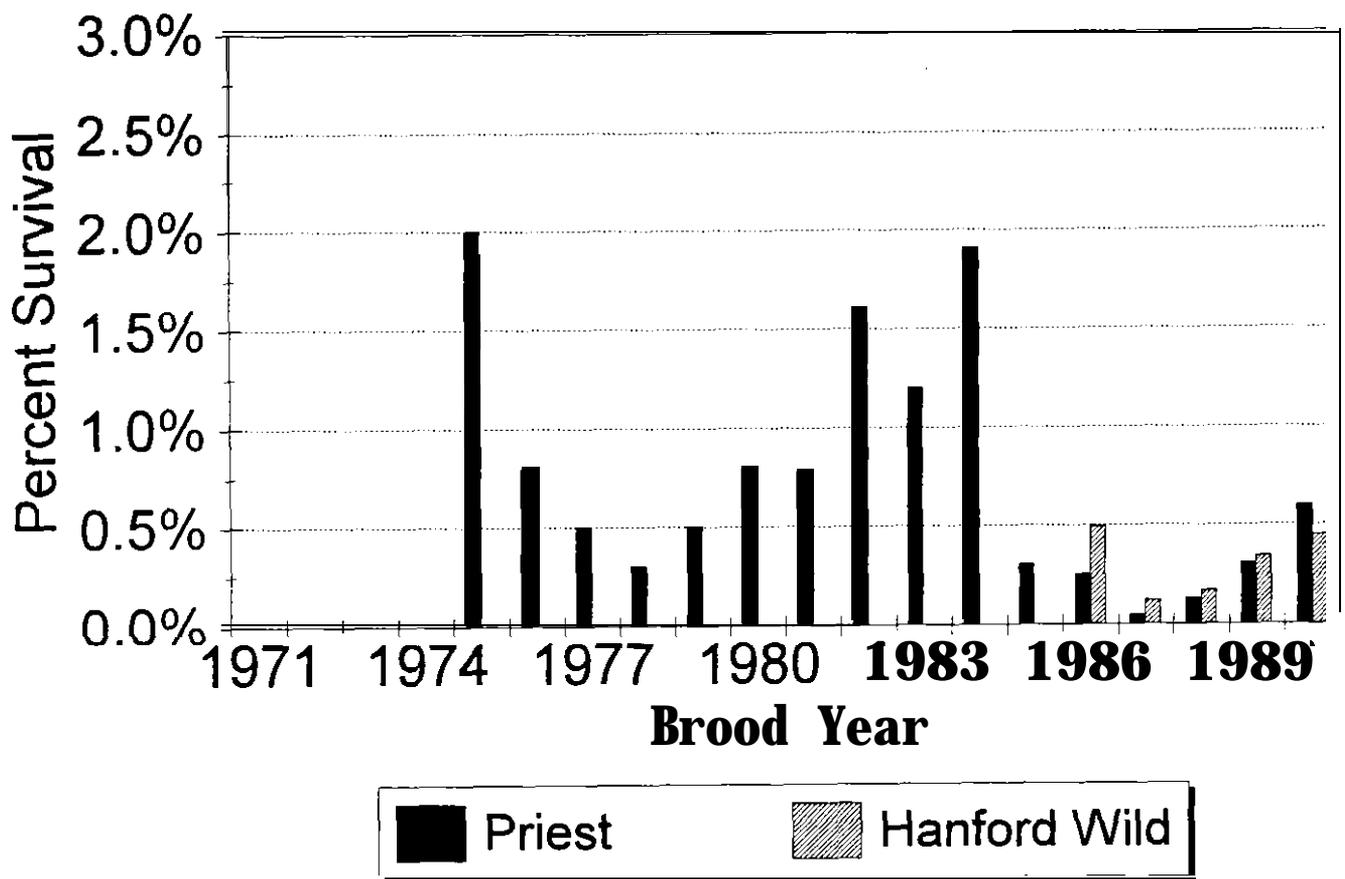


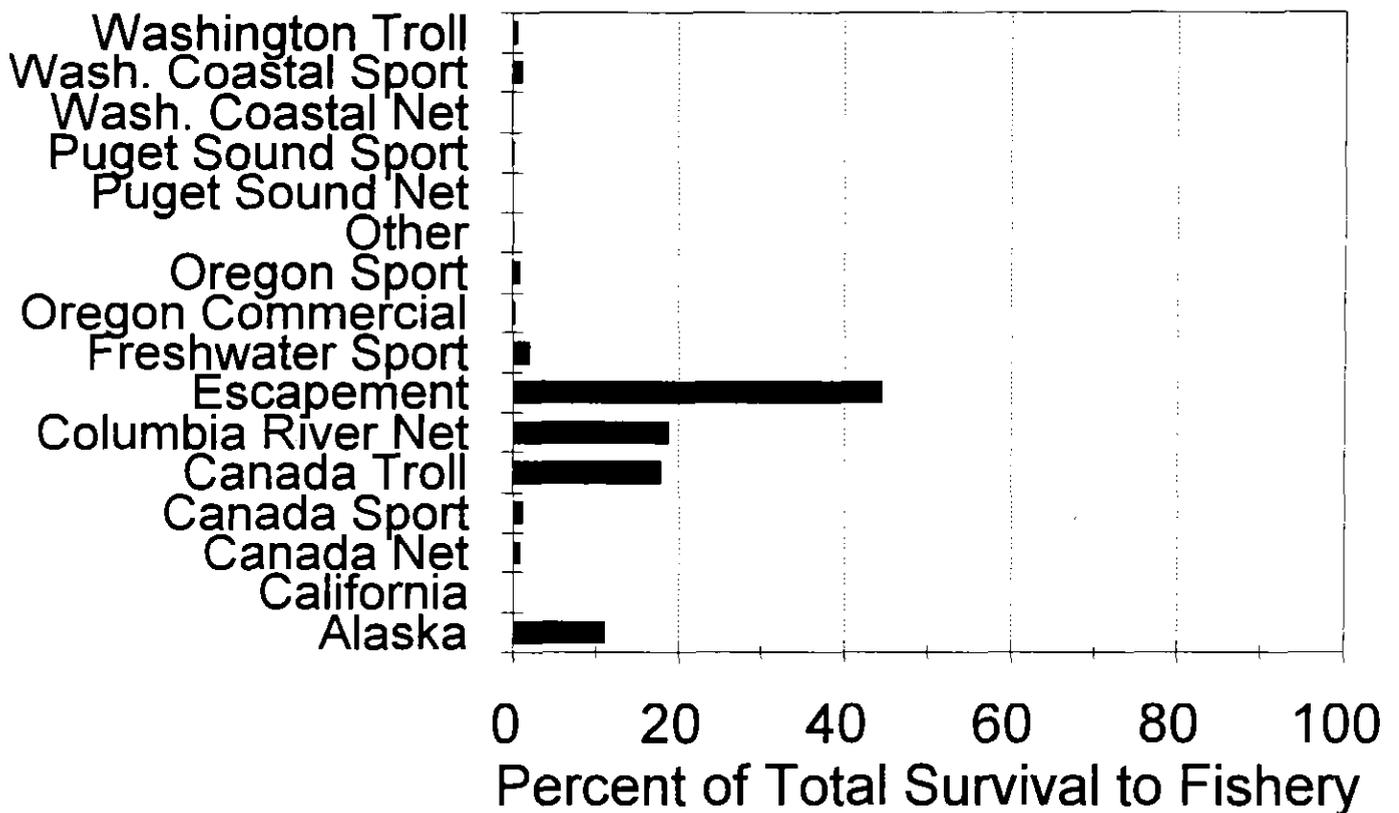
Figure 61. Percent of total survival to fisheries and escapement of Ringold Hatchery 1989 and 1990 brood spring chinook.

## Columbia River Fall Chinook Priest Rapids Hatchery, Hanford Wild



**Figure 62.** Survival by brood of Priest Rapids Hatchery and Hanford Reach wild upriver bright chinook.

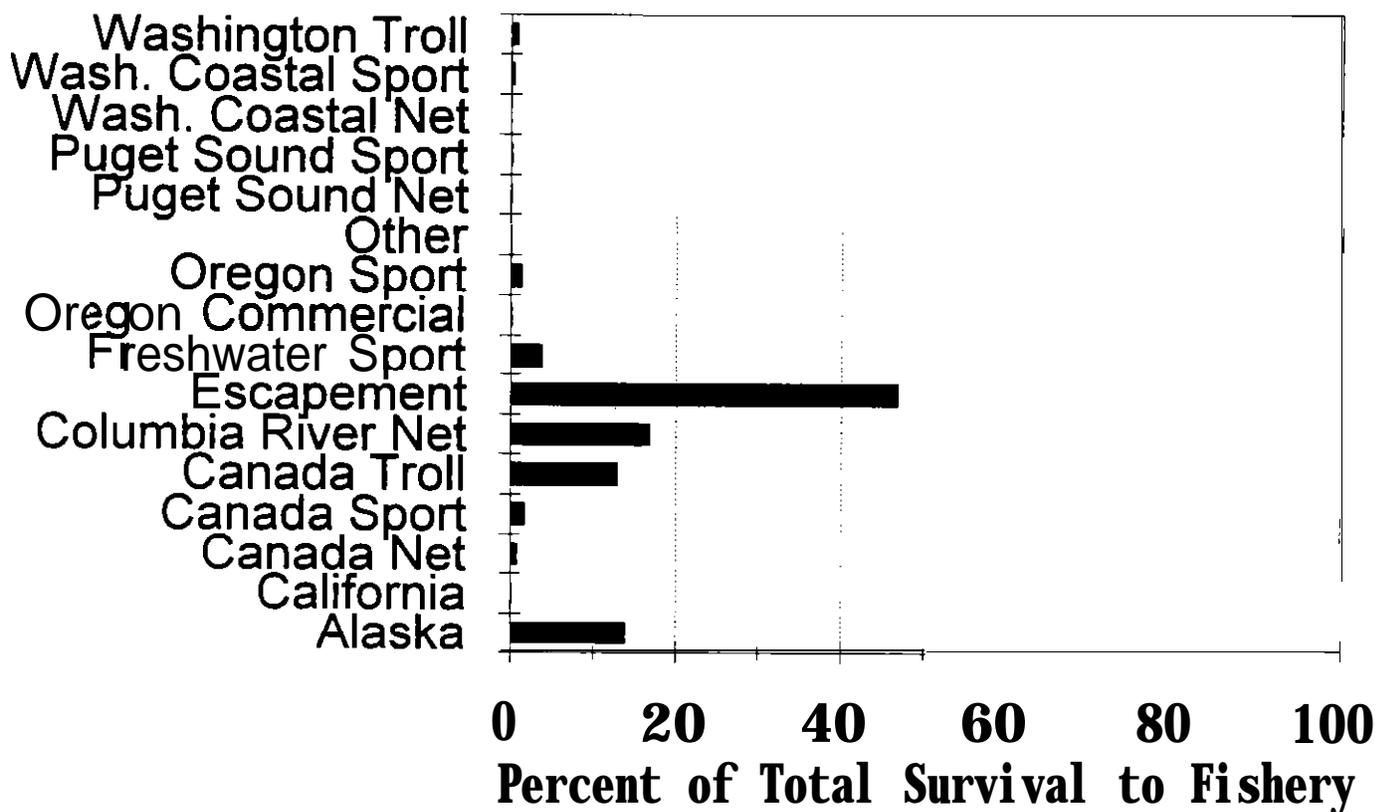
## Columbia River Fall Chinook Priest Rapids Hatchery, Subyearlings



**Figure 63.** Percent of total survival to fisheries and escapement of Priest Rapids Hatchery 1986-1990 broods upriver bright fall chinook.

# Columbia River Fall Chinook

## Hanford Reach



**Figure 64.** Percent of total survival to fisheries and escapement of Hanford Reach 1987-1989 broods upriver bright wild fall chinook.

# Columbia River Fall Chinook Turtle Rock Hatchery, Yearlings

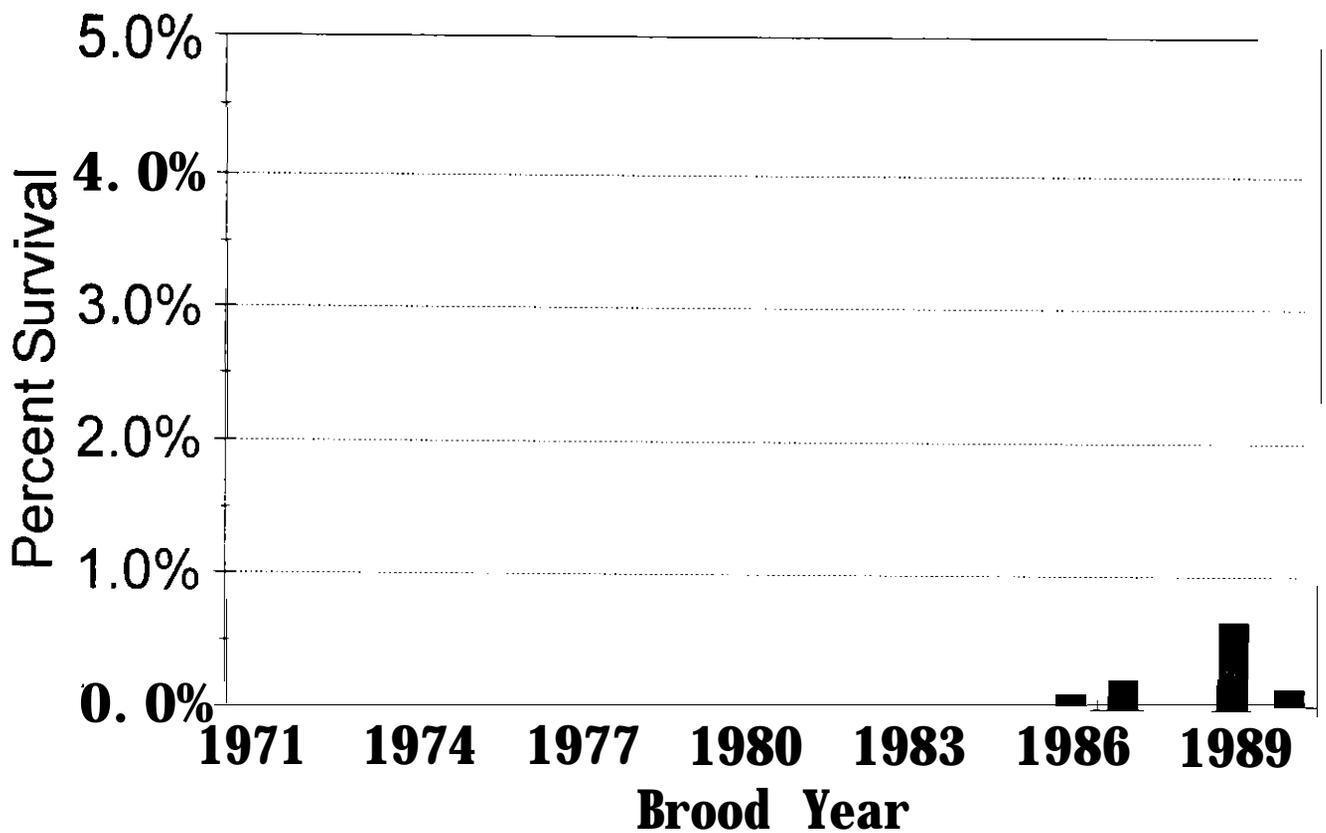


Figure 65. Survival by brood of Turtle Rock Hatchery yearling fall chinook

# Columbia River Fall Chinook Turtle Rock Hatchery, Yearlings

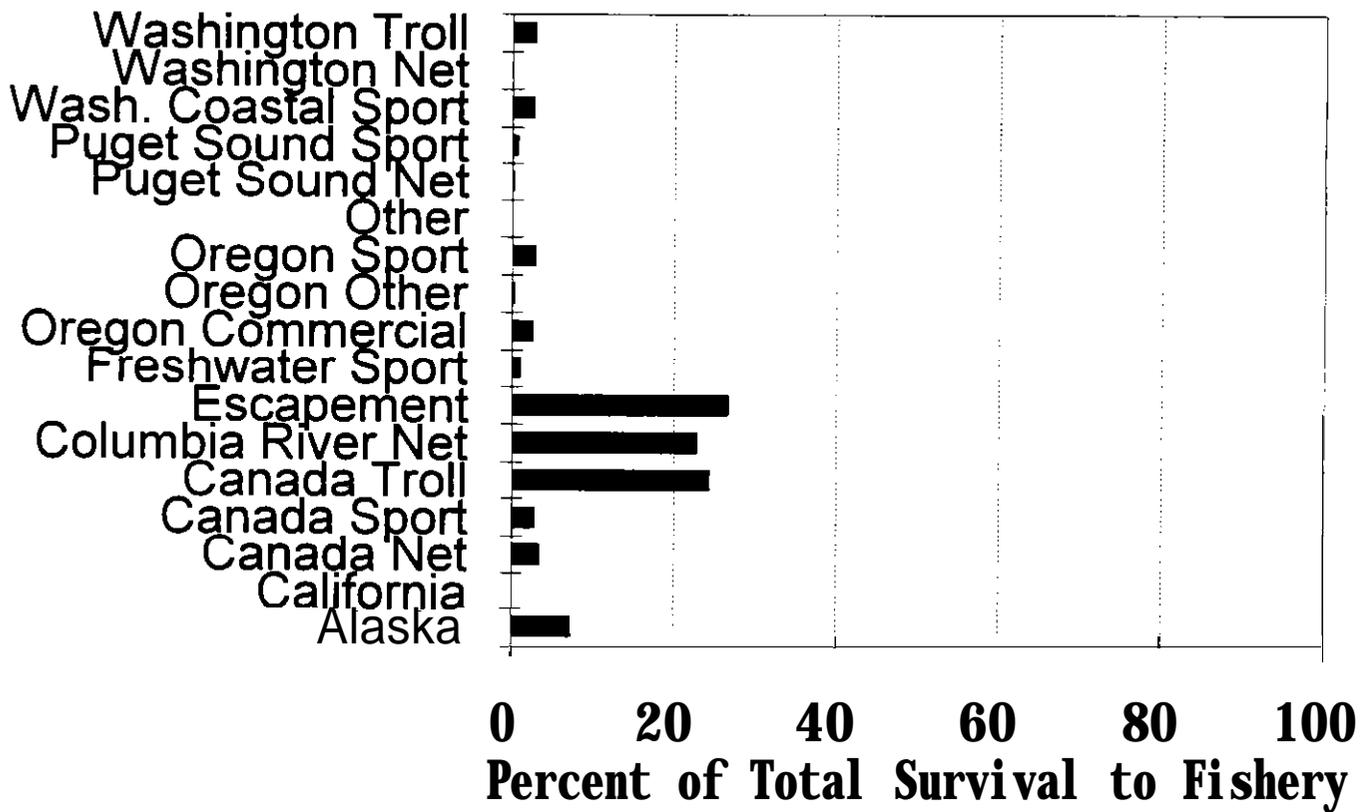


Figure 66. Percent of total survival to fisheries and escapement of Turtle Rock Hatchery 1986, 1987, 1989 and 1990 brood yearling fall chinook.

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## Columbia River Type S Coho Turtle Rock Hatchery

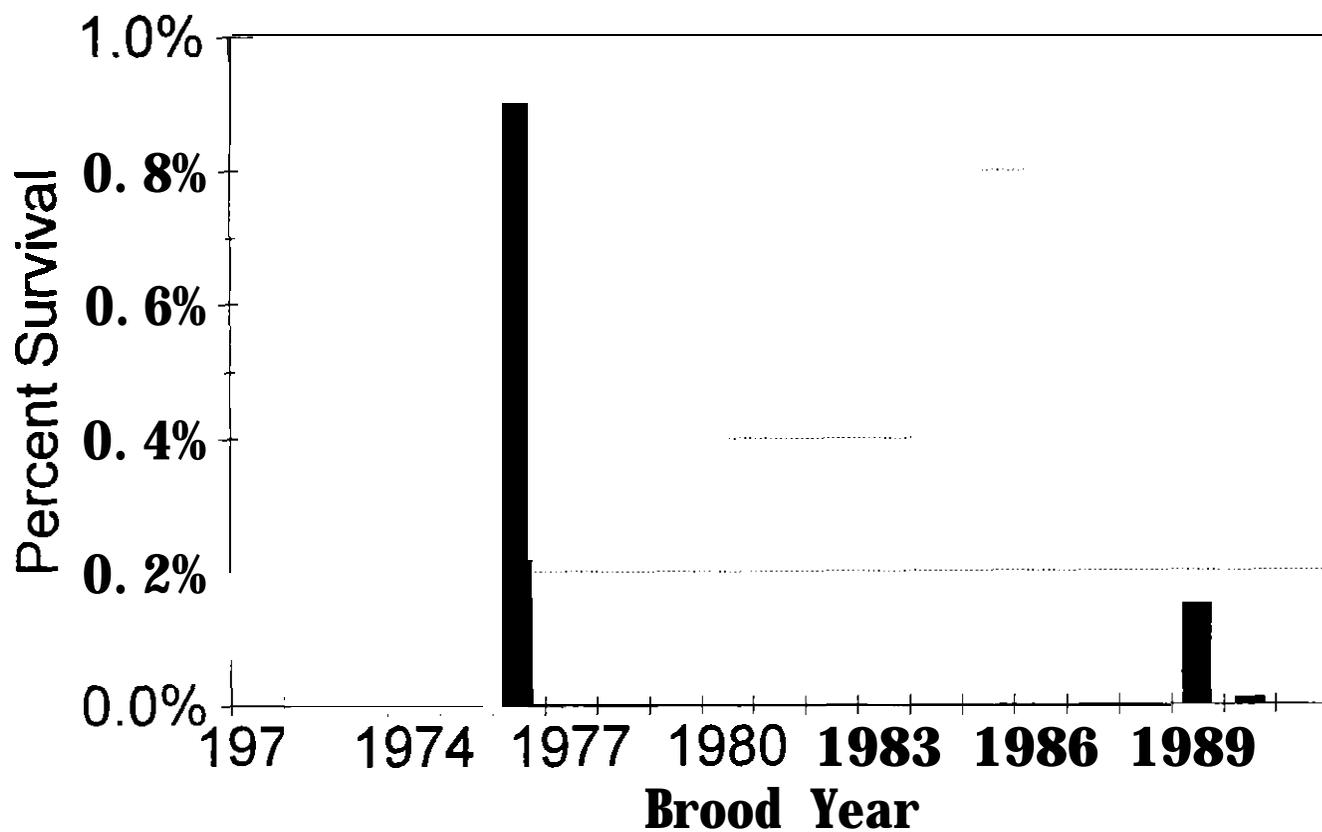


Figure 67. Survival by brood of Turtle Rock Hatchery Type S coho.

## Columbia River Type S Coho Turtle Rock Hatchery

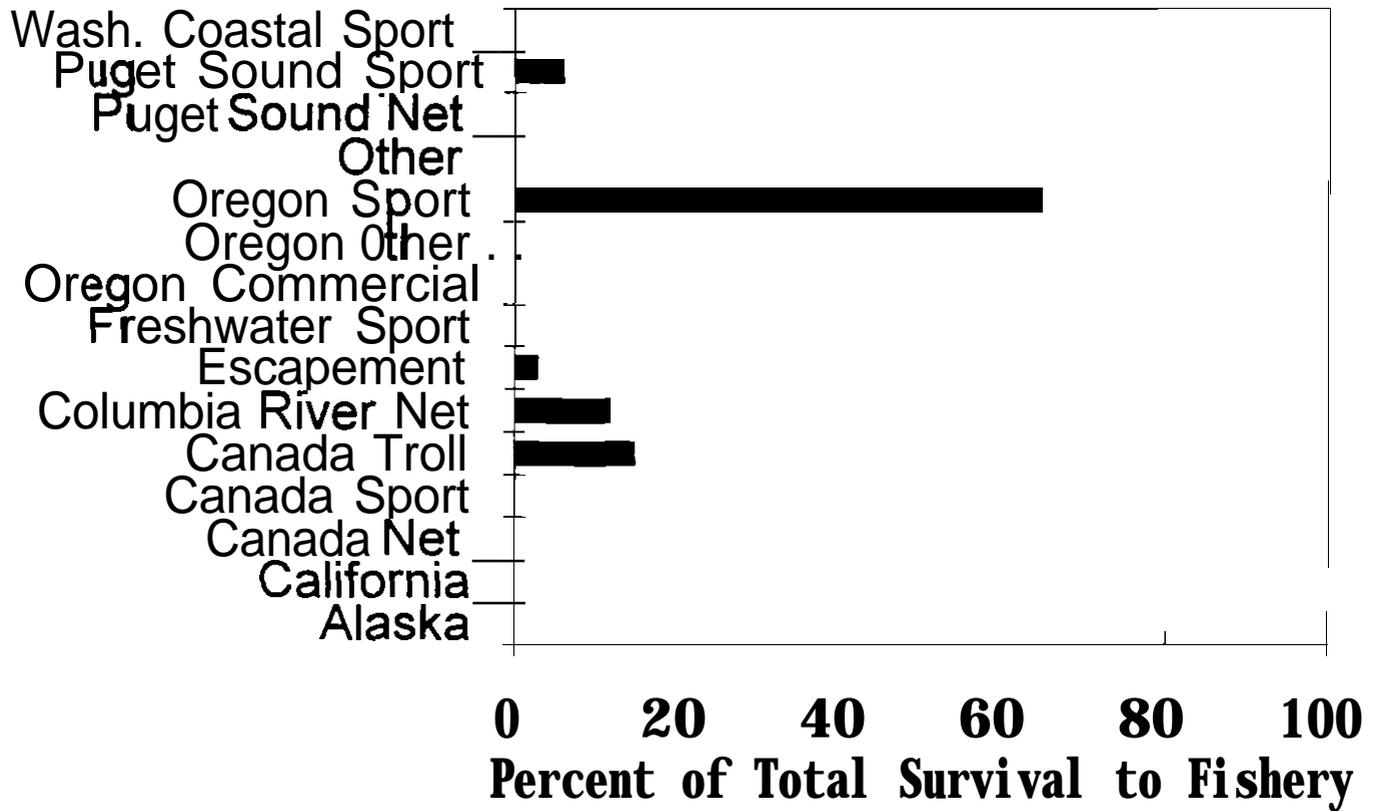


Figure 68. Percent of total survival to fisheries and escapement of Turtle Rock Hatchery 1989 and 1991 broods Type S coho.

## Columbia River Spring Chinook Chiwawa Pond, Yearlings

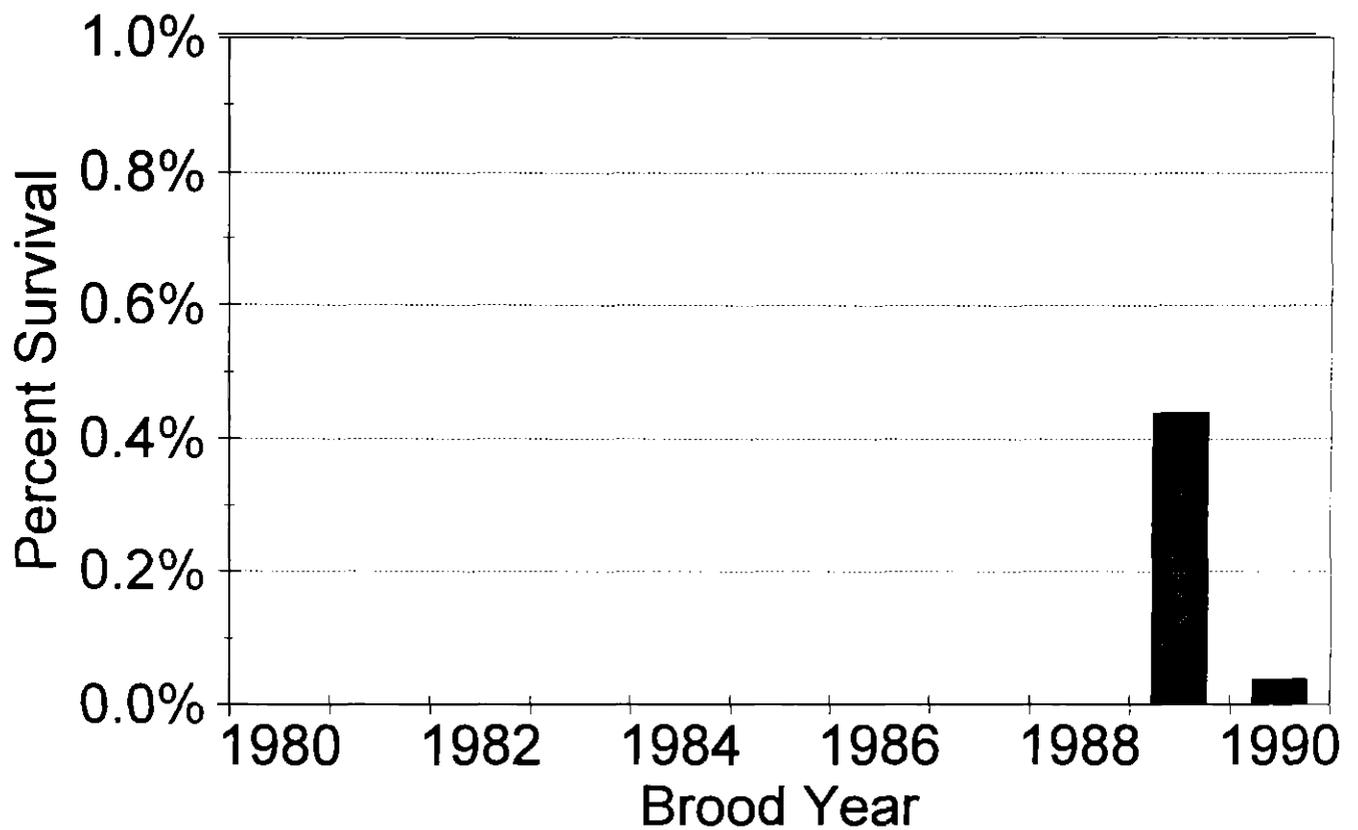


Figure 69. Survival by brood of Chiwawa Rearing Ponds yearling spring chinook.

# Columbia River Spring Chinook

## Chiwawa Pond, Yearlings

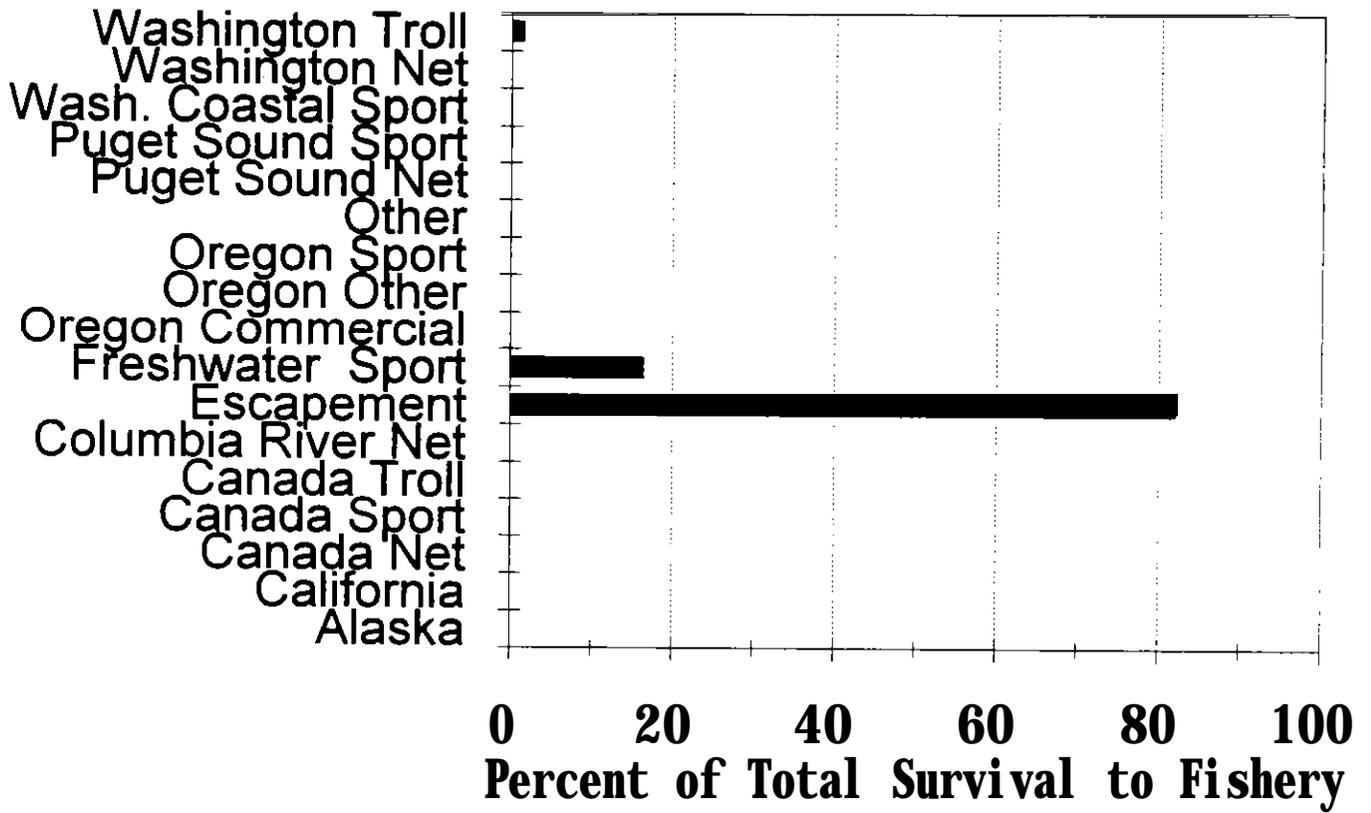


Figure 70. Percent of total survival to fisheries and escapement of Chiwawa Rearing Ponds 1989 and 1990 brood spring chinook.

## Columbia River Summer Chinook Dryden Pond, Yearlings

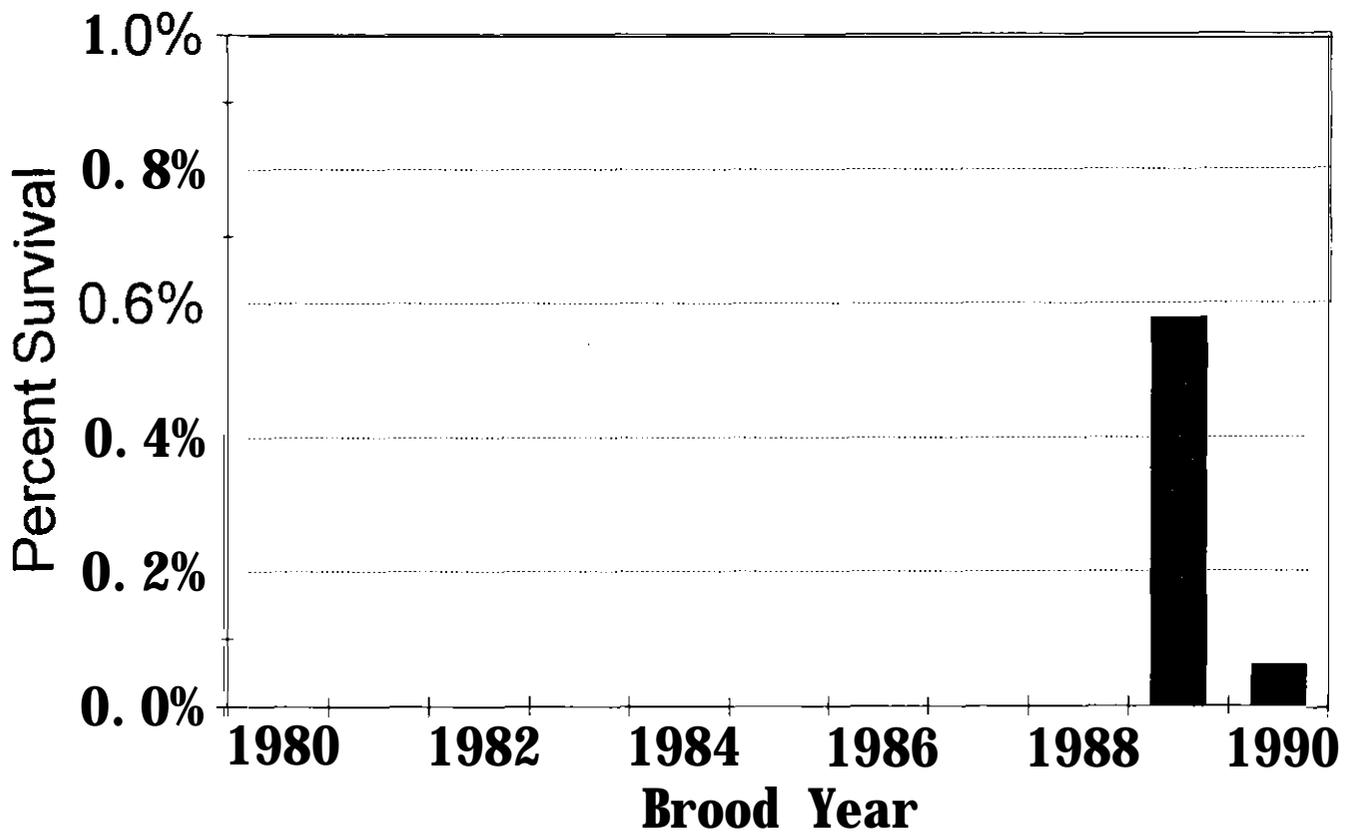
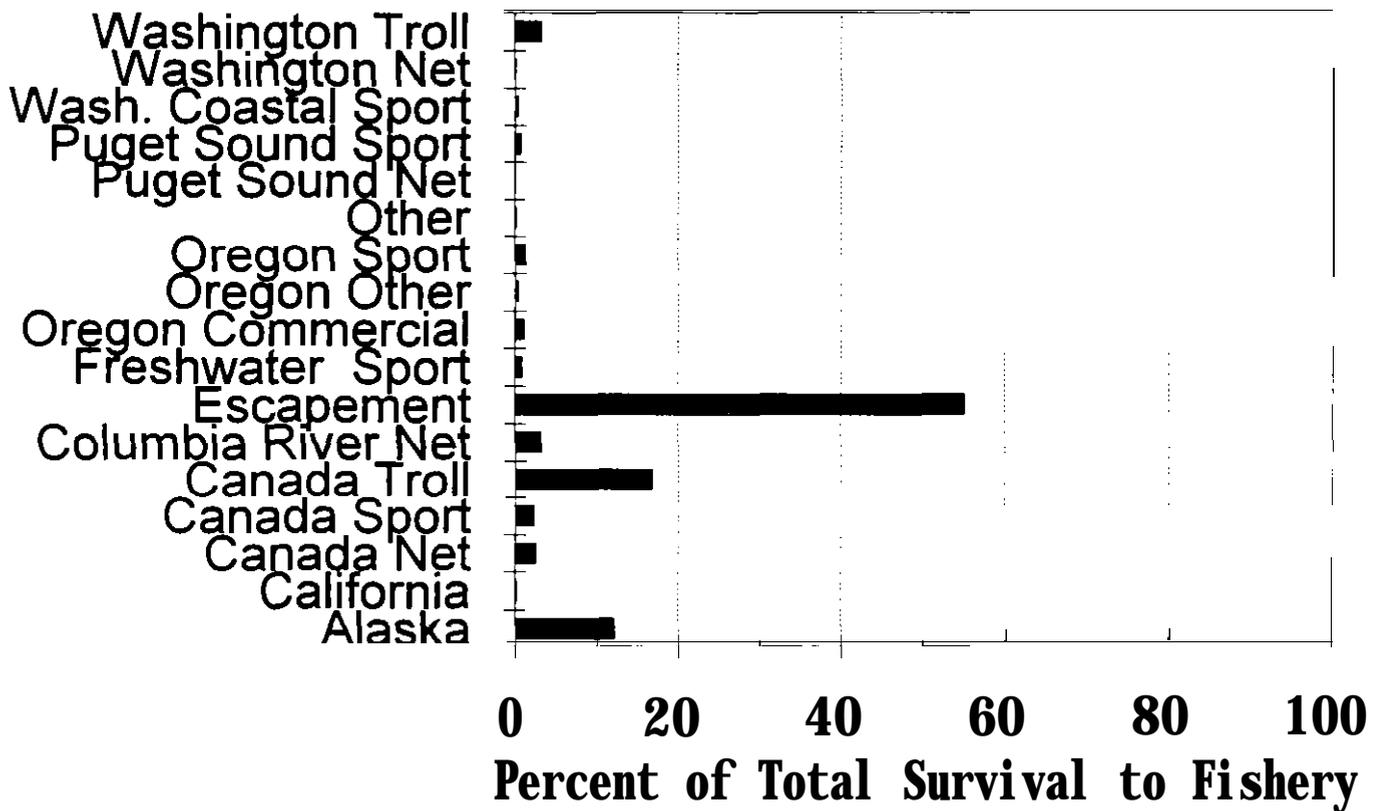


Figure 71. Survival by brood of Dryden Rearing Pond yearling summer chinook.

# Columbia River Summer Chinook Dryden Pond, Yearlings



**Figure 72.** Percent of total survival to fisheries and escapement of Dryden Rearing Pond 1989 and 1990 brood yearling summer chinook.

## Columbia River Summer Chinook Similkameen Pond, Yearlings

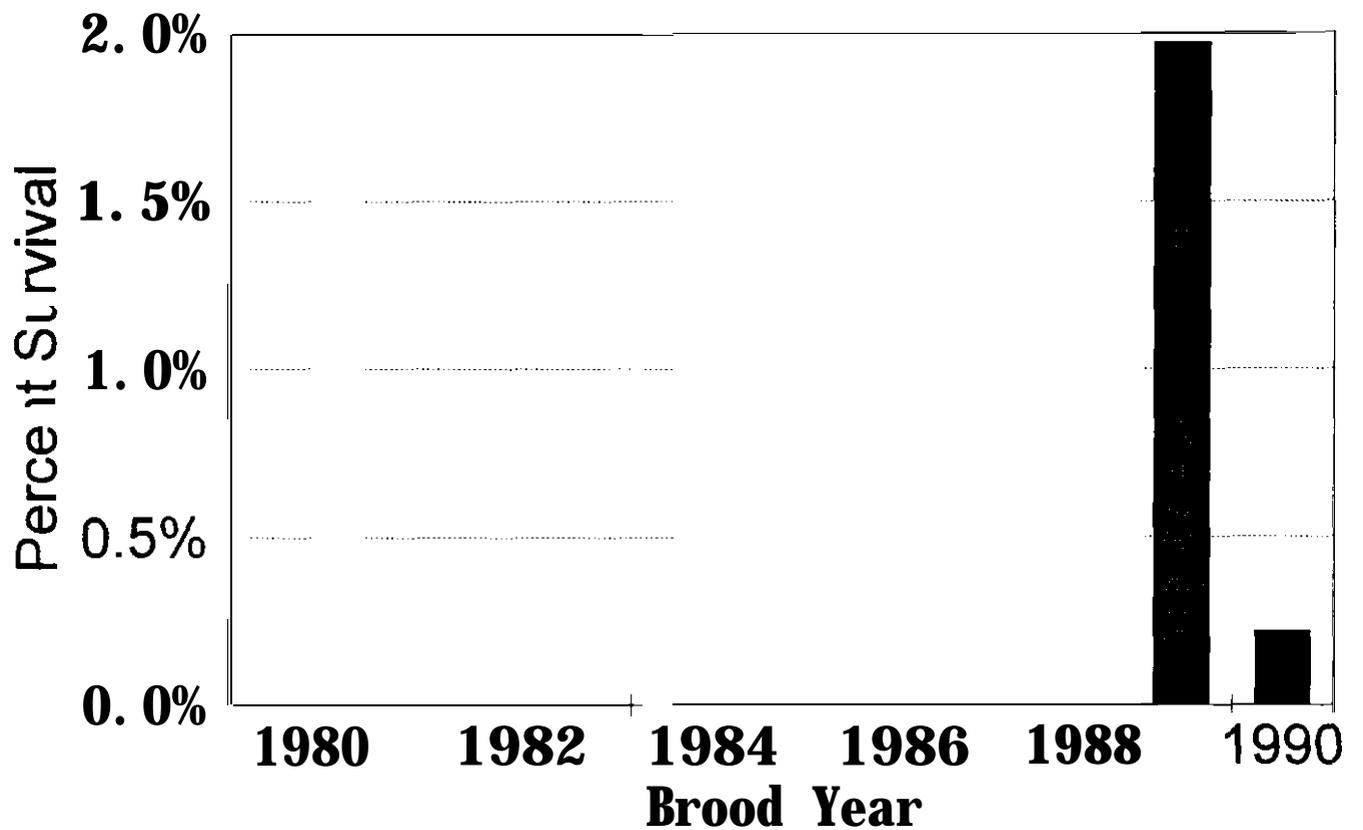


Figure 73. Survival by brood of Similkameen Rearing Pond yearling summer chinook.

# Columbia River Summer Chinook

## Similkameen Pond, Yearlings

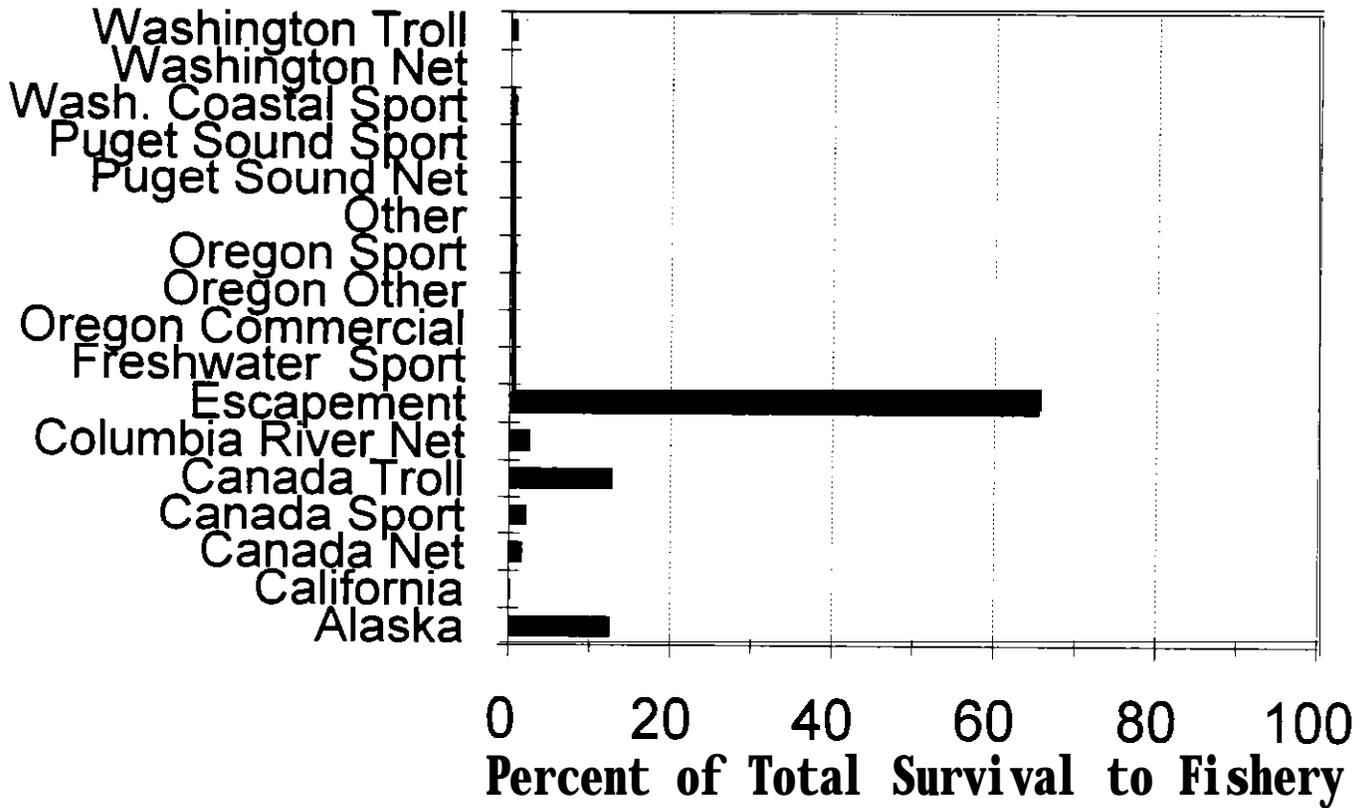


Figure 74. Percent of total survival to fisheries and escapement of Similkameen Rearing Pond 1989 and 1990 brood yearling summer chinook.

## Columbia River Summer Chinook Wells Dam Hatchery, Yearlings

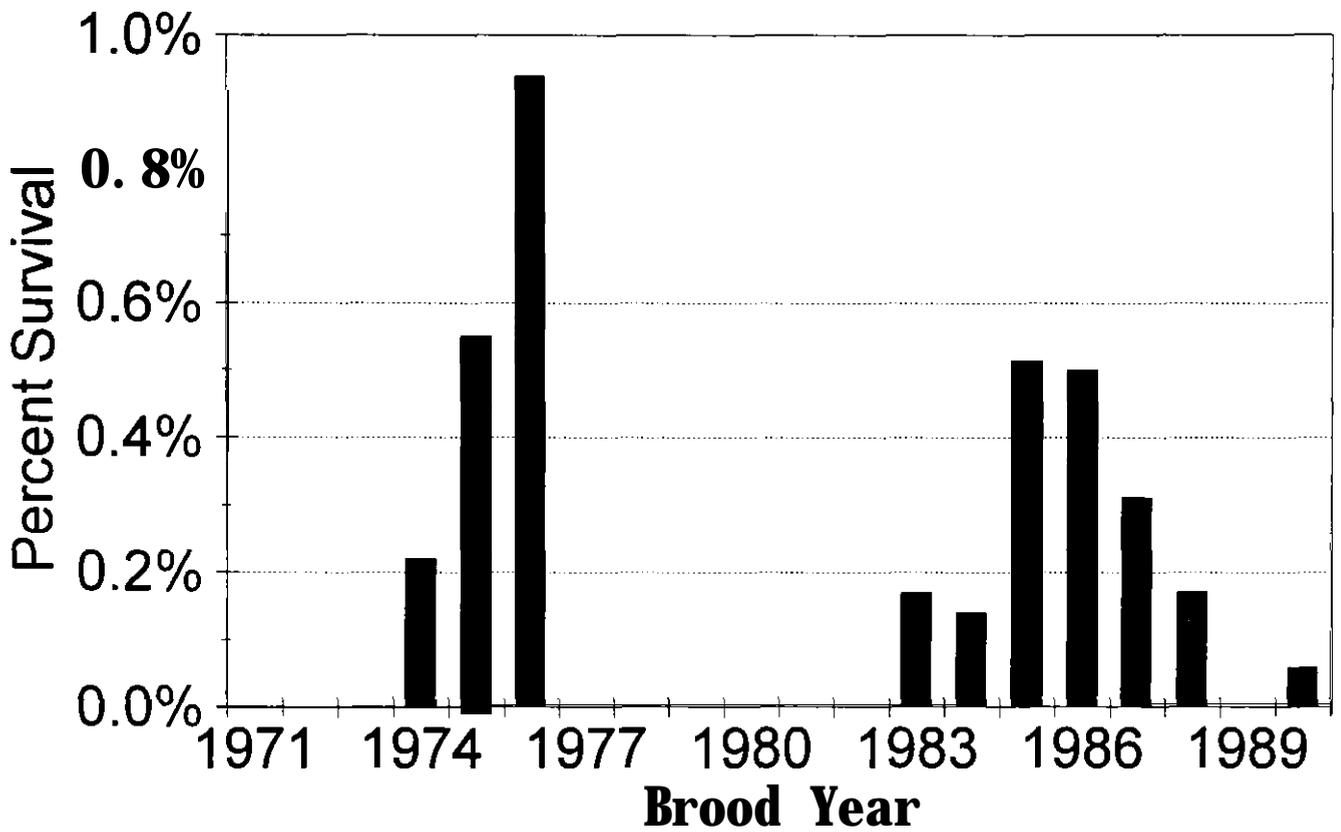


Figure 75. Survival by brood of Wells Hatchery yearling summer chinook.

# Columbia River Summer Chinook Wells Dam Hatchery, Yearlings

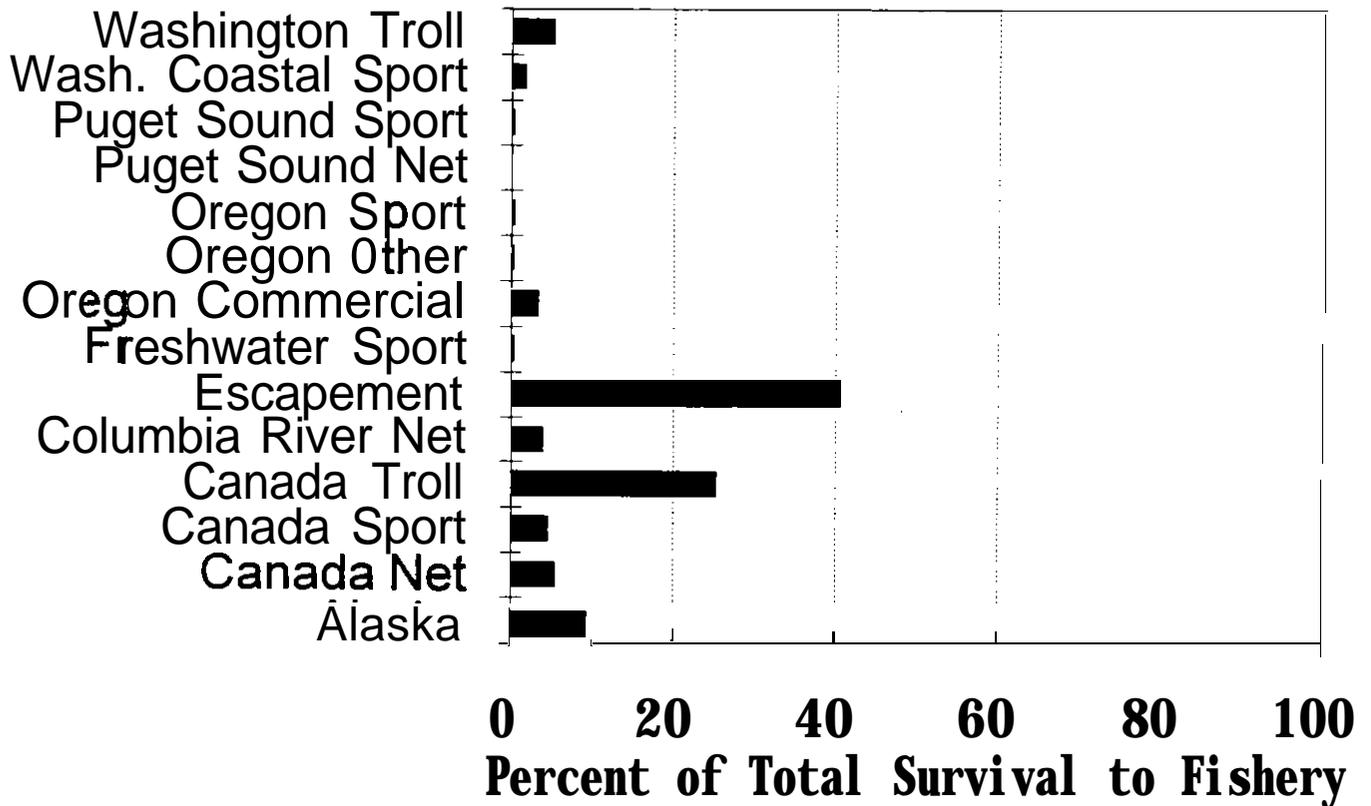


Figure 76. Percent of total survival to fisheries and escapement of Wells Hatchery 1986-1990 brood yearling summer chinook.

# Columbia River Summer Chinook Wells Dam Hatchery, Subyearlings

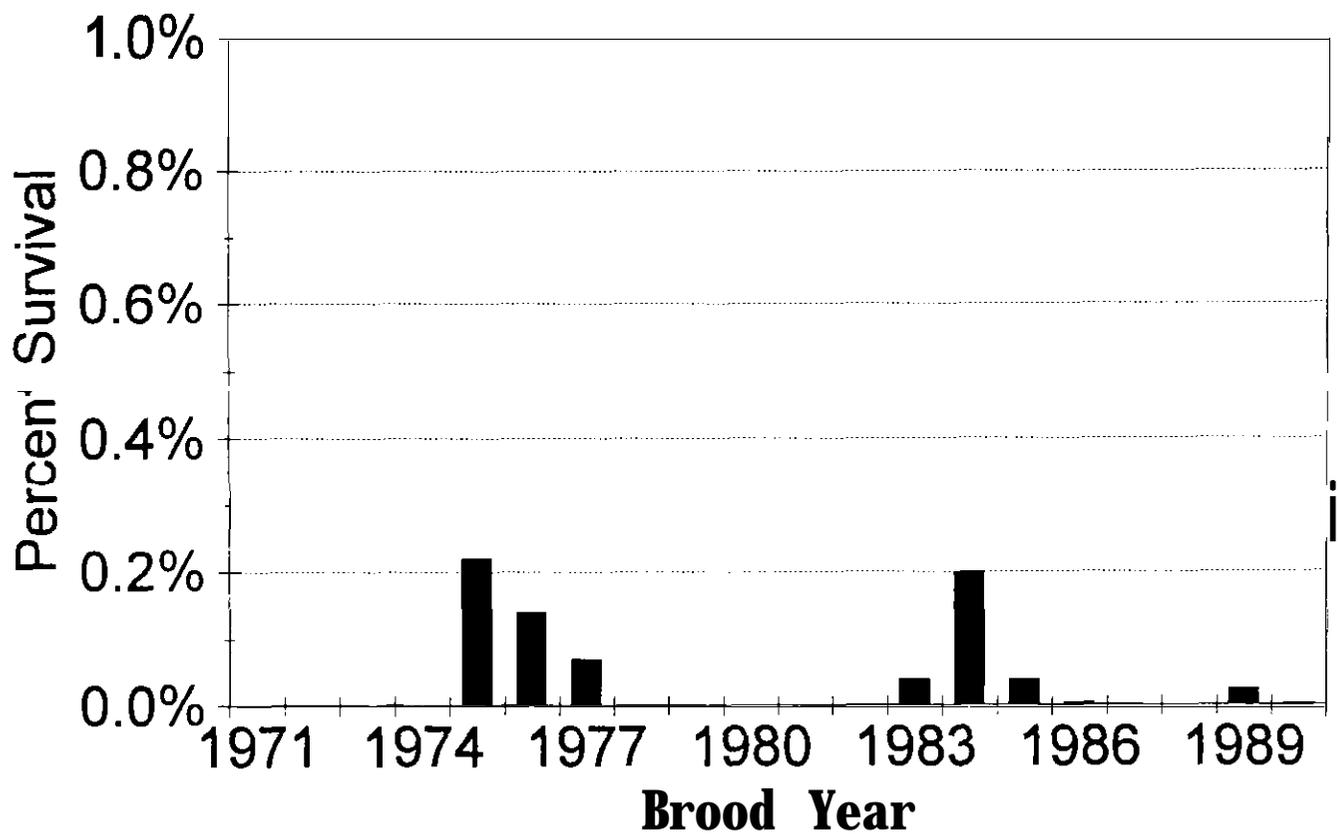


Figure 77. Survival by brood of Wells Hatchery subyearling summer chinook

# Columbia River Summer Chinook Wells Dam Hatchery, Subyearlings

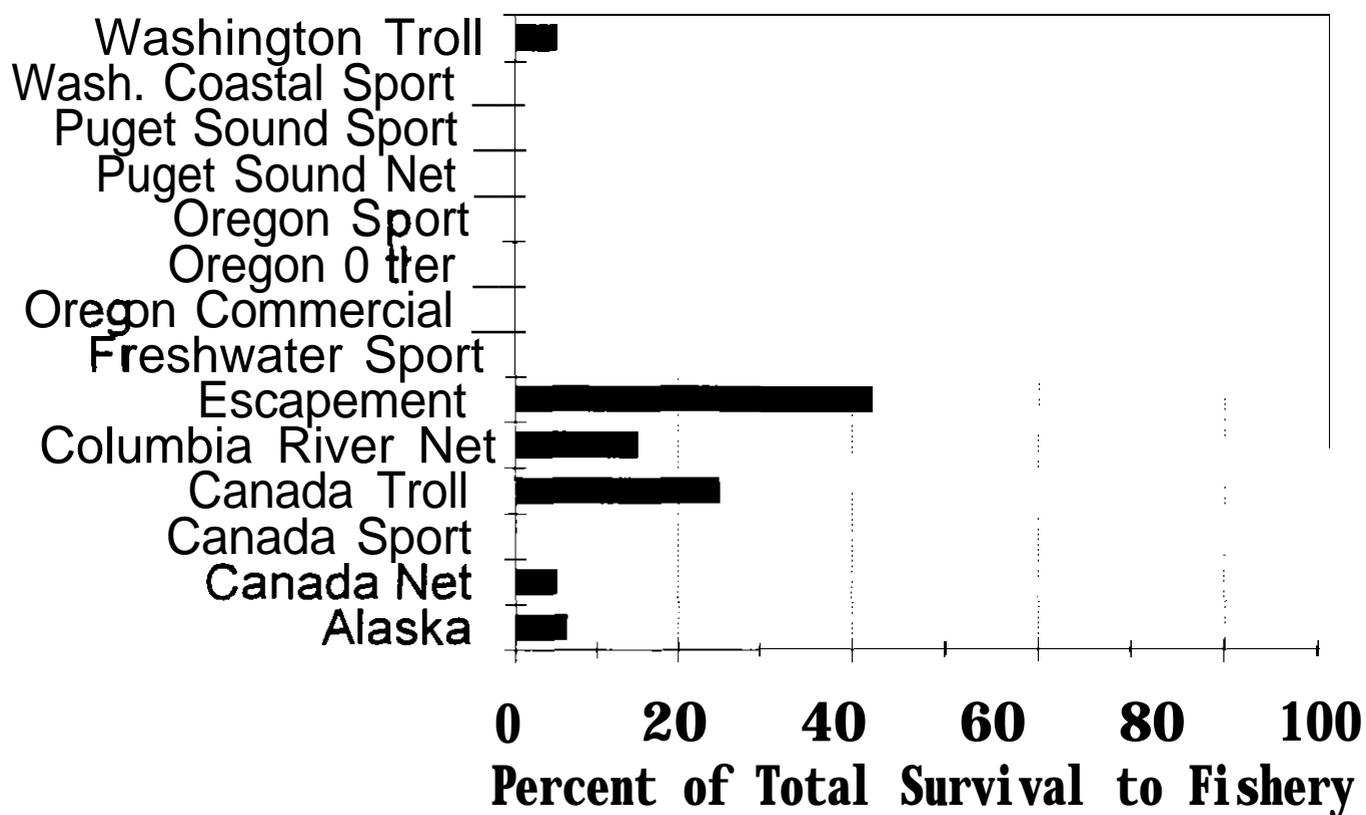


Figure 76. Percent of total survival to fisheries and escapement of Wells Hatchery 1986-1990 brood subyearling summer chinook.

# Columbia River Summer Chinook Carlton Rearing Pond, Yearlings

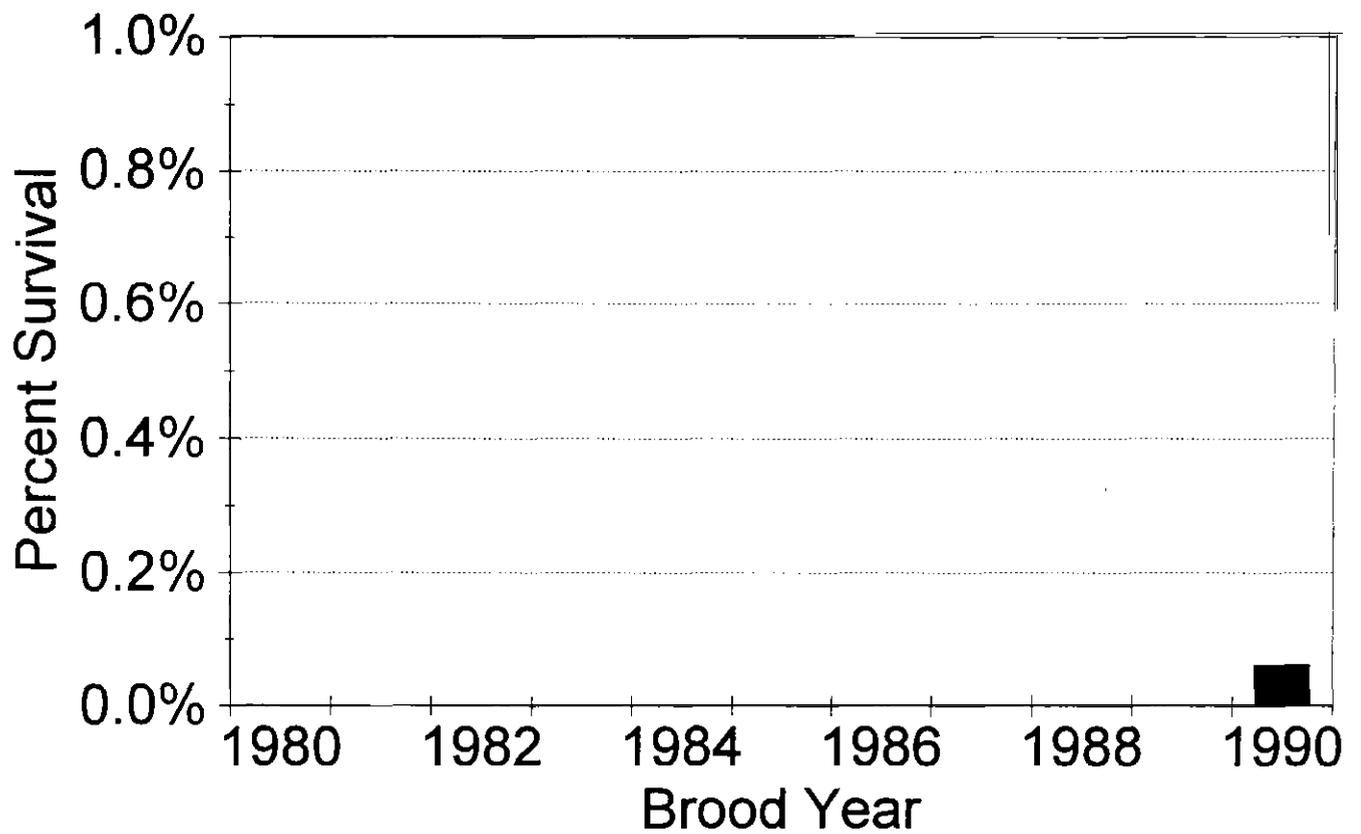


Figure 79. Survival by brood of Carlton Rearing Pond yearling spring chinook.

# Columbia River Spring Chinook Carlton Rearing Pond, Yearlings

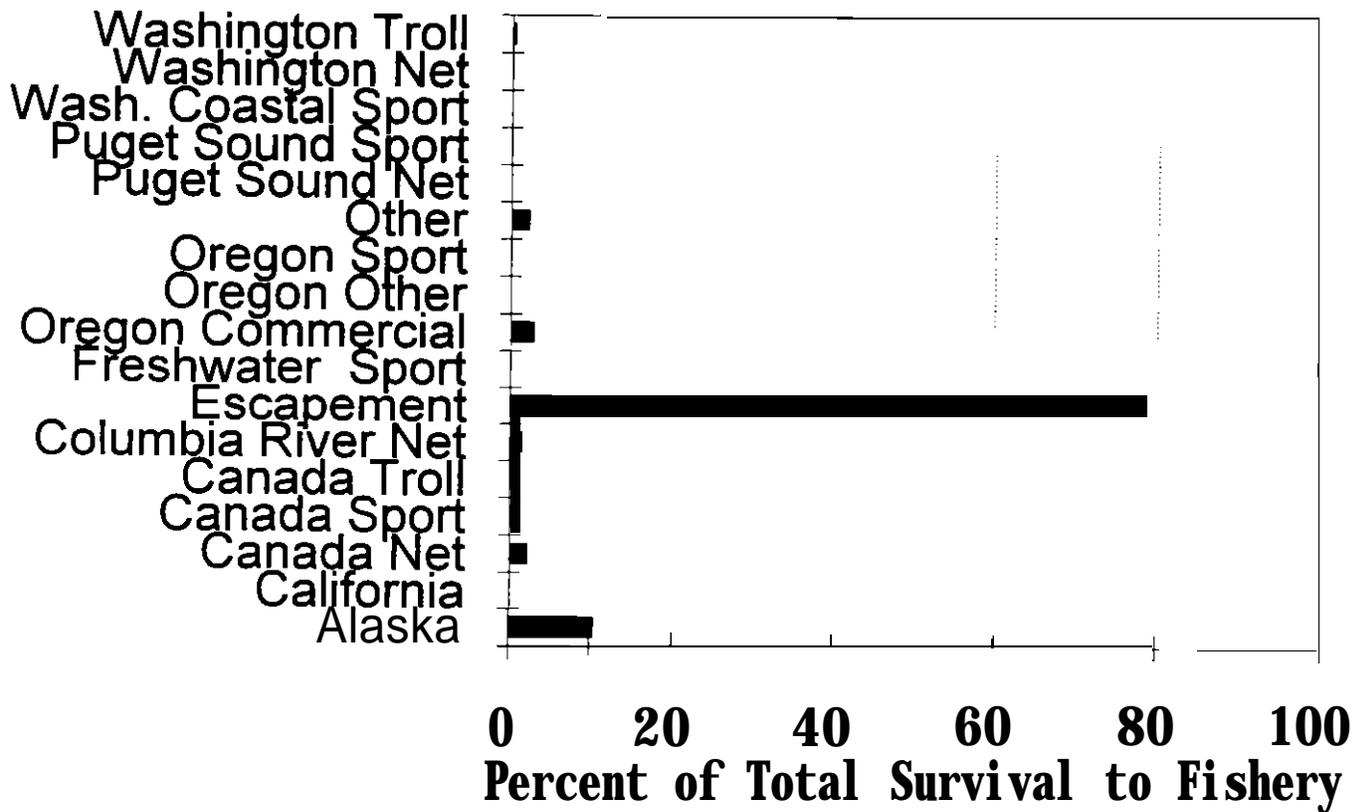


Figure 60. Percent of total survival to fisheries and escapement of Carlton Rearing Pond 1990 brood yearling spring chinook.

Appendix 1. Survivals by brood of Columbia River tule fall chinook.

<b>BroodYear</b>	<b>Grays River</b>	<b>Elochoman</b>	<b>Cowlitz</b>	<b>N.Toutle</b>	<b>Fallert Ck.</b>	<b>K. Falls</b>	<b>Washoug</b>	<b>Lewis Wld</b>
1971				0.40%	1.01%	1.35%		
1972				0.30%	0.28%	0.45%		
1973				0.90%	0.06%	0.90%	0.50%	
1974								
1975	1.90%							
1976	0.20%	0.33%		0.70%		0.68%	1.50%	1.51%
1977	0.30%	0.90%	0.40%	0.60%	0.06%	0.30%	0.30%	0.91%
1978	0.30%	0.10%	0.55%			0.10%		0.13%
1979	0.21%	0.80%			0.19%	0.30%	0.30%	0.50%
1960	0.20%	0.11%	0.40%		0.57%	0.43%	0.40%	
1981	0.04%	0.40%	0.25%			0.20%	0.25%	
1982	0.36%		0.17%				0.30%	0.97%
1963			0.95%				1.30%	0.75%
1984	3.40%		1.73%				1.20%	1.89%
1985	0.81%	0.52%	0.20%				0.60%	
1986			0.15%				0.19%	1.75%
1907			0.05%	0.03%			0.21%	0.14%
1988	0.03%	0.06%	0.11%			0.17%		0.70%
1989	0.07%		0.09%	0.04%			0.19%	0.55%
1990	0.04%		0.18%	0.15%			0.24%	0.60%
<b>Mean</b>	<b>0.605%</b>	<b>0.403%</b>	<b>0.402%</b>	<b>0.390%</b>	<b>0.362%</b>	<b>0.488%</b>	<b>0.534%</b>	<b>0.867%</b>
<b>Standard Error</b>	<b>0.261%</b>	<b>0.106%</b>	<b>0.125%</b>	<b>0.106%</b>	<b>0.138%</b>	<b>0.117%</b>	<b>0.116%</b>	<b>0.160%</b>

Appendix 2. Survivals by brood of Columbia River upriver bright fall chinook.

<b>BroodYear</b>	<b>LyonsFerry Yring, On-stat.</b>	<b>LyonsFeny Yring, Barged</b>	<b>LyonsFerry Sub-yring, On-stat.</b>	<b>LyonsFeny Sub-yring, Barged</b>	<b>Priest Rapids</b>	<b>Hanford</b>	<b>Reach</b>
1971							
1972							
1973							
1974							
1975						2.00%	
1976						0.80%	
1977						0.50%	
1978						0.30%	
1979						0.50%	
1960						0.80%	
1981						0.78%	
1982						1.60%	
1983	7.40%					1.20%	
1984	0.70%			0.60%	0.10%	1.90%	
1985	1.60%	1.90%		0.20%	0.20%	0.30%	
1986	1.43%	1.54%		0.44%		0.25%	0.49%
1967	0.32%	1.16%		0.02%	0.02%	0.05%	0.12%
1988	1.35%	1.51%		0.04%	0.01%	0.13%	0.17%
1989				0.09%	0.11%	0.31%	0.34%
1990	0.09%				0.22%	0.60%	0.45%
<b>Mean</b>	<b>2.133%</b>	<b>1.528%</b>	<b>0.232%</b>	<b>0.088%</b>	<b>0.761%</b>	<b>0.280%</b>	
<b>Standard Error</b>	<b>0.881%</b>	<b>0.131%</b>	<b>0.088%</b>	<b>0.033%</b>	<b>0.149%</b>	<b>0.066%</b>	

Appendix 3. Survivals by brood of Columbia River spring chinook

<b>Brood Year</b>	<b>Cowlitz</b>	<b>Fallert Ck.</b>	<b>Lewis R.</b>	<b>Klickitat</b>	<b>Tucannon</b>	<b>Ringold</b>	<b>Chiwawa</b>	<b>Carlton</b>	<b>Pd</b>
1971	3.90%								
1972	1.50%					0.01%			
1973									
1974	2.40%								
1975	7.10%					1.50%			
1976	10.20%					2.00%			
1977	5.60%					2.60%			
1978									
1979									
1980	0.80%								
1981	2.60%								
1982	1.10%								
1983	5.10%								
1984	2.50%								
1985	1.60%				0.30%				
1986	2.61%				0.24%				
1987	2.08%				0.16%				
1988			2.07%		0.35%				
1989	1.68%	0.36%	0.47%	0.29%	0.26%	0.41%	0.44%		
1990	0.46%	0.47%	0.65%	0.08%	0.03%	0.19%	0.04%	0.06%	
<b>Mean</b>	<b>3.202%</b>	<b>0.415%</b>	<b>1.063%</b>	<b>0.185%</b>	<b>0.223%</b>	<b>1.118%</b>	<b>0.240%</b>	<b>0.061%</b>	
<b>Standard Error</b>	<b>0.633%</b>	<b>0.039%</b>	<b>0.413%</b>	<b>0.074%</b>	<b>0.042%</b>	<b>0.398%</b>	<b>0.141%</b>	<b>0.000%</b>	

Appendix 4. Survivals by brood of Columbia River summer chinook

<b>Brood Year</b>	<b>Dryden Pd Wells Hatch.</b>	<b>Yring. Wells Hatch.</b>	<b>Subyring.</b>
1971			
1972			
1973			
1974		0.22%	
1975		0.55%	0.22%
1976		0.94%	0.14%
1977			0.07%
1978			
1979			
1980			
1981			
1982			
1983		0.17%	0.04%
1984		0.14%	0.20%
1985		0.51%	0.04%
1986		0.50%	0.00%
1987		0.31%	0.00%
1988		0.17%	
1989	0.58%		0.03%
1990	0.06%	0.06%	0.00%
<b>Mean</b>	<b>0.320%</b>	<b>0.357%</b>	<b>0.074%</b>
<b>Standard Error</b>	<b>0.183%</b>	<b>0.080%</b>	<b>0.025%</b>

Appendix 5. Survivals by brood of Columbia River Type N coho

<b>Brood Year</b>	<b>Elochoman</b>	<b>Cowlitz</b>	<b>K. Falls</b>	<b>Lewis River</b>	<b>Washougal</b>	<b>Wash. to Klick.</b>	<b>Klickitat</b>
1971							
1972	1.70%	4.30%					4.50%
1973							
IQ74	1.90%	1.40%					0.60%
IQ75							2.60%
1976							1.40%
1977					2.90%		2.10%
IQ78					5.20%		
IQ79					4.40%		
IQ80		2.10%			1.10%		
1981		2.10%			0.50%		
IQ82		1.60%			2.10%		
1983	3.60%	6.90%	6.90%				
IQ84	0.60%	1.70%	1.10%				0.60%
IQ85	4.50%	2.50%	6.50%				2.20%
IQ86		4.34%		8.35%			
IQ87		0.79%					
IQ88	8.07%	4.61%	8.85%	6.71%	4.59%	1.59%	1.70%
IQ89	0.30%	1.17%	0.68%	1.75%	3.25%	0.19%	0.55%
1990	0.35%	0.65%	0.16%	0.77%	0.17%	0.10%	0.13%
1991	0.01%	0.17%	0.11%	0.60%	0.13%	0.03%	0.14%
1992	0.01%	0.24%	0.08%	0.20%	0.08%	0.03%	0.14%
<b>Mean</b>	<b>2.104%</b>	<b>2.305%</b>	<b>3.048%</b>	<b>3.063%</b>	<b>2.220%</b>	<b>0.388%</b>	<b>1.388%</b>
<b>Standard Error</b>	<b>0.782%</b>	<b>0.478%</b>	<b>0.222%</b>	<b>1.318%</b>	<b>0.562%</b>	<b>0.270%</b>	<b>0.364%</b>

Appendix 6. Survivals by brood of Columbia River Type S coho

<b>Brood Year</b>	<b>Grays River</b>	<b>Elochoman</b>	<b>N.Toutle</b>	<b>Lewis River</b>	<b>Rocky Reach</b>
1971					
IQ72		1.40%	5.90%		
IQ73					
IQ74					
IQ75	2.10%				
1976	2.40%				0.90%
IQ77	1.10%		4.10%		
1978	0.40%		1.20%		
I. 979	2.20%				
IQ80	0.70%			0.60%	
1981	0.50%			0.20%	
IQ82	0.50%			6.90%	
1983	2.90%				
1984	0.50%				
1985	3.00%			5.20%	
IQ86			5.10%	4.52%	
1987			3.80%	1.40%	
1988	3.70%	3.46%	5.19%	5.58%	
1989	0.13%	0.20%	0.55%	1.03%	0.15%
1990	0.03%	0.47%	1.42%	0.32%	0.01%
1991	0.04%	0.03%	0.22%	0.32%	
1992	0.03%	0.16%	0.08%	0.26%	
<b>Mean</b>	<b>1.264%</b>	<b>0.953%</b>	<b>2.736%</b>	<b>2.394%</b>	<b>0.353%</b>
<b>Standard Error</b>	<b>0.301%</b>	<b>0.493%</b>	<b>0.682%</b>	<b>0.743%</b>	<b>0.226%</b>