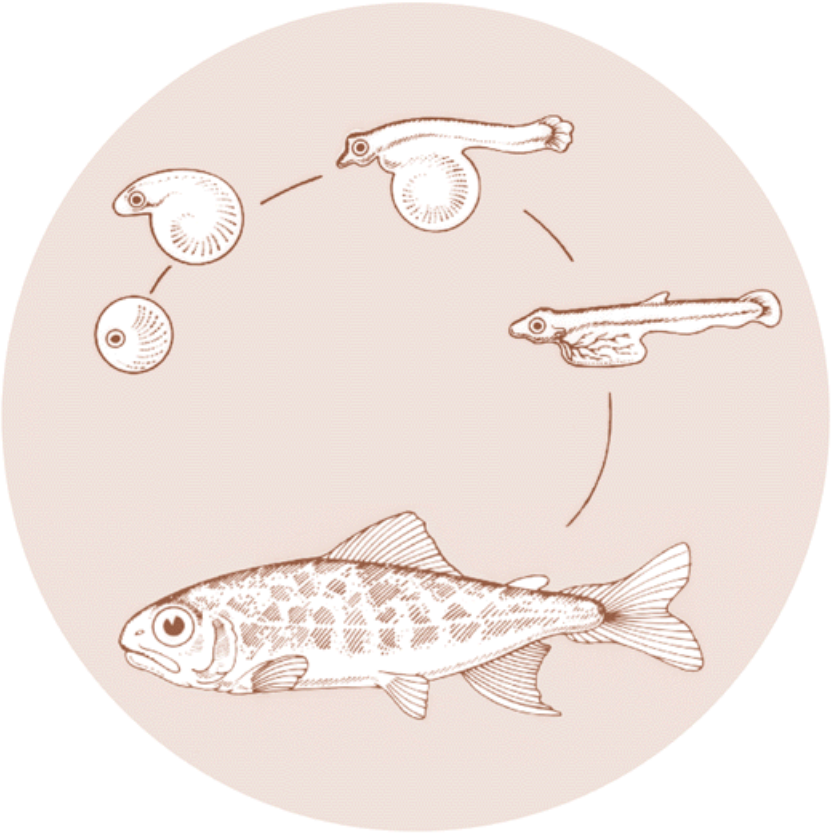
March 1994

ANNUAL CODED WIRE TAG PROGRAM (WASHINGTON) MISSING PRODUCTION GROUPS

Annual Report 1994



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ANNUAL CODED WIRE TAG PROGRAM (WASHINGTON) MISSING PRODUCTION GROUPS

ANNUAL REPORT 1994

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TABLE OF CONTENTS

ABSTRACT 1

INTRODUCTION 3

APPROACH 4

RESULTS 5
- Objective 1 5
- Objective 2 11
- Objective 3 11
  - Grays River Hatchery 11
  - Elokomin River Hatchery 11
  - Cowlitz River Hatchery 12
  - Toutle River Hatchery 12
  - Lower Kalama Hatchery 13
  - Kalama Falls Hatchery 13
  - Lewis River Hatchery 13
  - Speelyai Hatchery 14
  - Washougal River Hatchery 14
  - Klickitat River Hatchery 14
  - Lyons Ferry Hatchery 15
  - Tucannon River Hatchery 15
  - Ringold Springs Hatchery 16
  - Priest Rapids Hatchery 16
  - Rocky Reach Hatchery 17
  - Wells Dam Hatchery 17

LIST OF TABLES

Table 1. Tagging summary and expenditures during FY-94 for 1992 brood yearling coho and chinook and 1993 brood subyearling chinook. Table includes those production groups tagged under contract with BPA. 6

Table 2. Releases of 1993 brood subyearling fall chinook tagged during FY-94 under contract with BPA. 7

Table 3. Releases of 1992 and 1993 brood spring and summer chinook tagged during FY-94 under contact with BPA. 8

Table 4. Releases of 1992 brood coho tagged during FY-94 under contract with BPA. 9

Table 5. Releases of 1992 brood yearling chinook and coho and 1993 brood subyearling chinook during FY-94. This table represents groups tagged under other (non-BPA) funding sources. 10

LIST OF FIGURES

Figure 1. Survival of Grays River tule fall chinook by brood. 18

Figure 2. Survival of Grays River Type-S coho by brood. 19

Figure 3. Percent of total survival to fisheries of Grays River Type-S coho. Average of broods 1988-1990. 20

Figure 4. Survival of Elokomin tule fall chinook by brood. 2%

Figure 5. Percent of total survival to fisheries for 1988 brood Elokomin Hatchery tule fall chinook. 22

Figure 6. Survival of Elokomin Hatchery Type-N coho by brood.. 23

Figure 7. Percent of total survival to fisheries for Elokomin Hatchery Type-N coho. Average of broods 1988-1990 24

Figure 8. Survival of Elokomin Hatchery Type-S coho by brood. 25

Figure 9. Percent of total survival to fisheries for Elokomin Hatchery Type-S coho. Average of broods 1988-1990 26

Figure 10. Survival of Cowlitz Hatchery tule fall chinook by brood. 27

Figure 11. Percent of total survival to fisheries for Cowlitz Hatchery tule fall chinook. Average of broods 1986-1988 28

Figure 12. Survival of Cowlitz Hatchery spring chinook by brood 29

Figure 13. Percent of total survival to fisheries for Cowlitz Hatchery spring chinook. Average of broods 1986 and 1987. 30

Figure 14. Survival of Cowlitz Hatchery Type-N coho by brood 31

Figure 15. Percent of total survival to fisheries for Cowlitz Hatchery Type-N coho. Average of broods 1988-1990 32

Figure 16. Survival of Toutle Hatchery tule fall chinook by brood 33

Figure 17. Percent of total survival to fisheries for Toutle Hatchery fall chinook 34

Figure 18. Survival of Toutle Hatchery Type-S coho by brood 35

Figure 19. Percent of total survival to fisheries for Toutle Hatchery Type-S coho. average of 1989 and 1990 broods 36

Figure 20. Survival of Lower Kalama Hatchery tule fall chinook by brood. 37

Figure 21. Survival of 1980 and 1981 brood Lower Kalama Hatchery Type-N coho. 38

Figure 22. Survival of Lower Kalama Hatchery Type-S coho by brood 39

Figure 23. Percent of total survival to fisheries for Lower Kalama Hatchery Type-S coho. Average of broods 1988-1990 40

Figure 24. Survival of Kalama Falls Hatchery tule fall chinook by brood 41

Figure 25. Survival of Kalama Falls Hatchery spring chinook by brood 42

Figure 26. Survival of Kalama Falls Hatchery Type-N coho by brood 43

Figure 27. Percent of total survival to fisheries for Kalama Falls type-N coho. Average of broods 1988-1990. 44

Figure 28. Survival of Lewis River wild fall chinook by brood 45

Figure 29. Percent of total survival to fisheries for Lewis River wild fall chinook. Average of broods 1986-1988 46

Figure 30. Survival of 1988 brood Lewis River Hatchery spring chinook 47

Figure 31. Percent of total survival to fisheries for Lewis River Hatchery spring chinook. Average for 1988 brood only 48

Figure 32. Survival of Lewis River Hatchery Type-N coho by brood 49

Figure 33. Percent of total survival to fisheries for Lewis River Hatchery Type-N coho. Average of 1988-1990 broods 50

Figure 32. Survival of Lewis River Hatchery Type-S coho by brood 51

Figure 33. Percent of total survival to fisheries for Lewis River Hatchery Type-S coho. Average of broods 1988-1990 52

Figure 34. Survival of Washougal Hatchery tule fall chinook by brood 53

Figure 35. Percent of total survival to fisheries for Washougal Hatchery tule fall chinook. 54

Figure 36. Survival by brood of Washougal Hatchery Type-N coho released on-station.. 55

Figure 37. Percent of total survival to fisheries for Washougal Hatchery Type-N coho. Average of broods 1988-1990 56

Figure 38. Survival of Washougal Hatchery Type-S coho by brood 57

Figure 39. Survival by brood of Washougal Hatchery Type-N coho released off-station in the Klickitat River. 58

Figure 40. Percent of total survival to fisheries for Washougal Hatchery Type-N coho released off-station in the Klickitat River. Average of broods 1988-1990.. 59

Figure 41. Survival of Klickitat Hatchery fall chinook by brood. 60

Figure 42. Percent of total survival to fisheries for Klickitat Hatchery 1986 brood URB fall chinook 61

Figure 43. Survival of Klickitat Hatchery Type-N coho by brood. 62

Figure 44. Percent of total survival to fisheries for Klickitat Hatchery Type-N coho. Average of broods 1988-1990. 63

Figure 45. Survival by brood of Lyons Ferry [Snake River) subyearling fall chinook released on-station or barged downstream and released. 64

Figure 46. Percent of total survival to fisheries for Lyon Ferry fall chinook subyearlings released on-station. Average of broods 1986-1988 65

Figure 47. Percent of total survival to fisheries for Lyons Ferry fall chinook subyearlings barged downstream of hatchery. Average of broods 1986-1988. 66

Figure 48. Survival by brood of Lyons Ferry Hatchery yearling fall chinook released on-station or barged downstream and released. 67

Figure 49. Percent of total survival to fisheries for Lyons Ferry Hatchery yearling fall chinook released on-station. 68

Figure 50. Percent of total survival to fisheries for Lyons ferry Hatchery fall

chinook yearlings released after barging downstream of the hatchery. . . 69

Figure 51. Survival of Tucannon River Hatchery spring chinook by brood. . . . 70

Figure 52. Percent of total survival to fisheries for Tucannon river Hatchery spring chinook. Average of broods 1986-1988 71

Figure 53. Survival of Ringold Hatchery spring chinook by brood 72

Figure 54. Survival by brood of Hanford Reach wild URB fall chinook. 73

Figure 55. Percent of total survival to fisheries for Hanford Reach wild URB fall chinook. Average of broods 1987 and 1988 74

Figure 56. Survival of Priest Rapids Hatchery URB fall chinook by brood. 75

Figure 57. Percent of total survival to fisheries for Priest Rapids Hatchery URB fall chinook. Average of broods 1986-1988. 76

Figure 58. Survival of Rocky Reach Hatchery URB yearling fall chinook by brood. 77

Figure 59. Percent of total survival to fisheries for Rocky Reach Hatchery URB fall chinook. Average of broods 1986 and 1987.. 78

Figure 60. Survival of two broods of Rocky Reach Hatchery Type-S coho . . . 79

Figure 61. Percent of total survival to fisheries for 1989 brood Rocky Reach Type-S coho. 80

Figure 62. Survival of Wells Hatchery yearling summer chinook by brood. . . . 81

Figure 63. Percent of total survival to fisheries for Wells Hatchery yearling summer chinook. Average of broods 1986-1988.. 82

Figure 64. Survival of Wells Hatchery subyearling summer chinook by brood. 83

Figure 65. Percent of total survival to fisheries for wells Hatchery subyearling summer chinook. Average of broods 1986 and 1987. 84

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) [formerly the Washington Department of Fisheries (WDF) and the Washington Department of Wildlife (WDW)], 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.

Three main objectives of the WDFW portion of the study are to: 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 and contribution rates to the fisheries for each group, and 3) report findings of coded-wire tag recoveries for all 1986-1989 broods of chinook, and 1988 and 1989 broods of coho released from WDFW Columbia Basin hatcheries.

Objective 1 for FY-94 was met with a few modifications to the original FY-94 proposal. Several groups of fall chinook that were proposed for tagging under this contract were not tagged due to poor adult returns in 1993 with subsequent egg shortages at some hatcheries. Tags allocated to these groups were used to cover new production groups added to the study. Under Objective 2, snouts containing coded-wire tags that were recovered during FY-93 and FY-94 were decoded but survival estimates have not been made because data for these broods are still preliminary.

Survival, contribution rates to the various fisheries, and escapement were analyzed using coded-wire tag groups from 1986-1988 broods of spring, summer, and fall chinook, and 1988-1990 brood coho. Coho survivals for 1989 and 1990 brood releases were lower than survivals of 1988 brood releases. Survivals of 1988 brood Type N and Type S coho averaged 5.5% (range: 1.7-8.9 %) and 4.8% (range:3.5-5.9%). Survivals of 1989 brood coho averaged 0.9% (range: 0.3-1.8%) and 0.4 % (range: 0.2-I .O%) for Type N and Type S coho, respectively. Survivals of 1990 brood coho averaged 0.3% (range: O-1-0.5%) and 0.4% (range:0.02-0.8%) for Type-N and Type S coho, respectively. Survivals varied according to release location and date of release. Type N coho contributed primarily to the Washington and Oregon coastal sport and troll fisheries, and the Columbia River gillnet fishery. Type S coho contributed primarily to the Washington and Oregon coastal sport and troll fisheries.

Survivals of 1986-1988 brood fall and spring chinook were low, ranging from 0.02-1.8% and 0.1-2.6 %, respectively. Survivals of 1986-1988 brood summer chinook ranged from 0.0008-0.5%. Differences in survival rates within species varied among stocks and release location. Fall chinook contributed primarily to the Canadian, Washington coastal, and Columbia River gillnet fisheries; spring chinook to the Canadian and Washington coastal fisheries; and summer chinook to the Canadian and Alaska fisheries. Escapement as a percentage of total survival ranged from 0-56% for fall chinook, 45-96% for spring chinook, and 22-35% for summer chinook, for broods 1986-1988.

Data generated by this project contributes to WDFW's obligations for representative tagging under the Endangered Species Act (ESA) permit for operating Columbia Basin facilities. WDFW facilities operating outside the Snake River basin are required to have a Section 10, "Incidental Take" permit. Consistent with special conditions within this permit, WDFW has now reached it's objective to tag representative groups from all WDFW Columbia Basin releases.

INTRODUCTION

The Columbia Basin Fish and Wildlife Program Section 203 (a) proposes an interim goal of doubling the runs of salmon and steelhead in the Columbia River basin. Doubling means increasing the current run size of 2.5 million fish to 5.0 million fish. As part of this effort Section 206 (c) states an objective of exploring methods to substantially increase and improve hatchery production at existing hatcheries. Section 206 (e) (1) states that the Bonneville Power Administration (BPA) shall fund collection of Columbia Basin hatchery data for anadromous fish. These data will include at a minimum: number of returning adults; disposition of returning adults; source and description of broodstock; actions to maintain genetic diversity; and size, location and time of release of juvenile fish.

A system of monitoring and evaluating survival and contribution 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 this program in doubling the size of fish runs, a continuous long term data set is necessary.

In September 1989, under contract from the BPA the Washington Department of Fisheries (now WDFW) began coded-wire tagging production groups of anadromous salmonids that were not tagged by other programs (i.e. missing production groups). This project began with the tagging of juvenile salmon in 1990 (1989 brood fall chinook and 1988 broods of spring and summer chinook, and coho).

The sequential tagging of representative groups of juvenile salmon from each WDFW facility allows for long term evaluation of survival and fishery contribution of all release groups from the hatcheries. This information is essential for evaluating the effectiveness of hatchery production in the Basin, as well as for determining where improvements in hatchery fish performance are needed. These data also aid in more effective fisheries management programs, particularly for listed salmonid stocks.

As salmon mature in the ocean they are either harvested in various fisheries, or return to freshwater spawning areas where they can be enumerated. Each fishery or freshwater spawning area is sampled to recover coded-wire tags. Recovery data are reported to the Pacific States Marine Fisheries Commission (PSMFC). Release and recovery data, sampling rates, and ratios of marked to unmarked fish in the sample are stored in PSMFC computers. These data are used to estimate survival and contribution rates to each fishery for every hatchery or wild production group. Calculated survival and contribution rates are then used as a relative measure of each production group's effectiveness in meeting program goals, which directs

future efforts in maintaining or enhancing fish runs in the Columbia Basin and provides valuable information to salmon harvest managers.

APPROACH

The goals of this program are to develop a tool to estimate hatchery production survival and fishery contribution and to evaluate the effectiveness of WDFW Columbia River salmon hatcheries in meeting production goals 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 coded-wire tagged under objective 1 and decode these tags to estimate survival and contribution of each group released each year, and evaluate the results.

Objective 3. Develop preliminary catch and contribution data for all WDFW Columbia River hatcheries using 1986-1989 brood chinook, and 1988 and 1989 brood coho, and prepare an annual report for all WDFW Columbia Basin hatcheries.

RESULTS

Objective 1. A total of 1,032,145 fall chinook, 531,597 spring chinook, and 385,639 coho were tagged during the contract period (Table I). Releases of 1993 brood chinook tagged during FY-94 are given in Table 2. Releases of yearling chinook and coho (1992 brood) tagged during FY-94 are given in Tables 3 and 4, respectively. Releases of 1992 brood yearling salmon, and 1993 brood subyearling salmon tagged under other program funds are listed in Table 5.

Fewer fish were tagged in FY-94 due to production program shortfalls at some hatcheries and changes in funding source for tagging programs. The following changes were made in FY-94:

1. **Decreased fall chinook tags at Grays River Hatchery by 295,000 (one year reduction due to egg shortfalls)**
2. **Decreased coho tags at Grays River by 30,000 (one year reduction due to egg shortfalls)**
3. **Eliminated 45,000 coho tags at Rocky Reach Hatchery (coho program eliminated)**
4. **Eliminated 225,000 summer chinook tags at Wells Hatchery (funded now by PUD).**

Newly established production groups used some of the tags that had been budgeted for other programs. These include:

1. **50,000 tagged spring chinook at Cowlitz Hatchery,**
2. **50,000 Washougal Type-N coho reared and released at Champion Pond (Klickitat River)**
3. **100,000 spring chinook tags at Klickitat Hatchery.**

Funds for the balance of the remaining tags will be carried over to FY-95.

Table 1. Tagging summary and costs during FY-94 for 1992 brood yearling coho and chinook and 1993 brood subyearling chinook. Table includes those production groups tagged under contract with BPA. F = Fall chinook, Sp = Spring chinook.

HATCHERY	SPECIES	TAG DATE	NUMBER TAGGED	COST ($)[1]
GRAYS	F.CHINOOK	APR 28,1994	53,566	5.946
GRAYS	TYPE-S COHO	JAN 5, 1994	32,126	3,566
ELOKOMIN	F.CHINOOK	MAY 22, 1994	186,807	20,736
ELOKOMIN	TYPE-N COHO	JAN 10, 1994	31,795	3,529
ELOKOMIN	TYPE-S COHO	JAN 10,1994	32,362	3,592
TOUTLE	F. CHINOOK	MAY 2, 1994	92,333	10,249
TOUTLE	TYPE-S COHO	JAN 4, 1994	32,825	3,644
COWLITZ	SP. CHINOOK	JAN 26,1994	51,309	5,695
LOWER KALAMA	F. CHINOOK	JUN 13,1994	92,731	10,293
LOWER KALAMA	SP. CHINOOK	MAY 27, 1993	113,715	12,622
LOWER KALAMA	TYPE-S COHO	DEC 15,1994	32,627	3,622
KALAMA FALLS	F. CHINOOK	JUN 1,1994	94,155	10,451
KALAMA FALLS	TYPE-N COHO	DEC 13,1993	32,249	3,580
WASHOUGAL	F. CHINOOK	JUNE 7,1994	189,990	21,089
WASHOUGAL	TYPE- N COHO ON-STATION	NOV 2,1993	30,227	3,355
WASHOUGAL	TYPE-N COHO KLICKITAT RIVER	NOV 4,1993	62,187	6,903
KLICKITAT	F. CHINOOK	APR 19,1994	230,109	25,542
KLICKITAT	SP. CHINOOK	APR 7,1994	221,695	24,608
KLICKITAT	TYPE-N COHO	JUL 13, 1993[2]	47,226	5,242
RINGOLD	SP. CHINOOK	OCT 19,1993	41,509	4,608
ROCKY REACH	F. CHINOOK	SEP 19,1993	92,454	10,263
CHAMPION POND KLICKITAT RIVER	TYPE-N COHO	FEB 17,1994	52,015	5,774
KLICKITAT	SP. CHINOOK	JUN 21, 1994	103,369	11,475
TOTALS			1,949,381	216,383

[1] DOES NOT INCLUDE APPLICABLE OVERHEAD RATES DUE TO A CHANGE IN RATES DURING FISCAL YEAR 1994.

[2] FISH ARE TAGGED PRIOR TO THE START OF THE FISCAL YEAR **DUE TO OPERATIONAL LOGISTICS. BILLING OCCURS** AFTER THE BEGINNING OF THE FISCAL YEAR.

Table 2. Releases of 1993 brood subyearling fall chinook tagged during FY-94 under contract with BPA.

HATCHERY	SPECIES	RELEASEDATE	NUMBER TAGS RELEASED	TOTAL RELEASE
GRAYS	FALL CHINOOK	9/28/94	52,616	64,100
ELOKOMIN	FALL CHINOOK	6/4/94-7/5/94	173,864	1,176,000
TOUTLE	FALL CHINOOK	6/11/94-6/20/94	91,687	2,044,500
KALAMA FALLS	FALL CHINOOK	6/2/94-6/28/94	92,630	3,305,900
LOWER KALAMA	FALL CHINOOK	6/27/94	91,323	2,297,300
WASHOUGAL	FALL CHINOOK	6/15/94-7/12/94	186,368	6,021,603
KLICKITAT	FALL CHINOOK	5/17/94-6/13/94	225,978	4,463,OOO
ROCKY REACH	FALL CHINOOK	4/21-25/94	87,991	202,000
TOTALS			1,002,457	19,574,403

Table 3. Releases of 1992 and 1993 brood spring (SP.) chinook tagged during FY-93[3] and FY-94 under contract with BPA.

HATCHERY	SPECIES	RELEASE DATE	NUMBER TAGS RELEASED	TOTAL RELEASE
LOWER KALAMA	SP.CHINOOK	4/3/94	110,226'	572,100
KLICKITAT	SP. CHINOOK SUBYEARLINGS	6/1/94	217,431	296,400
RINGOLD	SP. CHINOOK	4/11/94	27,486	781,742
COWLITZ	SP. CHINOOK	4/4/94	50,185	1.134.100
TOTALS			405,328	1,134,100

[3] SOME GROUPS ARE TAGGED IN THE PREVIOUS FISCAL YEAR DUE TO LOGISTICAL CONSTRAINTS. BILLINGS FOR THESE GROUPS OCCUR IN THE PROPER FISCAL YEAR.

Table 4. Releases of 1992 brood coho tagged during FY-94 under contract with BPA.

HATCHERY	SPECIES	RELEASEDATE	NUMBER TAGS RELEASED	TOTAL RELEASE
GRAYS	TYPE-S COHO	4/15/94	31,609	80,300
ELOKOMIN	TYPE-S COHO	4/14/94	30,130	593,300
ELOKOMIN	TYPE-N COHO	4/20/94-5/9/94	29,111	1,500,400
TOUTLE	TYPE-S COHO	4/18/94-5/11/94	32,622	430,100
KALAMA FALLS	TYPE-N COHO	4/25/94-5/3/94	30,065	1,055,600
LOWER KALAMA	TYPE-S COHO	5/1/94	31,071	508,100
WASHOUGAL	TYPE-N COHO ON-STATION	4/19/94	28,860	535,672
WASHOUGAL	TYPE-N COHO KLICKITAT R.	4/11/94-4/15/94	60,507	2,252,565
KLICKITAT	TYPE-N COHO	4/30/94-6/7/94	33,034	950,000
WASHOUGAL CHAMPION PND	TYPE-N COHO	4/26/94	46,273	240,000
TOTALS			353,282	8,145,987

Table 5. Releases of 1992 brood yearling chinook and coho and 1993 brood subyearling chinook during FY-94. This table represents groups tagged under other (non-BPA) funding sources. SP= Spring chinook, SU= Summer chinook.

HATCHERY	SPECIES	RELEASE DATE	NUMBER TAGS RELEASED	TOTAL RELEASE
COWLITZ	FALL CHINOOK	JUNE 1994	199,353	4,419,900
COWLITZ	TYPE-N COHO	MAY-JUN, 1994	71,671	4,029,300
LEWIS RIVER	SP. CHINOOK	FEB-MAR, 1994	146,602	642,000
LEWIS RIVER	TYPE-N COHO	APR-MAY, 1994	71,026	869,400
LEWIS RIVER	TYPE-S COHO	APR-MAY, 1994	70,947	839,300
KLICKITAT	SP. CHINOOK	APRIL 1994	233,010[4]	606,400
KLICKITAT	SP. CHINOOK	APRIL 15, 1994	0	942,000
LYONS FERRY	FALL CHINOOK	APR 18-19 , 1994	597,398	603,661[5]
TUCANNON	SP. CHINOOK	APR 18, 1994	79,151	83,409[3]
RINGOLD	FALL CHINOOK	JUNE-JULY 1994	215,012	3,433,334
PRIEST RAPIDS	FALL CHINOOK	JUN 14-20, 1994	185,683	6,705,836
ROCKY REACH	FALL CHINOOK	JUN 21,1994	196,159	838,000
ROCKY REACH	FALL CHINOOK	APR 21, 1994	87,991	202,000
ROCK ISLAND	SP. CHINOOK	APR 26, 1994	82,976	85,113[3]
ROCK ISLAND	SU. CHINOOK	APR-MAY,1994	605,055	627,131
ROCK ISLAND	SOCKEYE	SEP-OCT, 1994	138,637	190,443
METHOW	SP. CHINOOK	APR 15-18, 1994	75,712	76,763[3]
METHOW	SU. CHINOOK	APR 21-22, 1994	392,636	402,641[3]
SIMILKAMEEN	SU. CHINOOK	APR 7, 1994	537,190	548,182
TOTALS			4,101,395	26,149,588

[4] **Tagged as part** of a BPA funded acclimation study.

[5] Groups were tagged at the 100% level. Discrepancy between tagged release and total release, are the AD only fish.

Objective 2. A total of 3,794 tags were recovered from Columbia River fall, spring, and summer chinook, and coho during FY-94. A total of 447 fish with missing adipose fins had no tag in the snout resulting in a no tag/lost tag rate of 10.5%.

Objective 3. Summaries of coded wire tag information for groups of 1986-1988 brood chinook and 1988-1990 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 dviding the total estimated recoveries for 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"[5]

Grays River Hatchery- Grays River Hatchery rears and releases Tule fall chinook and Type-S (early) coho. Fall chinook survivals range from 0.1% to over 8.0% (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.O%. A group of large (> 12 g) 1985 brood fish released in May survived at over 1%. Fall chinook from the 1986-l 988 broods were not tagged.

Type-S coho survivals range from O.I-3.4% depending on brood and release type (Figure 2). 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-l 990 broods ranged from 0.02-3.8%. Grays River Type-S coho contributed primarily to the Oregon and Washington sport fisheries, and the Columbia River gillnet fishery. Escapement amounts to about 15% of the total survival (Figure 3).

Elokomin River Hatchery- Elokomin Hatchery rears and releases Tule fall chinook, and both Type-N and Type-S coho. Fall chinook survivals range from 0.01%-0.52% depending on brood (Figure 4). 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 5).

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[5] 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 0.3-8.1% (Figure 6). Survival of 1988-I 990 brood Type-N coho ranged from 0.3-8.1%. These fish contributed primarily to the Oregon fisheries, the Columbia River gillnet fishery, and to the Washington coastal sport fisheries (Figure 7). Elokomin Type-S coho at this hatchery survive from 0.2-3.5% (Figure 8). Survivals of the 1988-l 990 broods ranged from 0.2-3.5%. These broods contribute primarily to the Oregon and Washington coastal sport and troll fisheries and to escapement (Figure 9).

Cowlitz River Hatchery- Cowlitz Hatchery rears and releases fall chinook, spring chinook, and Type-N coho. Survivals of fall chinook range from 0.01-I .73% (Figure 10). Most tag groups represent fish released in June at sizes ranging from 5.0-6.5 g, however there have been some releases of larger juvenile fish in the fall months. Survivals of 1986, 1987, and 1988 broods of fall chinook were 0.15%, 0.05%, and O.lO%, respectively. These broods contributed mainly to escapement (54.1%), but moderate catches were made by Washington coastal sport and troll fishers and Canadian fishers (Figure 11).

Cowlitz spring chinook survivals range from 0.8-1 0.2% (Figure 12). Most tag groups represent fish released as yearlings (45-60 g) in either March, April, or May. Survivals of 1986 and 1987 brood fish were 2.6% and 2.1%, respectively. The majority of the survival was as escapement (45.1%; Figure 13), but moderate catches were made by Washington coastal sport and troll fishers, Cowlitz River sport fishers, and Canadian fishers.

Survivals of Cowlitz Type-N coho range from 0.5-6.9% (Figure 14). Survivals of 1988, 1989, and 1990 broods were 4.7%, 1.2%, and 0.5%, respectively. Oregon and Washington fishers accounted for most of the catch of the 1988-1 990 brood fish (Figure 15). The Columbia River gillnet fishery accounted for about 11% of the total survival and escapement about 22% of the total survival.

Toutle River Hatchery- 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 it is now in full production. Survivals of 1971-1977 brood fall chinook ranged from 0.3-0.9% (Figure 16). The survival of the 1987 and 1988 brood fall chinook was 0.02% and 0.03%, respectively. Chinook released at Toutle hatchery range in size from 4.5-5.5 g, and are released primarily in June. The majority of the both brood's fish were caught by Canadian fishers, and Washington and Oregon coastal fishers (Figure 17). Escapement was nearly 50% of the total survival.

Toutle Type-S coho survivals have ranged from 0.6-5.9% depending on brood and release type (Figure 18). Survivals of the 1989 and 1990 brood fish were 0.6% and 0.8%, respectively. Oregon and Washington coastal fishers caught the

majority of the 1989 and 1990 brood fish. Escapement of the two broods averaged nearly 25% of the total survival (Figure 19).

Lower Kalama Hatchery- Lower Kalama Hatchery rears and releases Tule fall chinook, spring chinook, and Type-N or 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 20). Survivals have ranged from 0.06-1.O%. This hatchery was only recently included in this project (1991 brood) and therefore no current survival or contribution data are available.

Tag groups of 1980 and 1981 brood Type-N coho were released from the hatchery and had survivals of 2.7% in each brood (Figure 21). Survivals for the 1988, 1989 and 1 990 broods of Type-S coho were 5.9%, 0.3%, and 0.6%, respectively (Figure 22). Oregon and Washington coastal sport fishers harvested the largest proportion of these fish. Columbia River gillnet fishers caught about 7% of these fish, and about 20% of the total survival was to escapement (Figure 23).

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 therefore current tag data are unavailable for this stock. It will be several years before survivals and contribution rates will be known. Past releases were made from Kalama Falls Hatchery (Figure 25)

Kalama Falls Hatchery- Kalama Falls Hatchery rears and releases fall chinook, and either Type-S or Type-N coho. Fall chinook are reared to 4.5-5.5 g and released in late-May to July. Fall chinook (1971-1981 broods) survivals have ranged from 0.1-1.4% (Figure 24). The 1988 brood was most recently tagged and was part of a release timing study. A single tag group was released in each of three months: June, July, and August of 1989. The average survival of the three 1988 brood groups was 0.15%. The June release had the lowest overall survival and the July group the highest overall survival.

Type-N coho survivals have ranged from 0.1-8.94% depending on brood (Figure 26). No tagged fish of this stock were released prior to 1983. The survivals of the 1988-1990 broods were 8.9%, 0.7%, and 0.1 %, respectively. Columbia River gillnetters caught the highest proportion of these fish (Figure 27). Oregon and Washington sport fishers caught nearly equal percentages of these fish.

Lewis River Hatchery- Lewis River Hatchery rears and releases spring chinook and both Type-N and Type-S coho. The hatchery does not rear fall chinook. The Lewis River supports a viable self-sustaining population of naturally reproducing fall chinook. Survivals of these wild chinook range from 0.13-1.89% (Figure 28). Survivals of the 1986-l 988 broods were: 1.7%, 0.8%, and 0.5%, respectively.

The majority of the survival of these three broods was to escapement (55%). Significant catches were made by Canadian, and Columbia River gillnet fisheries (Figure 29).

The 1988 brood spring chinook were tagged with funds provided by Pacific Power and Light Company. Survival of this brood was 1.1 % (Figure 30). Escapement and the freshwater sport fishery accounted for over 50% of the total survival (Figure 31). The Canadian and Washington troll fisheries each harvested significant numbers of these fish.

Only four broods of Type-N coho have been previously tagged at Lewis River Hatchery. Funding for this tagging has come from the Pacific Salmon Treaty (PST). Survivals range from 0.6-9.2% (Figure 32). Survivals of the 1988-1990 broods were 6.9%, 1.8%, 0.6%, respectively. The Washington and Oregon coastal sport fisheries caught the majority of the fish from the 1988-1990 broods. The Columbia River gillnet fishery and escapement accounted for significant portions of the total survival (Figure 33).

Survivals of Type-S coho range from 0.2-6.9% depending on brood (Figure 34). The majority of the survival of the 1988-1990 broods was to the Oregon and Washington coastal fisheries. Escapement accounted for about 25% of the total survival (Figure 35).

Speelyai Hatchery- Speelyai Hatchery rears both coho and spring chinook, but transfers most of these fish to Lewis River. The only releases directly from the hatchery support a resident coho fishery in Merwin Lake.

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.

Fall chinook survivals range from 0.1-5.0% (Figure 36). Generally higher survivals have been obtained from larger fish (> 15 g) released in the early fall. Most of the chinook production is released in June at sizes ranging from 4.5-6.0 g. Survivals of the 1986 and 1987 broods were 0.19% and 0.21%, respectively. The majority of the survival of these two broods was to the Canadian fisheries and escapement (Figure 37).

Survivals of Type-N coho released on-station range from 0.5-5.2% (Figure 38). Survivals of 1988-1990 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 gillnet catches accounted for about 25% and

20% of the total survival, respectively (Figure 39).

Survivals of Type-S coho range from 0.4-6.9% (Figure 40). The 1984 brood was the last brood of Type-S coho to be reared at Washougal Hatchery.

Fewer Type-N coho released off-station into the Klickitat River (Figure 41) survived than those released on-station at Washougal or at Klickitat Hatcheries. Survival of the 1988, 1989 and 1990 broods was 1.6%, 0.2%, and 0.1% respectively (Figure 41). The majority of the surviving fish released off-station contributed to the Oregon and Washington coastal fisheries and the Columbia River gillnet fishery. Escapement amounted to 6.0% of the total survival (Figure 42).

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, the hatchery reared and released imported Tule fall chinook. The hatchery also rears and releases spring chinook and Type-N coho. Type-S coho were reared previously. The 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. The results of this experiment will not be available for several years. Survivals of fall chinook range from 0.05%-1%, depending on brood (Figure 43). Survival of 1986 brood chinook was about 0.4%. The majority of the catch was in the Columbia River gillnet fishery, the Canadian troll fishery and the Alaska fisheries (Figure 44). No tags were recovered at the hatchery. Data from later broods is preliminary and not reported here.

Survivals of spring chinook from recent broods are not yet available.

Survivals of Type-N coho have ranged from 0.1-4.5%, depending on brood and release type (Figure 45). Survival of the 1988, 1989, and 1990 broods was 1.7%, 0.6%, and 0.1 %, respectively. Washington and Oregon coastal sport fishers, and Columbia River gillnetters caught the majority of the fish from these broods (Figure 46). There have been no returns of tagged fish to the hatchery.

Survivals of 1972-1983 brood Type-S coho ranged from 1.6-4.5%.

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: 0.01-0.55%, Figure 47) have been much lower than survivals of yearling fish (0.3-7.3%; Figure 50). Survivals of barged fish, regardless of age, have been equal to

or greater than survivals of fish released on-station (Figures 47 and 50). Subyearling fish contributed primarily to the Columbia River gillnet fishery, the Canadian commercial fisheries, and escapement. Escapement of tagged fish released on-station appears to be slightly higher than those released from barges. Contribution of yearling fish has been mainly to Canadian, Columbia River gillnet, and Washington coastal troll fisheries (Figure 51). Escapement amounted to approximately 27% of the survival, however the estimated escapement reported here is an underestimate because data from trapping operations at the dams are not available. Contribution rates to various fisheries did not appear to differ among barged or on-station releases (Figures 51 and 52).

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 and a portion of the run was used to supply the hatchery releases. Captured adults are now transported to the Lyons Ferry Hatchery and spawned there. This change in procedure has resulted in lower adult holding mortality, and lower egg to fry mortalities. After rearing to approximately 18 g at the Lyons Ferry Hatchery, these fish are transported to an acclimation pond at the Tucannon Hatchery where they are reared through the winter and volitionally released in the spring. Survivals of these yearling plants have ranged from 0.02-0.3% (Figure 53). Nearly 96% of the total survival of the 1986-1988 broods was to escapement. A few fish have been captured in Oregon, Canadian, and Washington fisheries (Figure 54). No tag recoveries from these broods were found in the Columbia river gillnet 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-l 15 g. Broods between 1978 and 1989 were not tagged, so data are available. Survivals of spring chinook (broods 1975-77) ranged from 1.5-2.6% (Figure 55).

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 1987 and 1988 broods were about 0.2% each year (Figure 56). The majority of the survival was to the Alaska, and Canadian fisheries, the Columbia River gillnet fishery, and escapement (Figure 57).

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 58). Survivals of the 1986, 1987, and 1988 broods was 0.3%, 0.1 %, and 0.2%, respectively. The

majority of the survival of these broods was Alaska and Canadian fisheries, the Columbia River gillnet fishery, and escapement (Figure 59).

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 the yearling fish have ranged from 0.07-3.6% (Figure 60). The 1986 and 1987 brood survivals were 0.1% and 0.2%, respectively. Chinook released as yearlings contributed primarily to the Canadian and Columbia River gillnet fisheries (Figure 61). Escapement was approximately 25% of the total survival.

Rocky Reach coho were tagged only in 1976 and 1989. Survivals were 0.9% and 0.2%, respectively (Figure 62). The majority of survivors contributed to the Oregon sport fishery, the Canadian troll, and the Columbia River gillnet fishery (Figure 63).

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 O.l-0.9% (Figure 64). Survivals of the 1986,1987, and 1988 brood yearlings were 0.5%,0.3%, and 0.1 %, respectively. These broods contributed primarily to Canadian and Alaskan fisheries and to escapement (Figure 65).

Survivals of 1986 and 1987 brood subyearling releases were 0.006% and 0.0008%, respectively (Figure 66). Contribution of subyearling fish was primarily to Canadian fishers, Columbia River gillnetters and to escapement (Figure 67).

In conclusion, during FY-94 all three objectives were met. Under objective one, at least one production group from every hatchery was coded-wire tagged. Tag numbers declined from previous fiscal years due to shortages of fish at some hatcheries. 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. For objective three survival and contribution rates were determined for coho salmon released between 1990 and 1992 (1988-1990 broods) and chinook released between 1987 and 1989 (1986-1988 broods). Figures l-67 depict the data base for both estimated survival and contribution by brood.

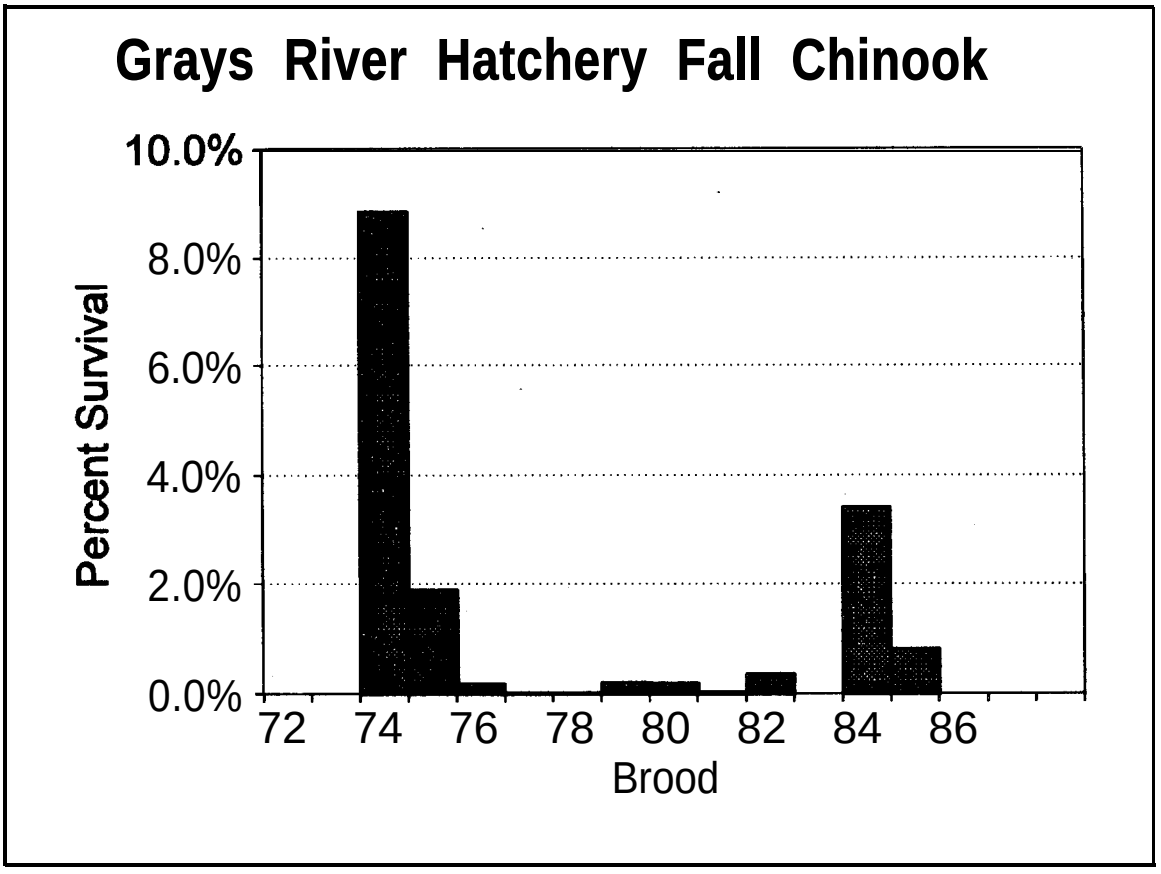

Figure 1 Survival of Grays River Hatchery tule fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

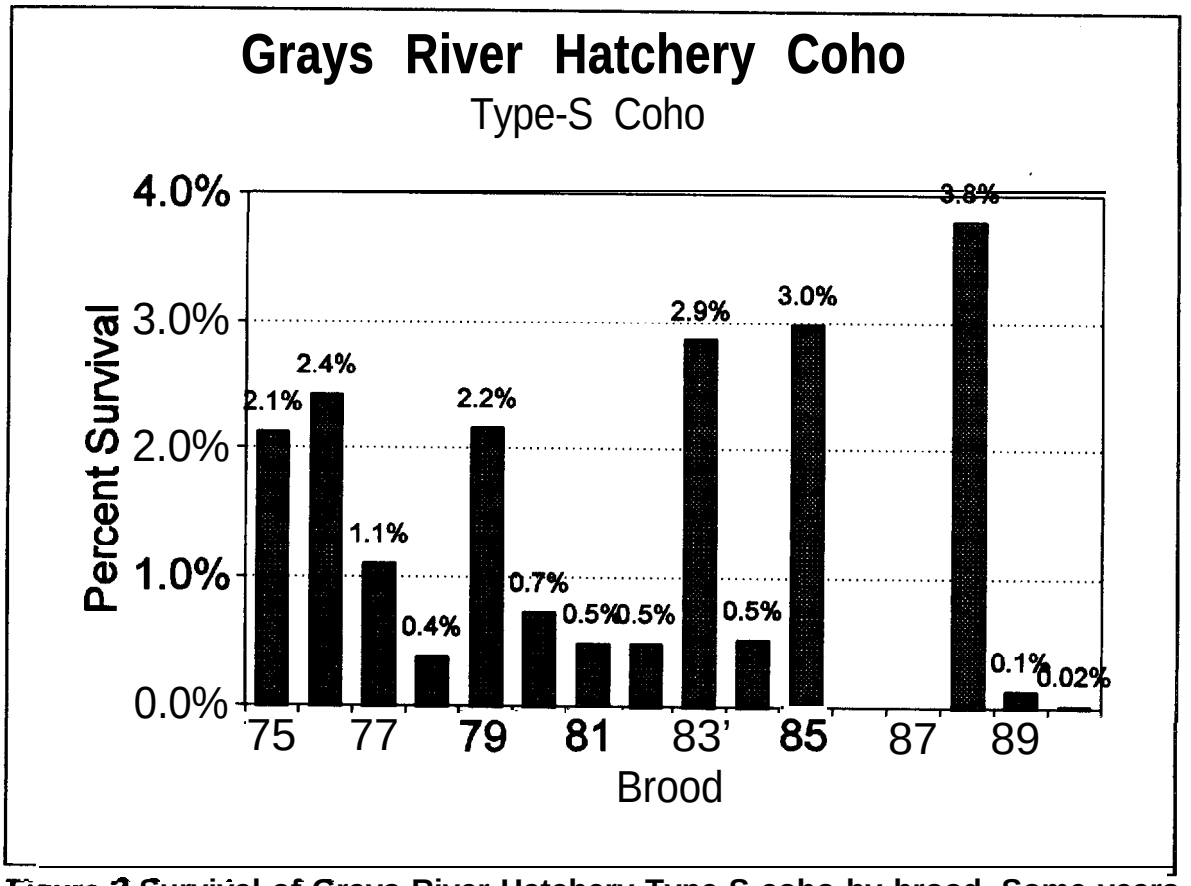

Figure 2 Survival of Grays River Hatchery Type-S coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

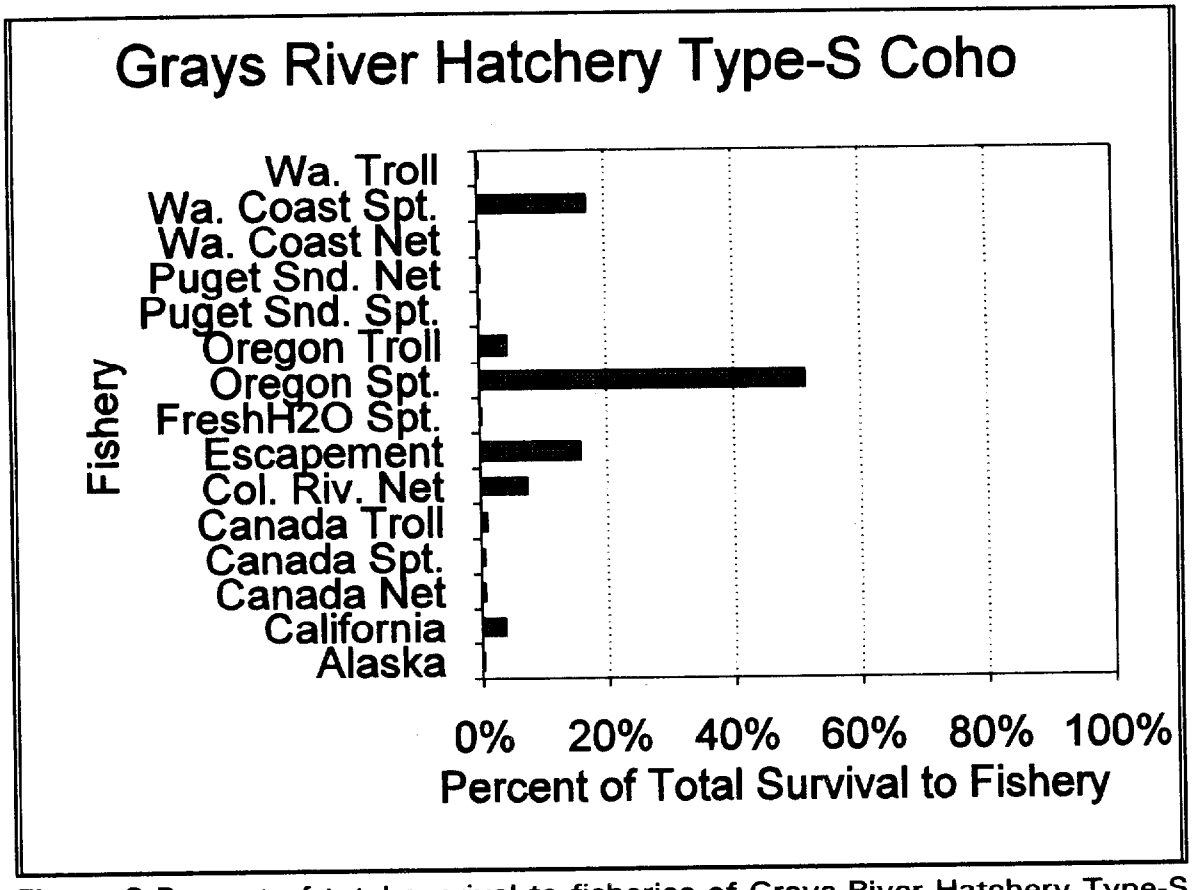

Figure 3 Percent of total survival to fisheries of Grays River Hatchery Type-S coho. Average of broods 1988-1990.

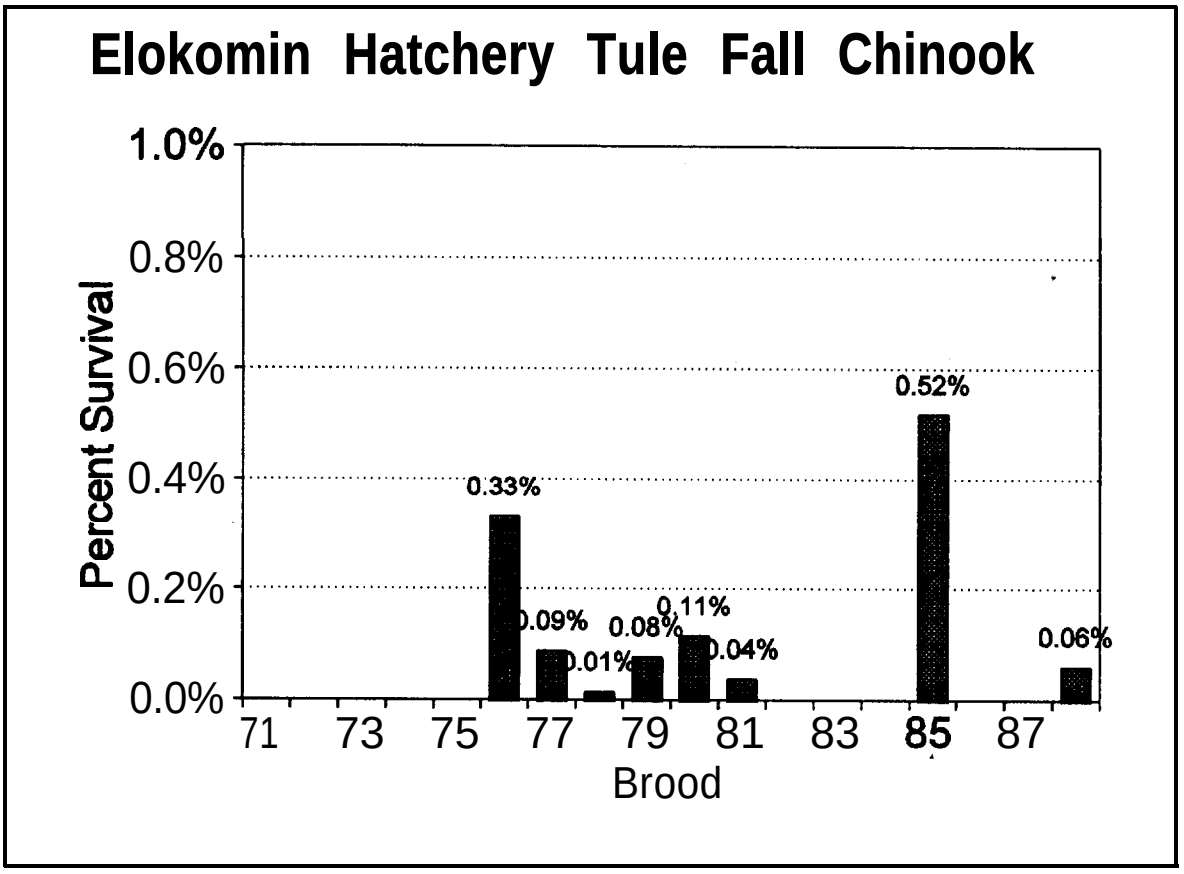

Figure 4 Survival of Elokomin Hatchery tule fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

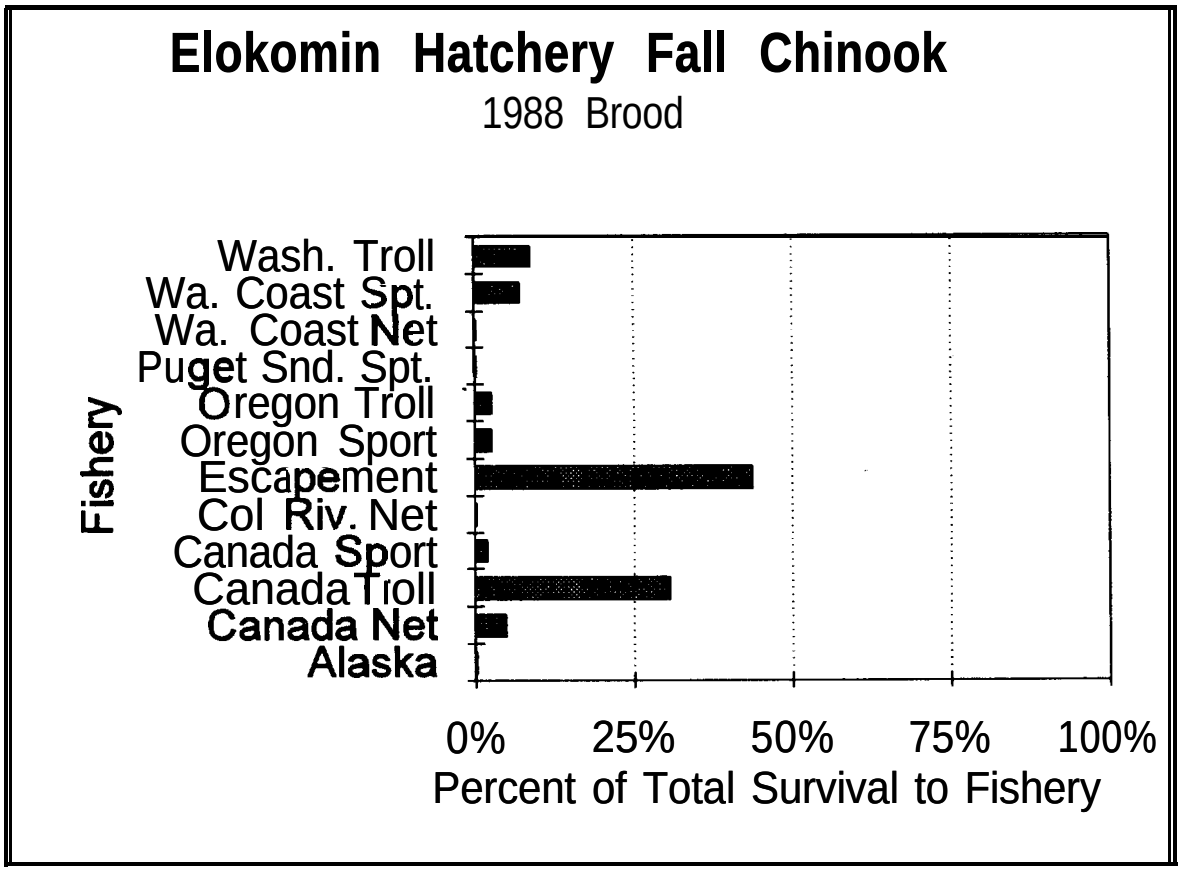

Figure 5 Percent of total survival to fisheries for 1988 brood Elokomin Hatchery fall chinook. Data represent an average of three tagged releases.

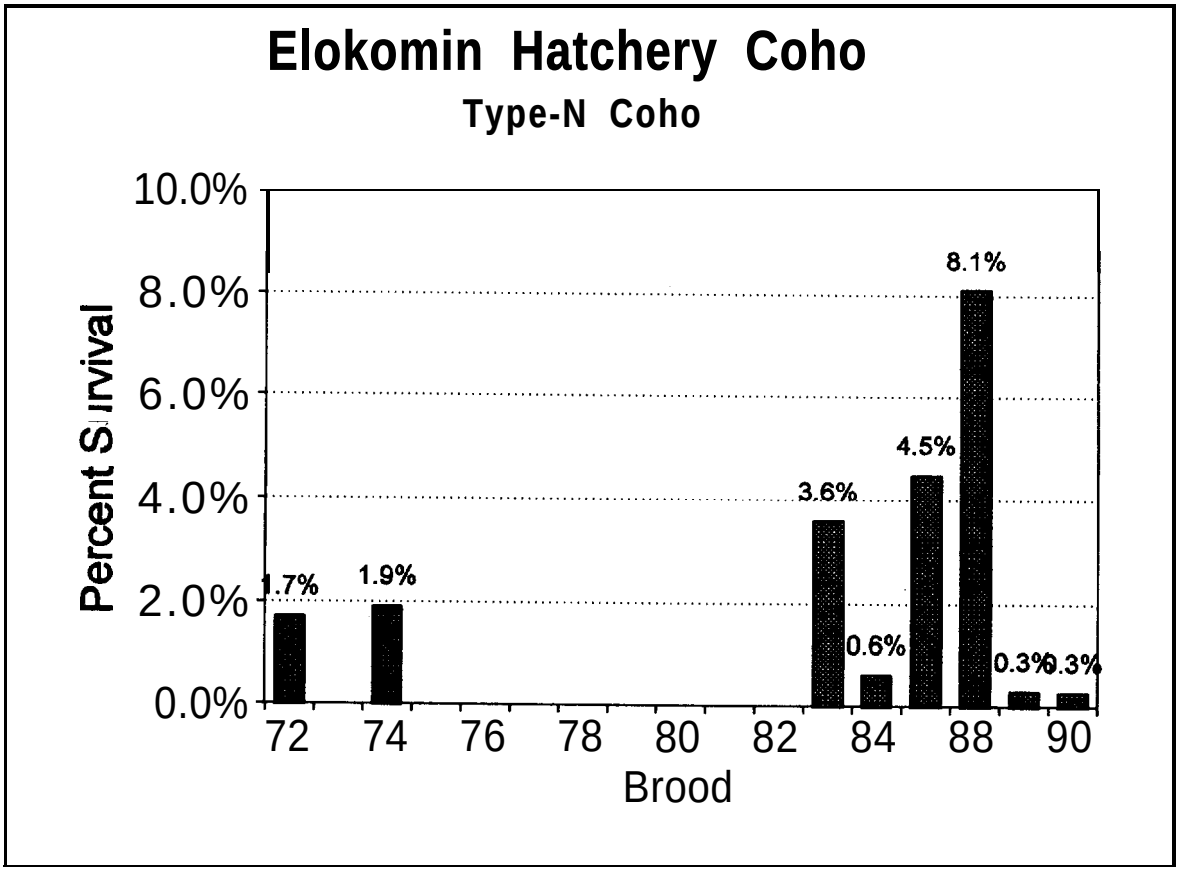

Figure 6 Survival of Elokomin Hatchery Type-N coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

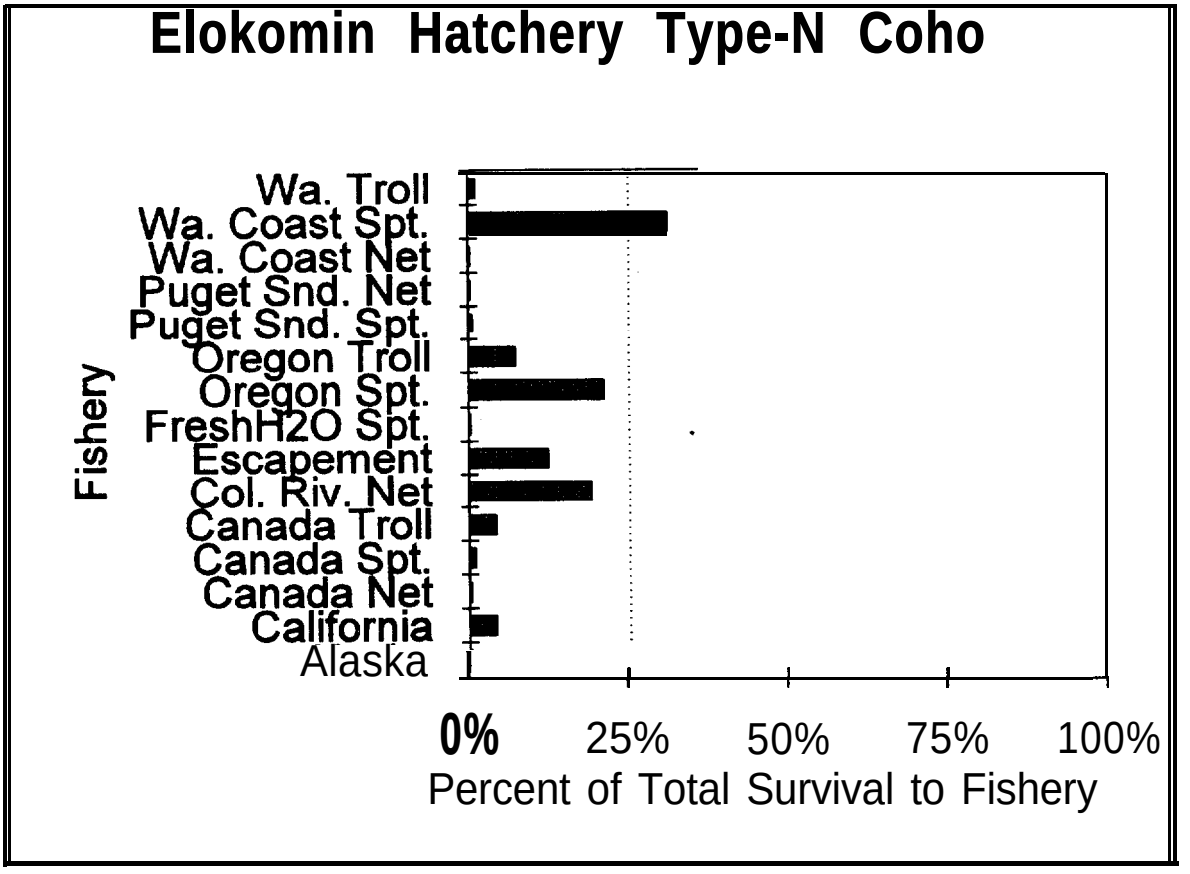

Figure 7 Percent of total survival to fisheries for Elokomin Hatchery Type-N coho. Average for 1988-1990 broods.

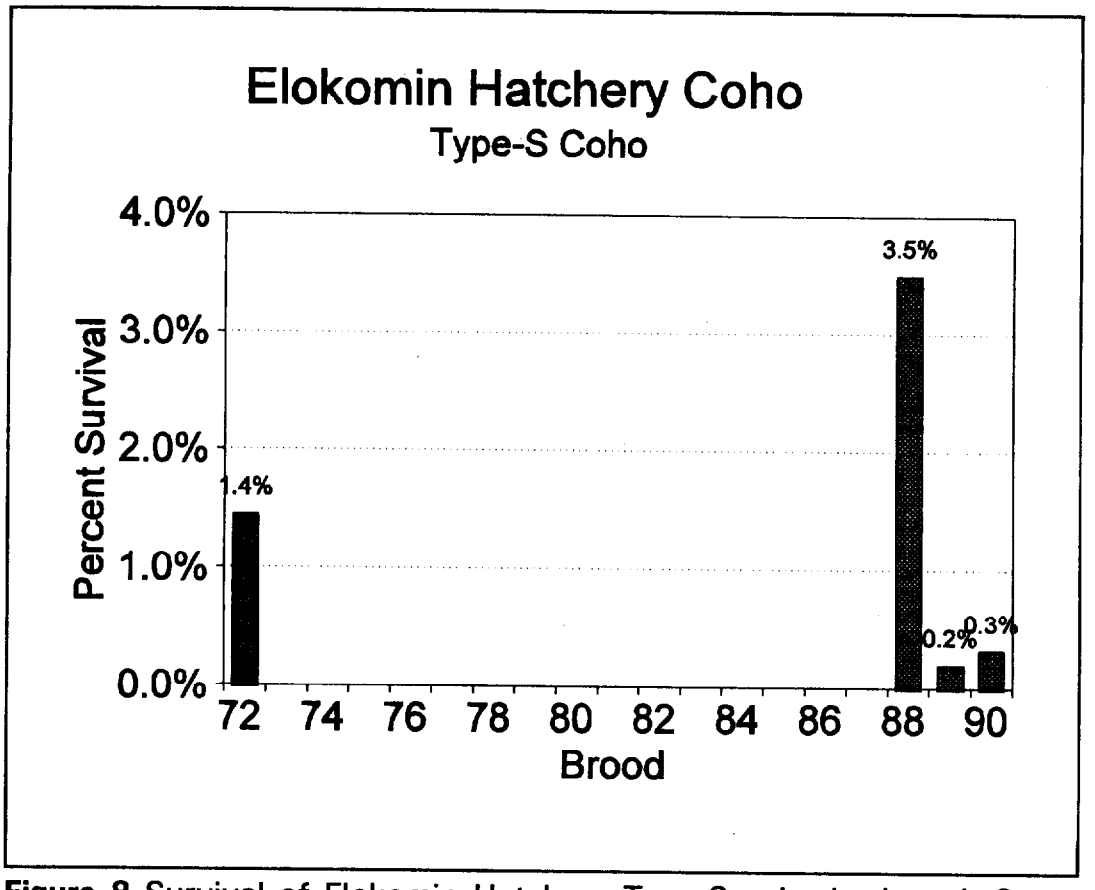

Figure 8 Survival of Elokomin Hatchery Type-S coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

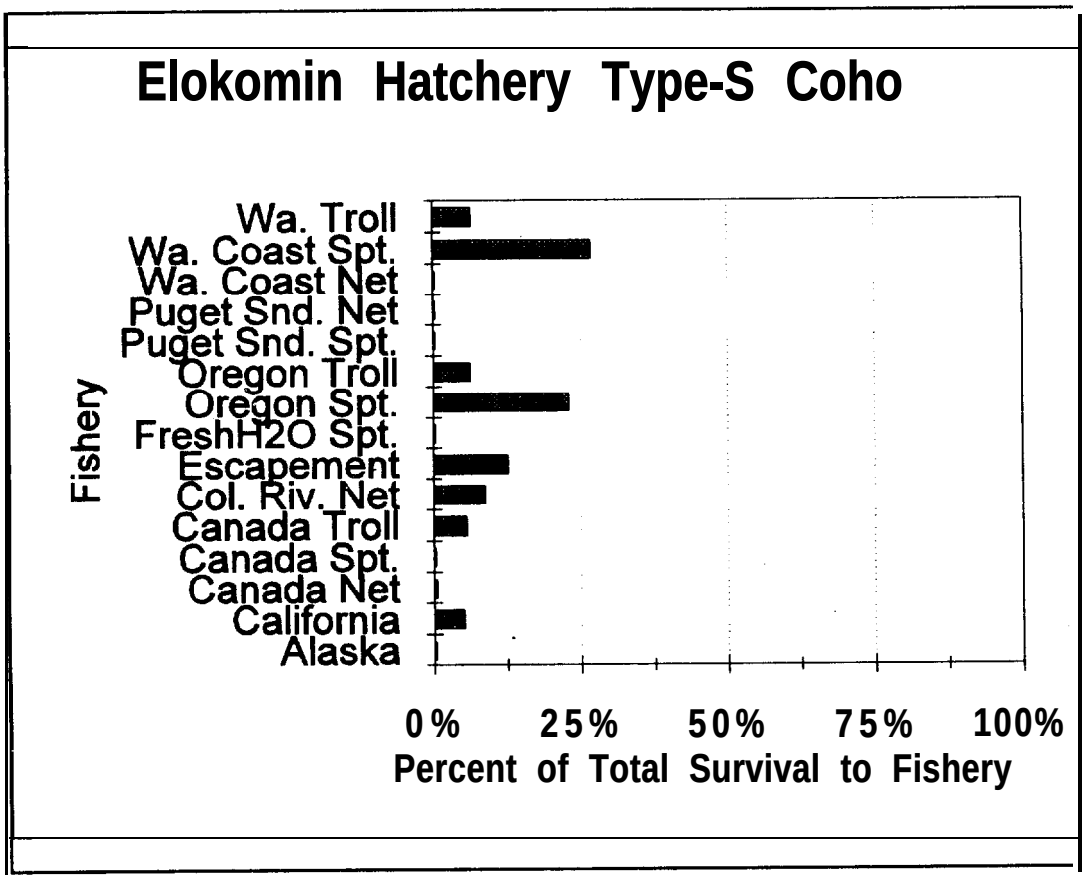

Figure 9 Percent of total survival to the fisheries for Elokomin Hatchery Type-S coho. Average for 1988-I 990 broods.

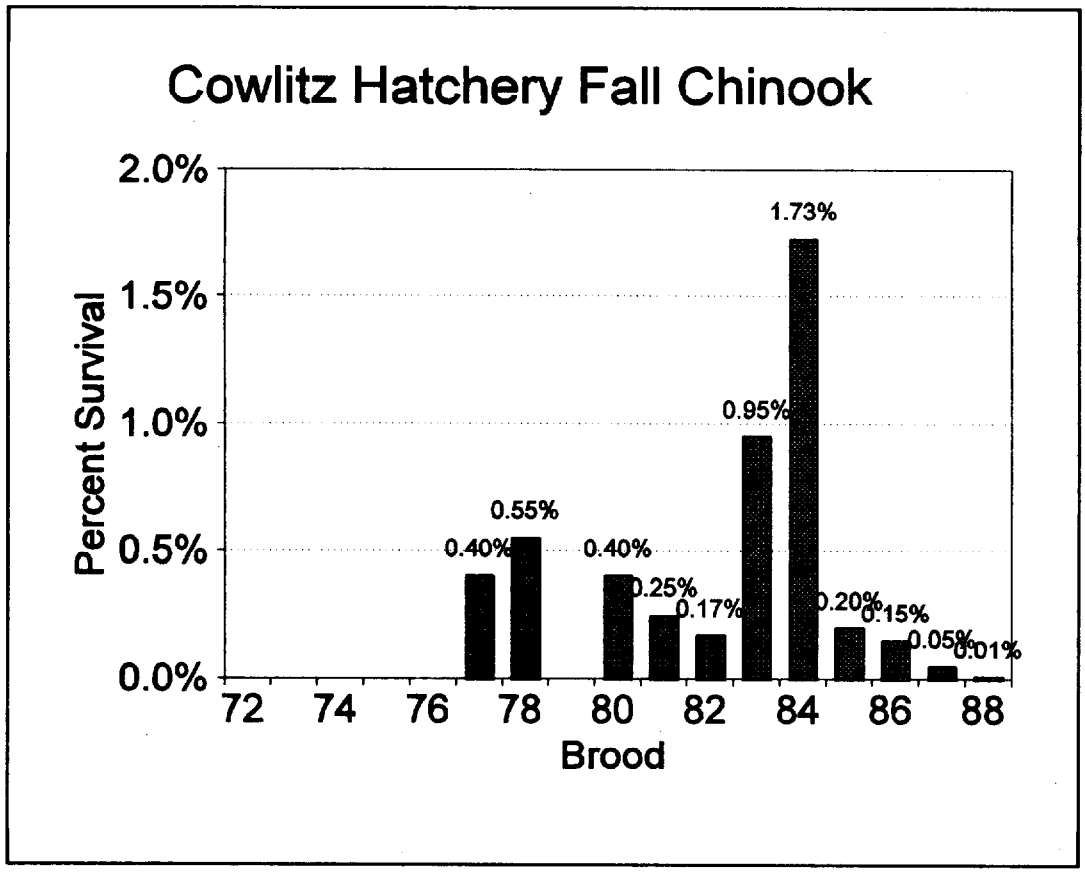

Figure 10 Survival of Cowlitz Hatchery tule fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

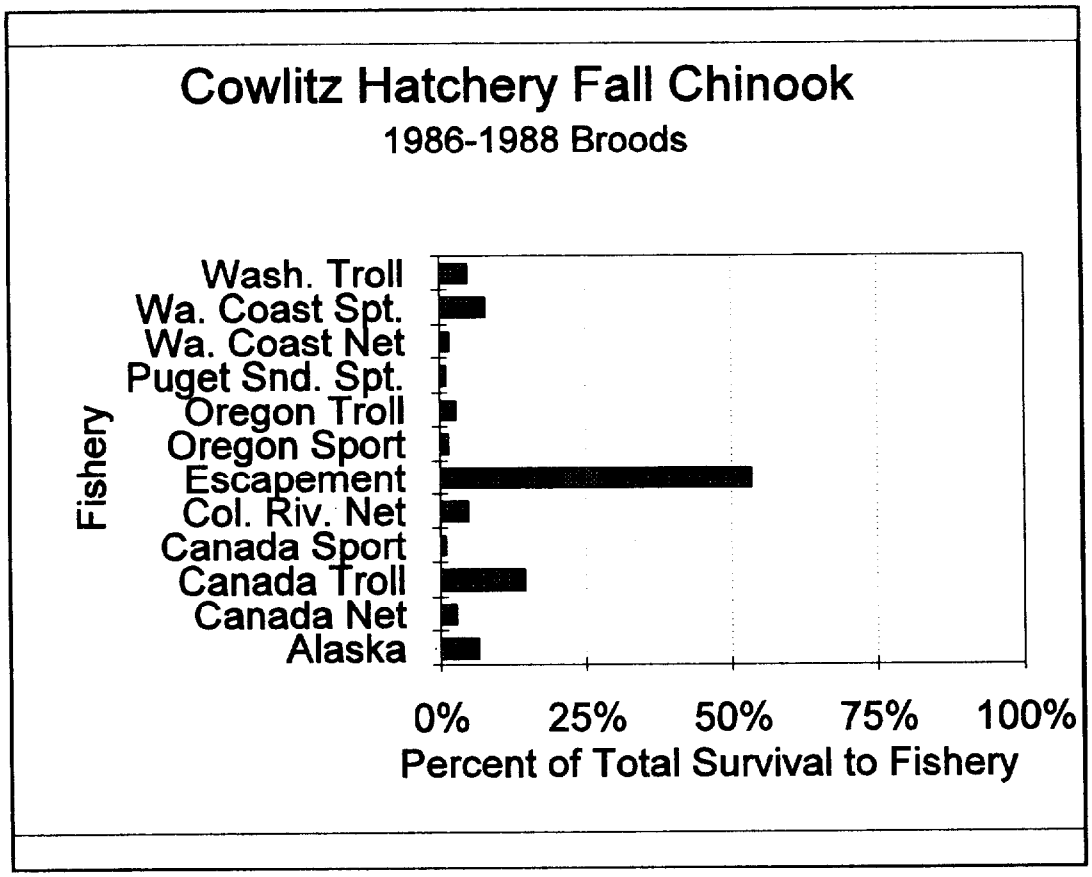

Figure 11 Percent of total survival to fisheries for Cowlitz Hatchery tule fall chinook. Average of broods 1986-1988.

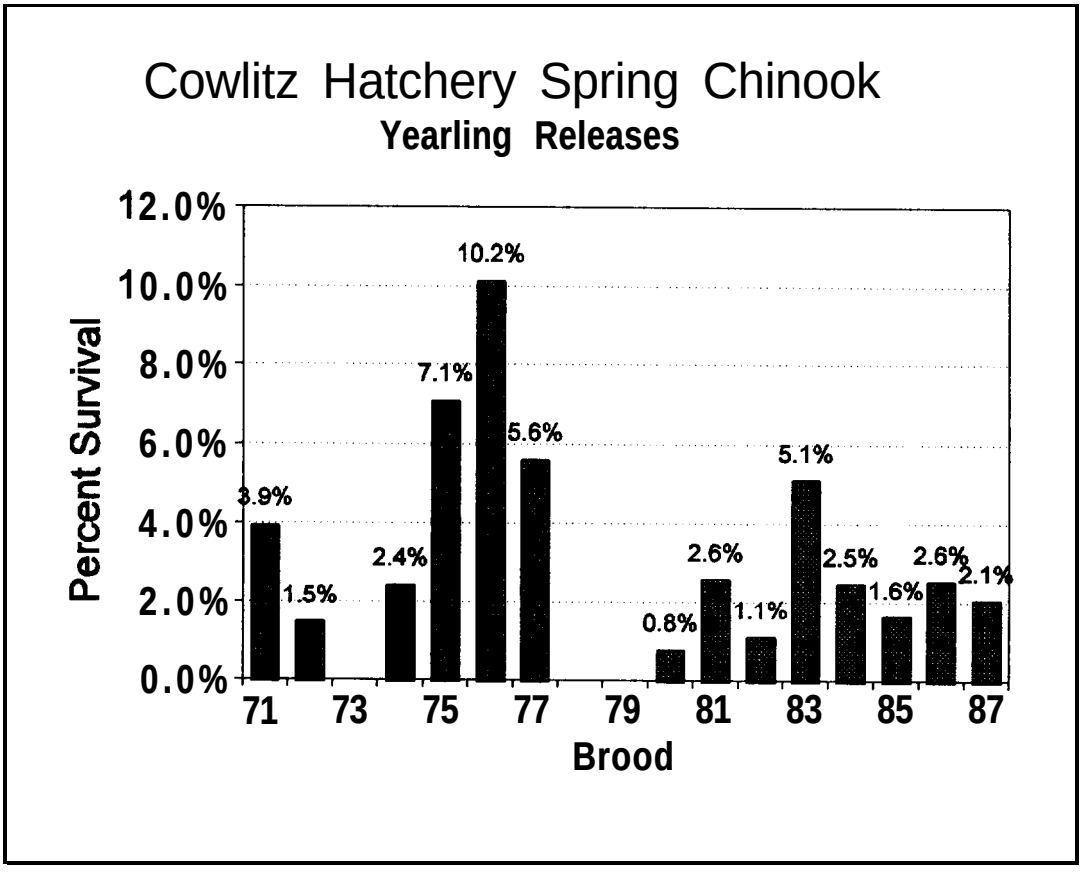

Figure 12 Survival of Cowlitz Hatchery spring chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

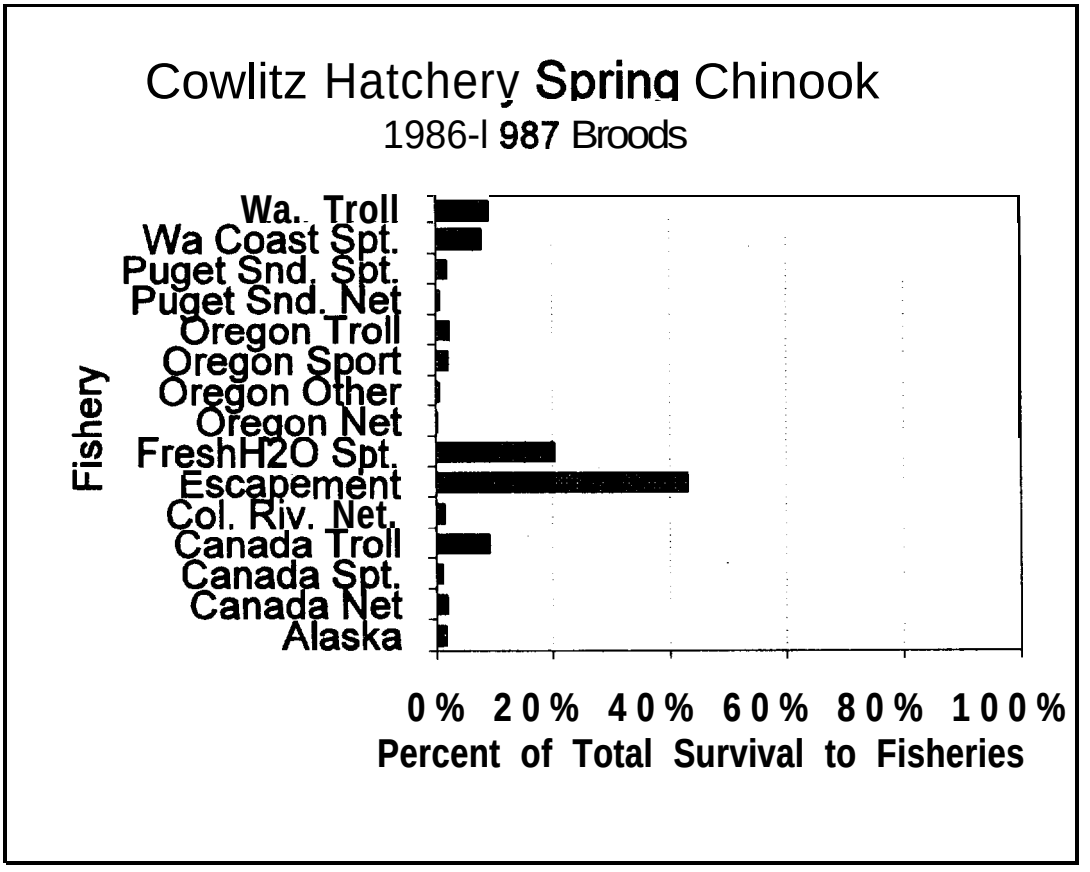

Figure 13 Percent of total survival to fisheries for Cowlitz Hatchery spring chinook. Average of broods 1986 and 1987.

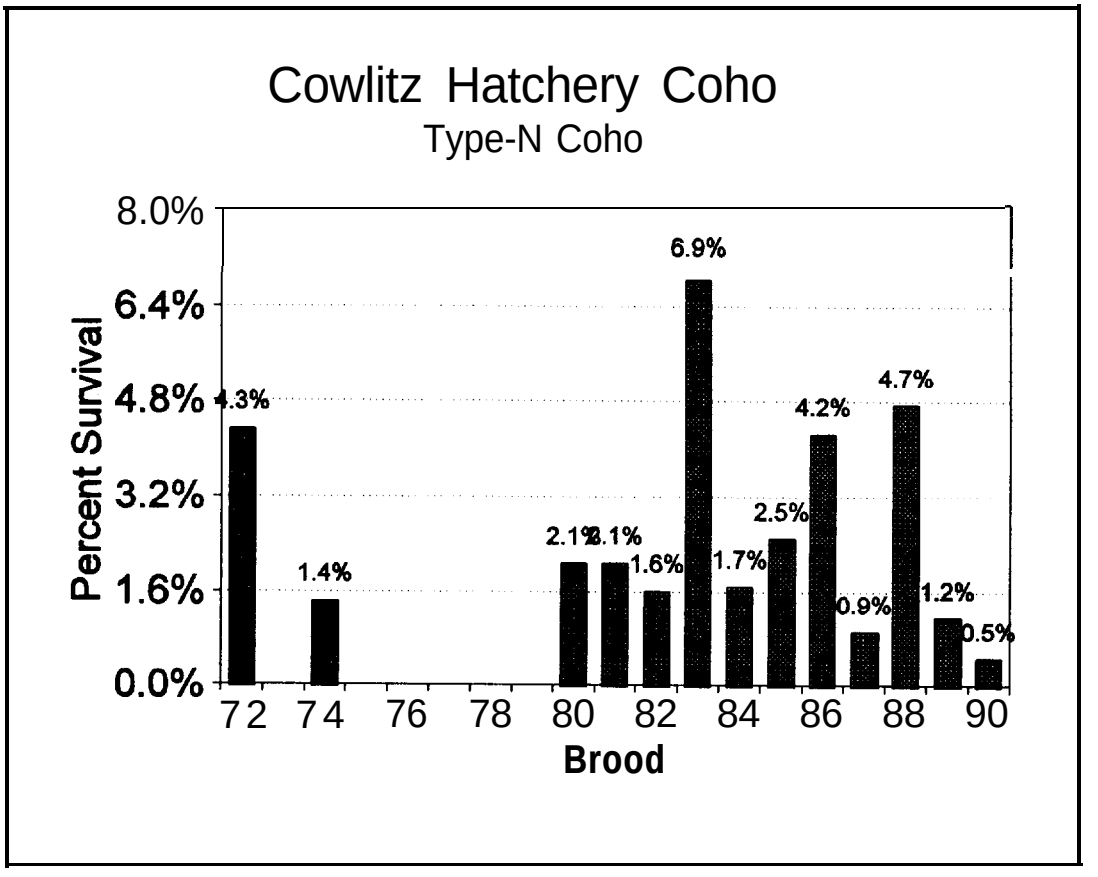

Figure 14 Survival of Cowlitz Hatchery Type-N coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

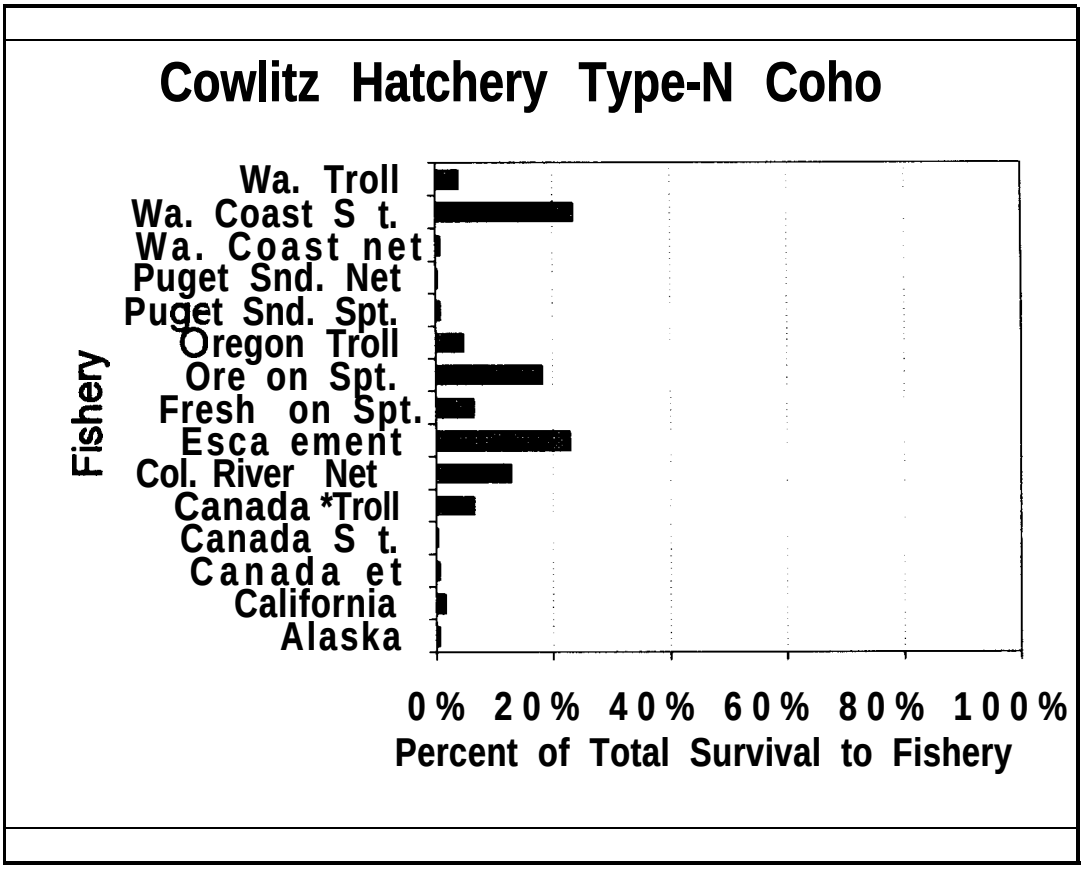

Figure 15 Percent of total survival to fisheries of Cowlitz Hatchery Type-N coho. Average of broods 1988-l 990.

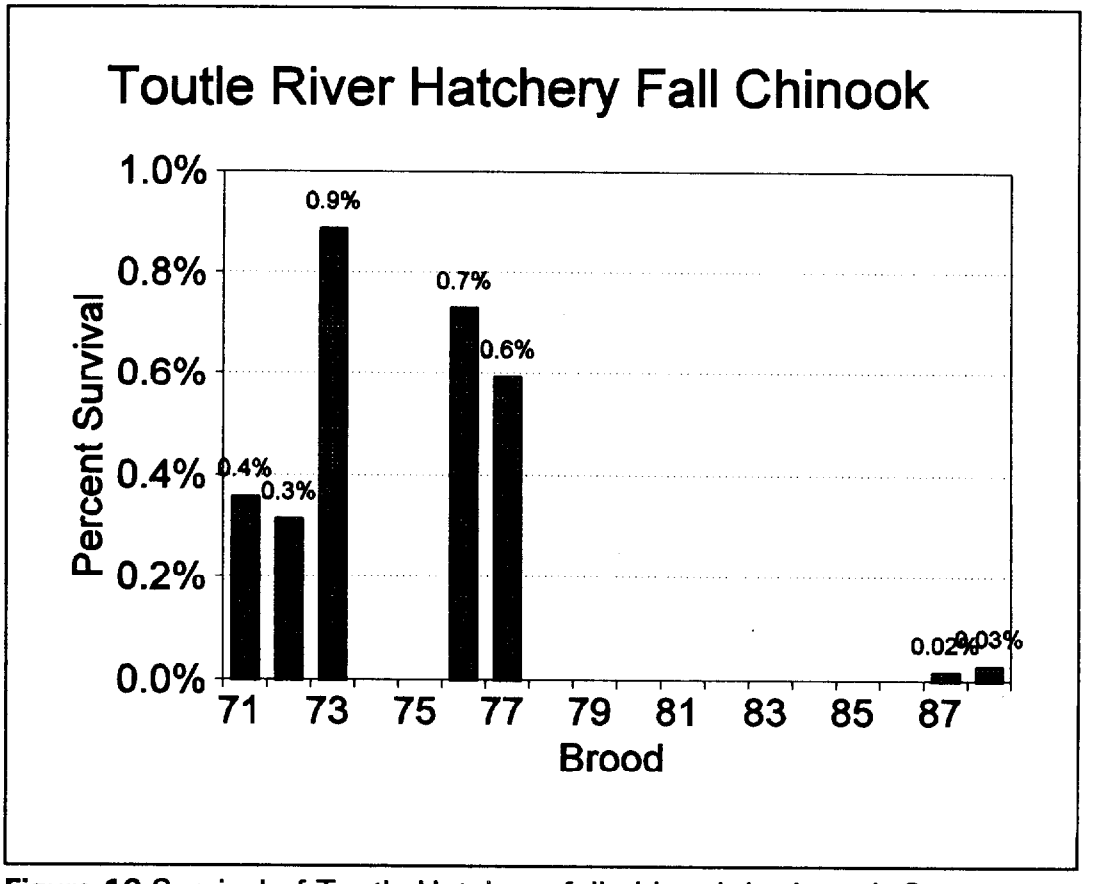

Figure 16 Survival of Toutle Hatchery fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

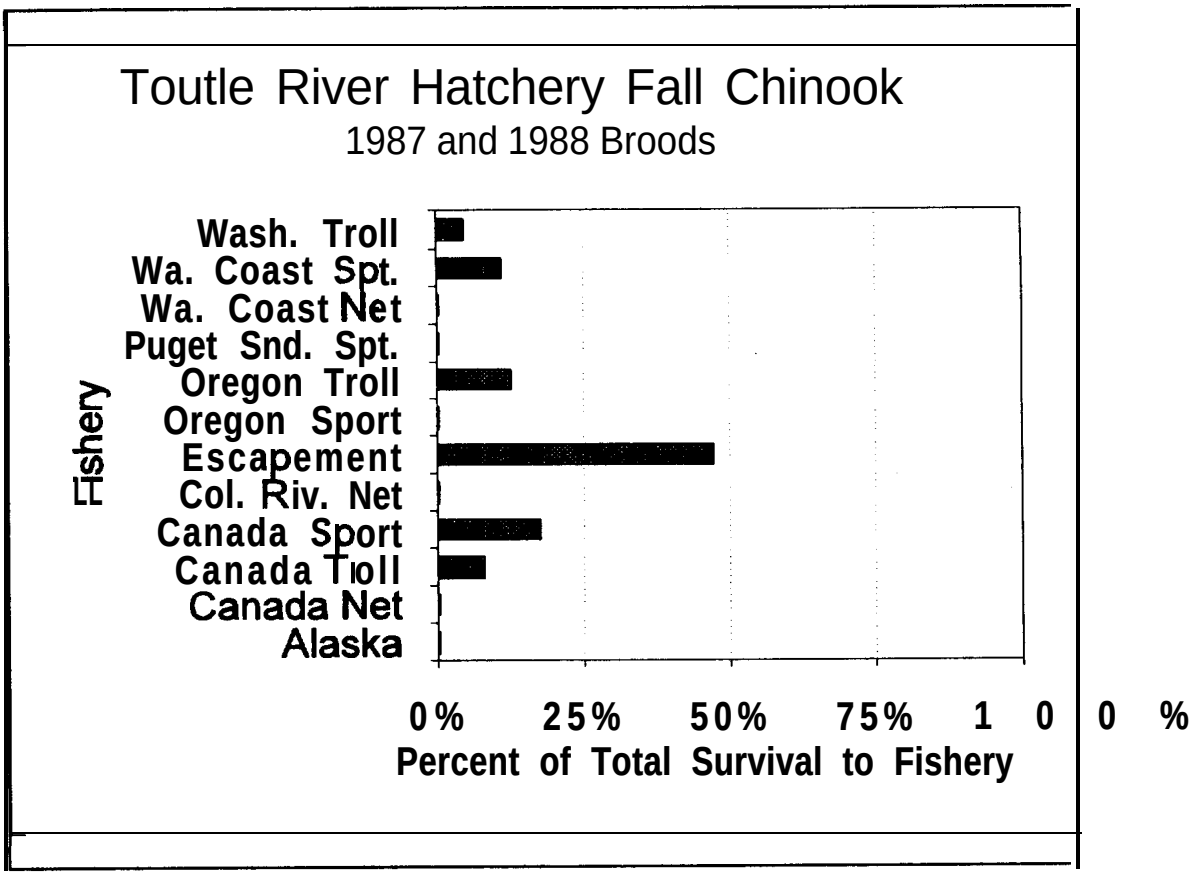

Figure 17 Percent of total survival to fisheries for Toutle River Hatchery fall chinook. Average of broods 1987 and 1988.

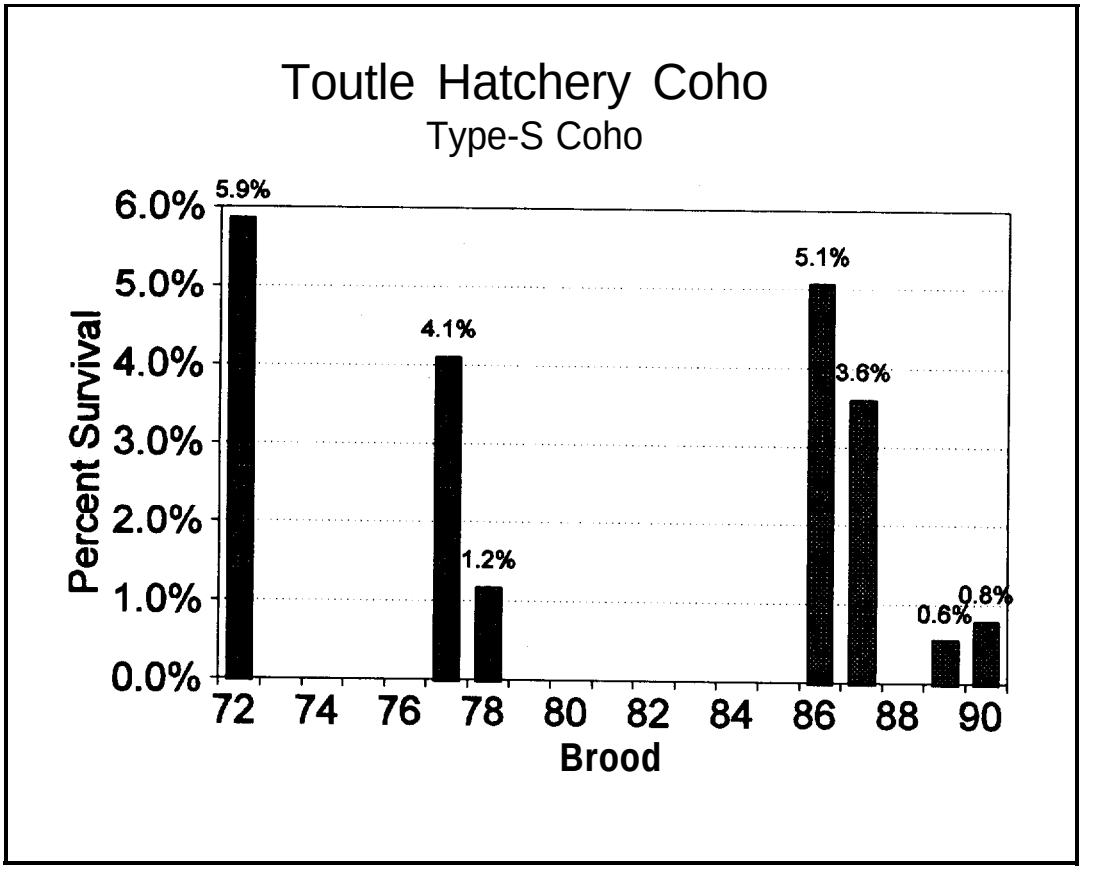

Figure 18 Survival of Toutle River Hatchery Type-S coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

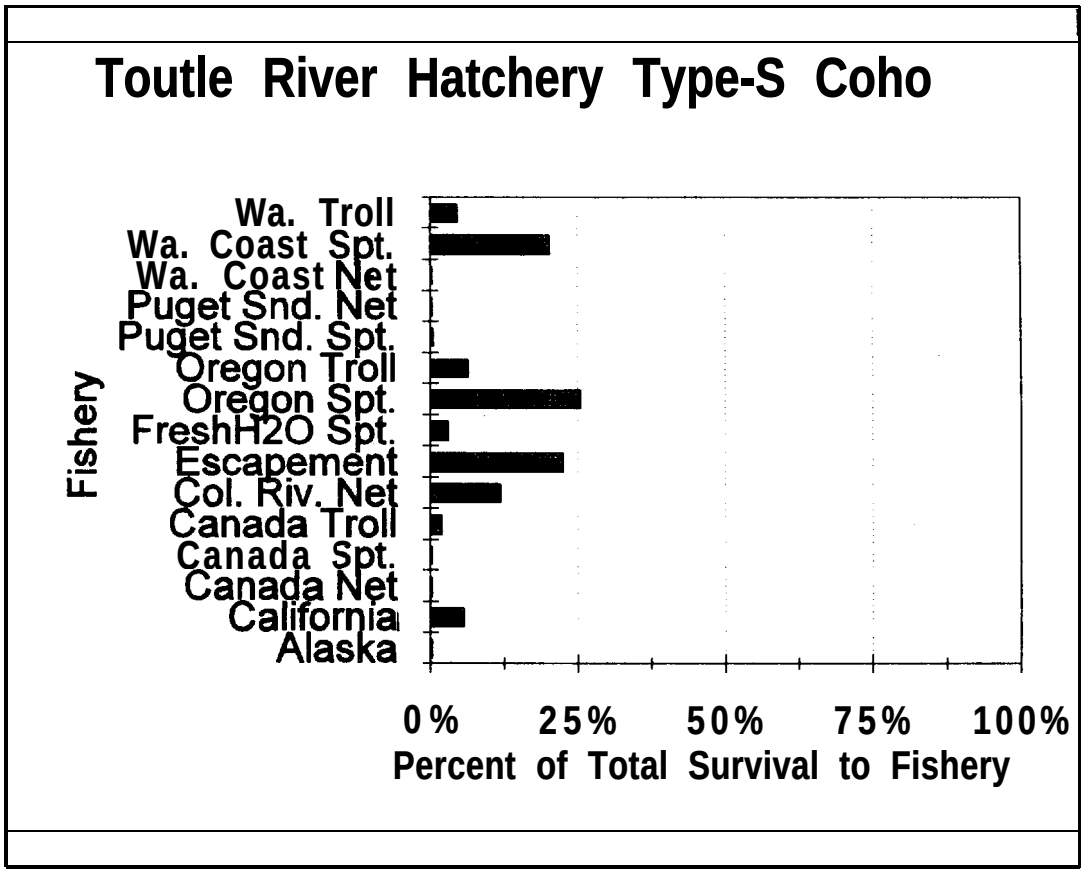

Figure 19 Percent of total survival to fisheries for Toutle Hatchery Type-S coho. Average of 1989 and 1990 broods.

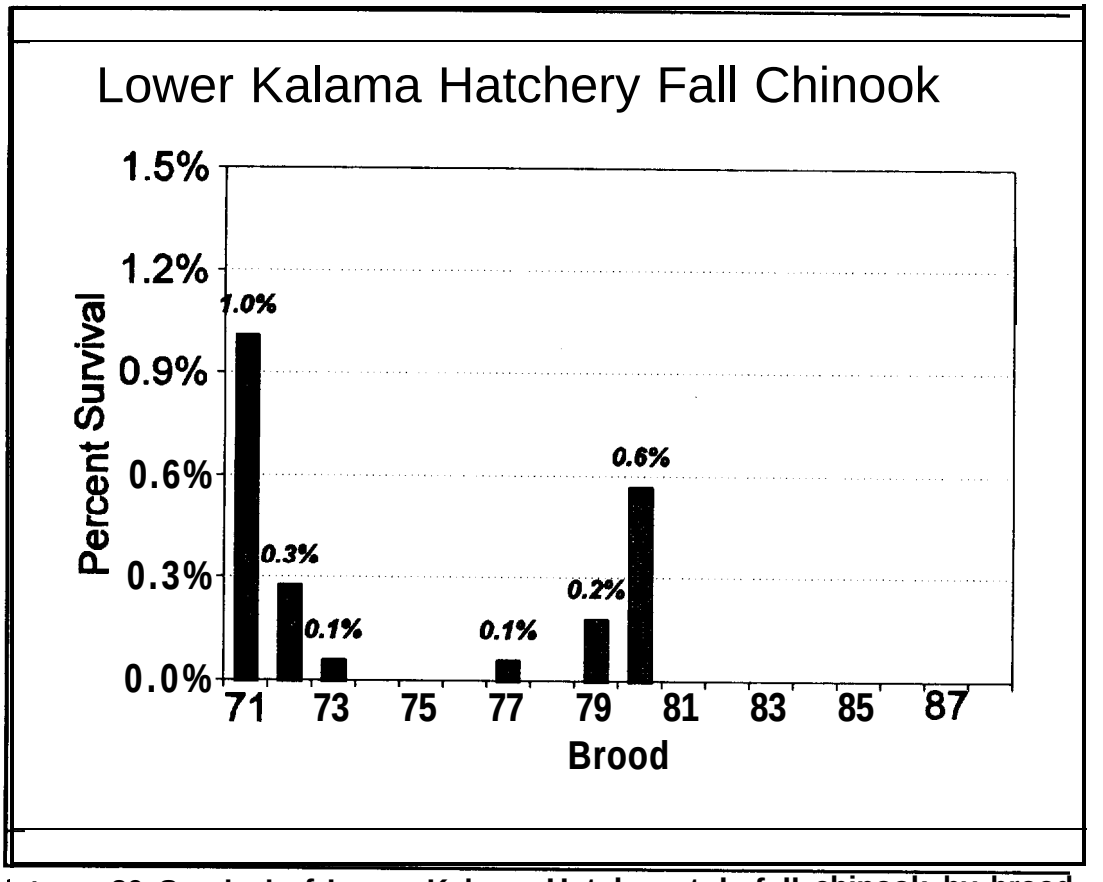

Figure 20 Survival of Lower Kalama Hatchery tule fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

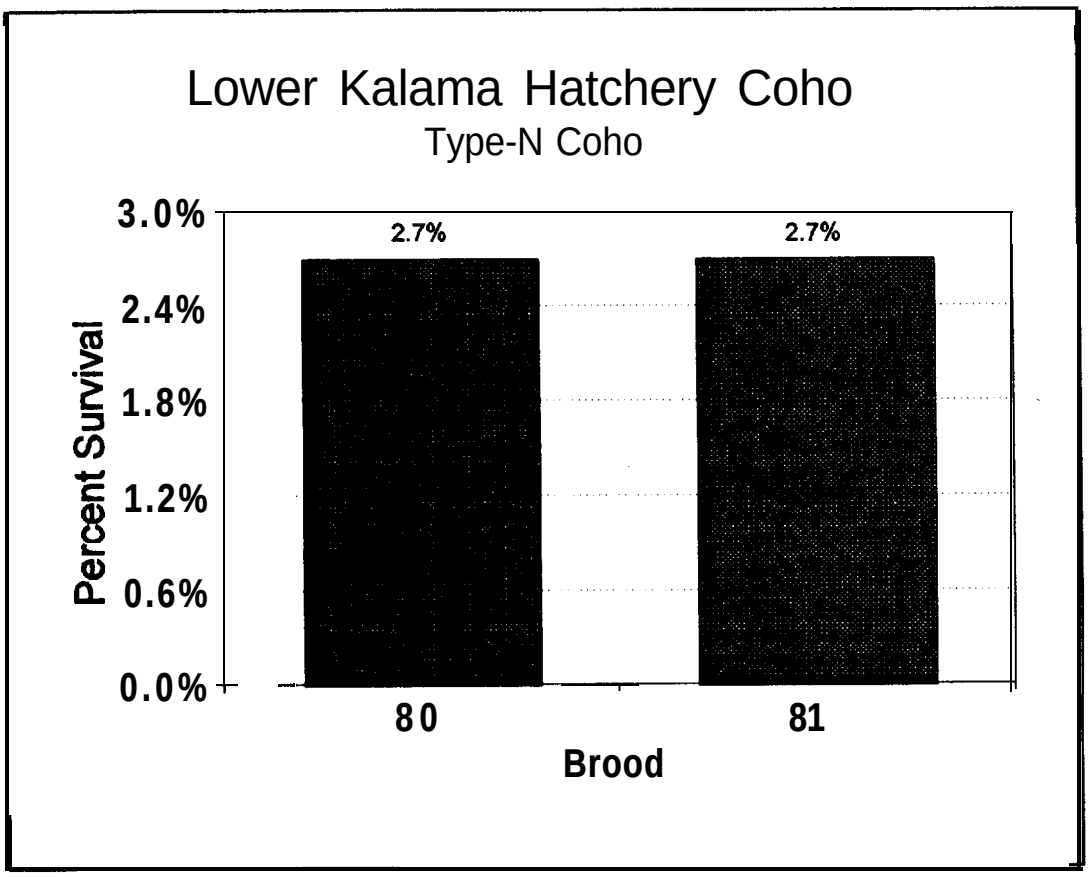

Figure 21 Survival of 1980 and 1981 brood Lower Kalama hatchery Type-N coho. Type-N coho are no longer released from this hatchery.

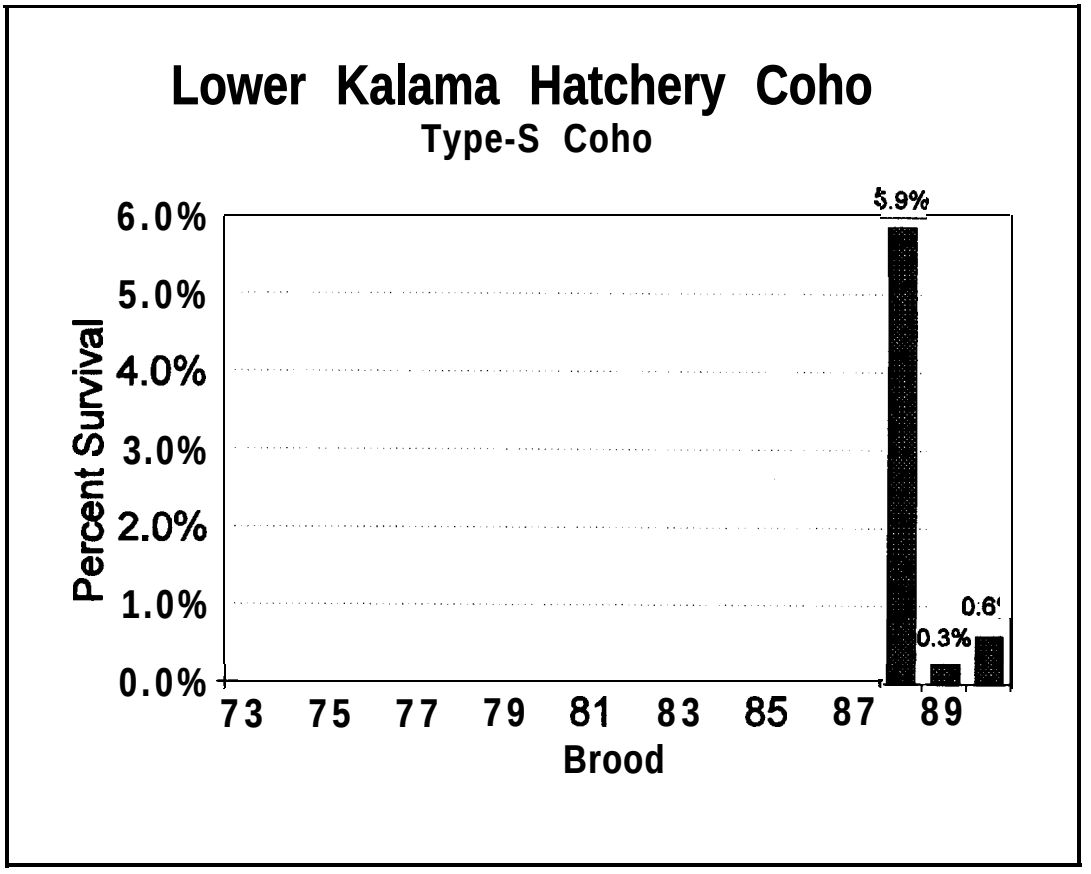

Figure 22 Survival of Lower Kalama Hatchery Type-S coho by brood. Each brood is represented by a single point estimate of survival.

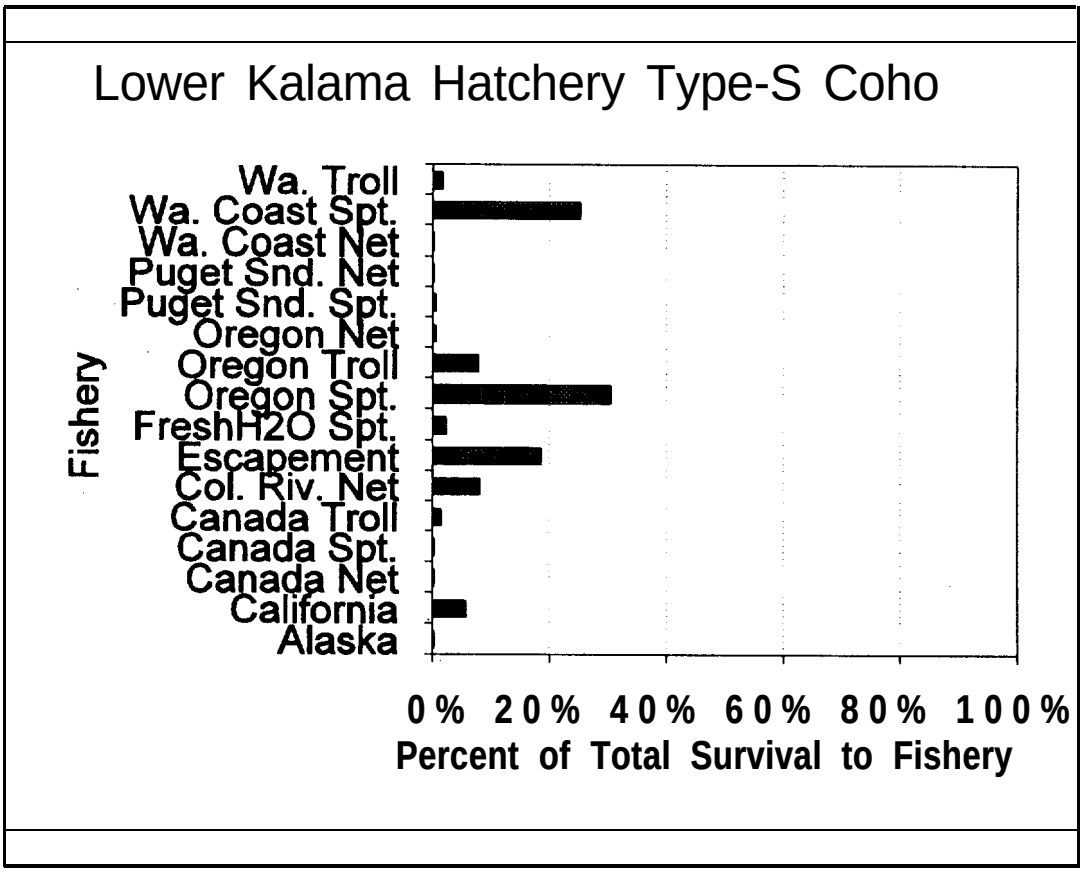

Figure 23 Percent of total survival to fisheries for Lower Kalama Hatchery Type-S coho. Average of broods 1988-1990.

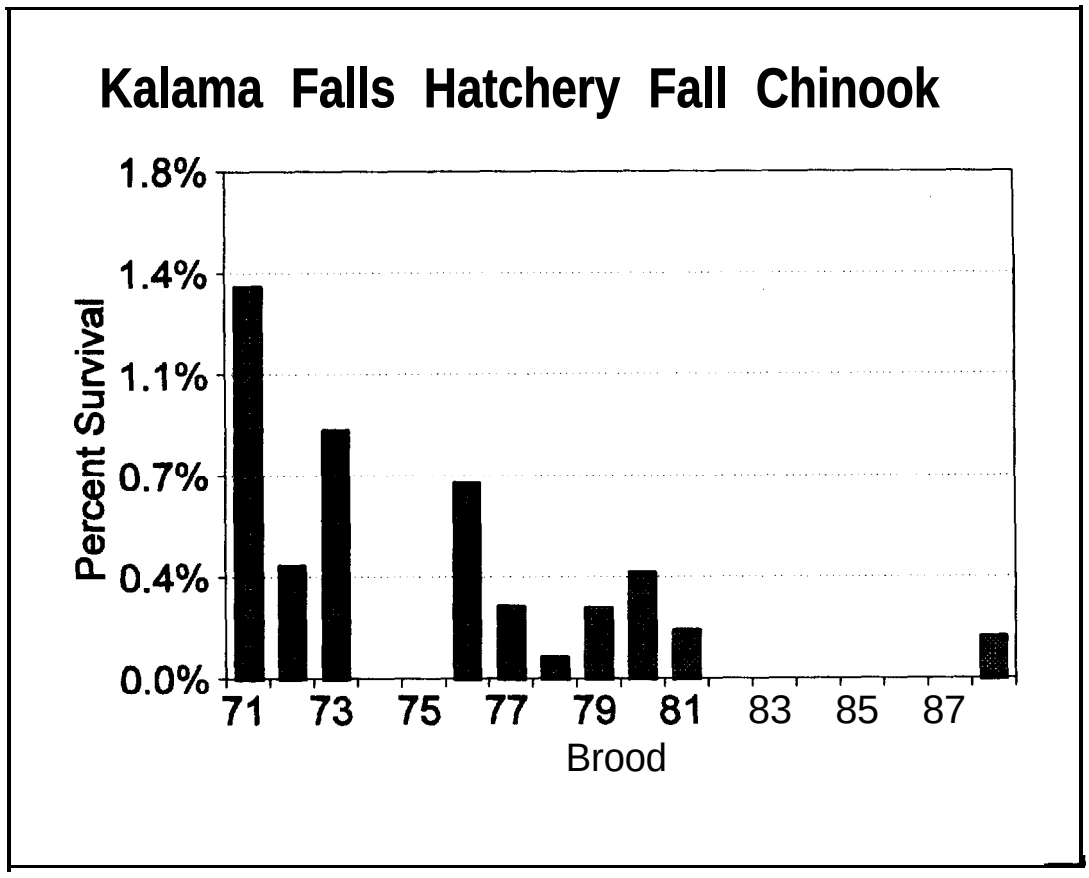

Figure 24 Survival of Kalama Falls Hatchery tule fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

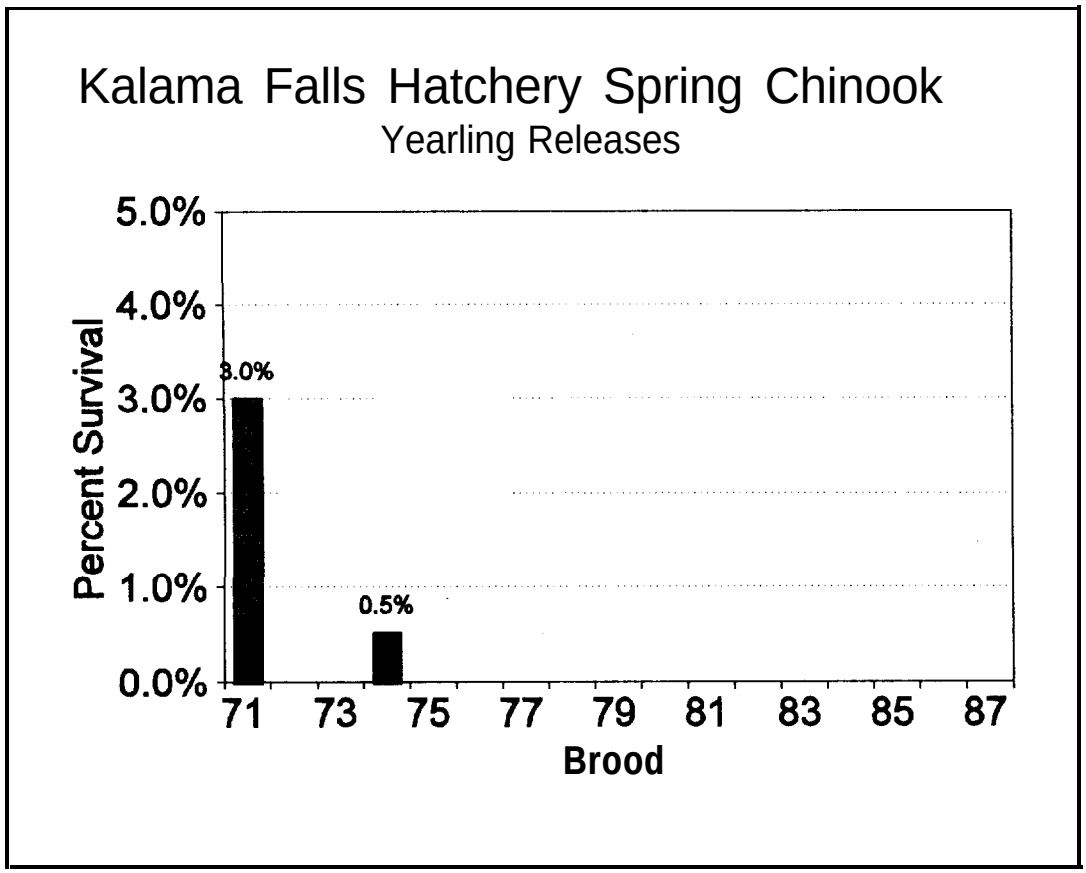

Figure 25 Survival of Kalama Falls hatchery spring chinook by brood. More recent broods have been tagged but data are not yet available to report.

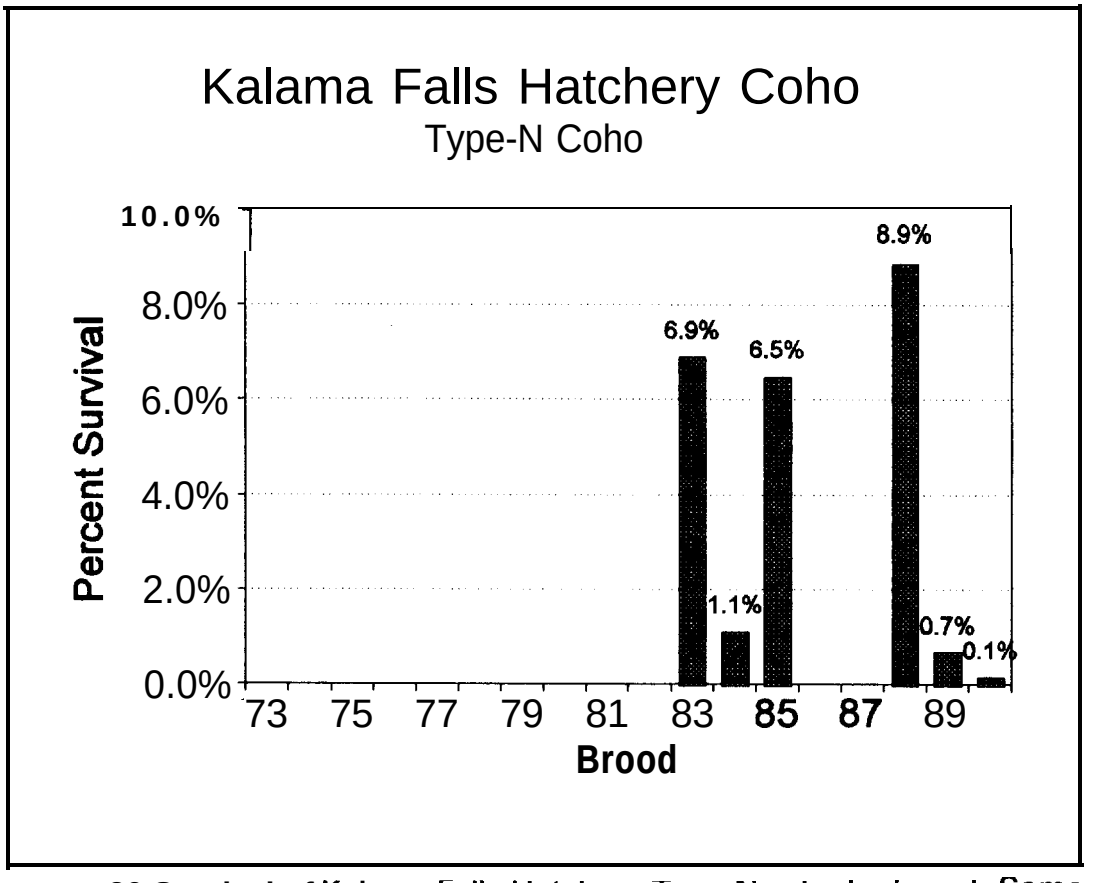

Figure 26 Survival of Kalama Falls Hatchery Type-N coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

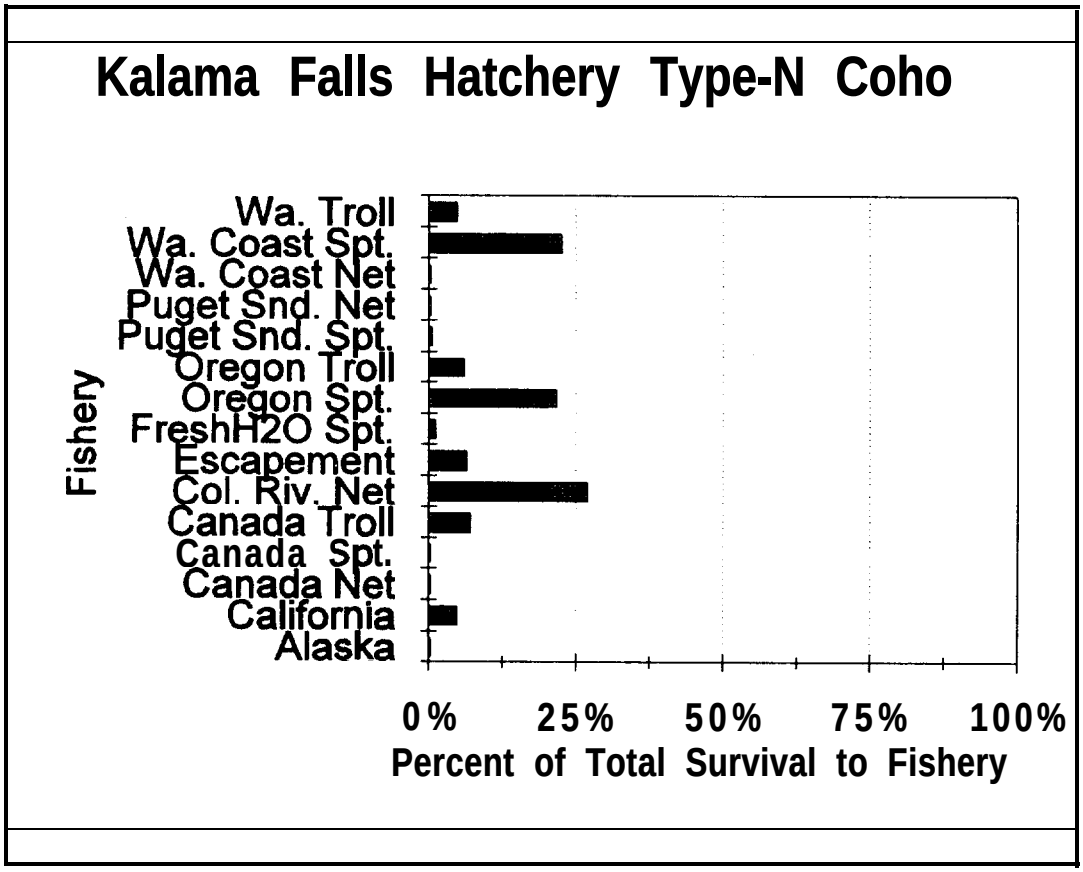

Figure 27 Percent of total survival to fisheries for Kalama Falls Hatchery Type-N coho. Average of broods 1988-1 990.

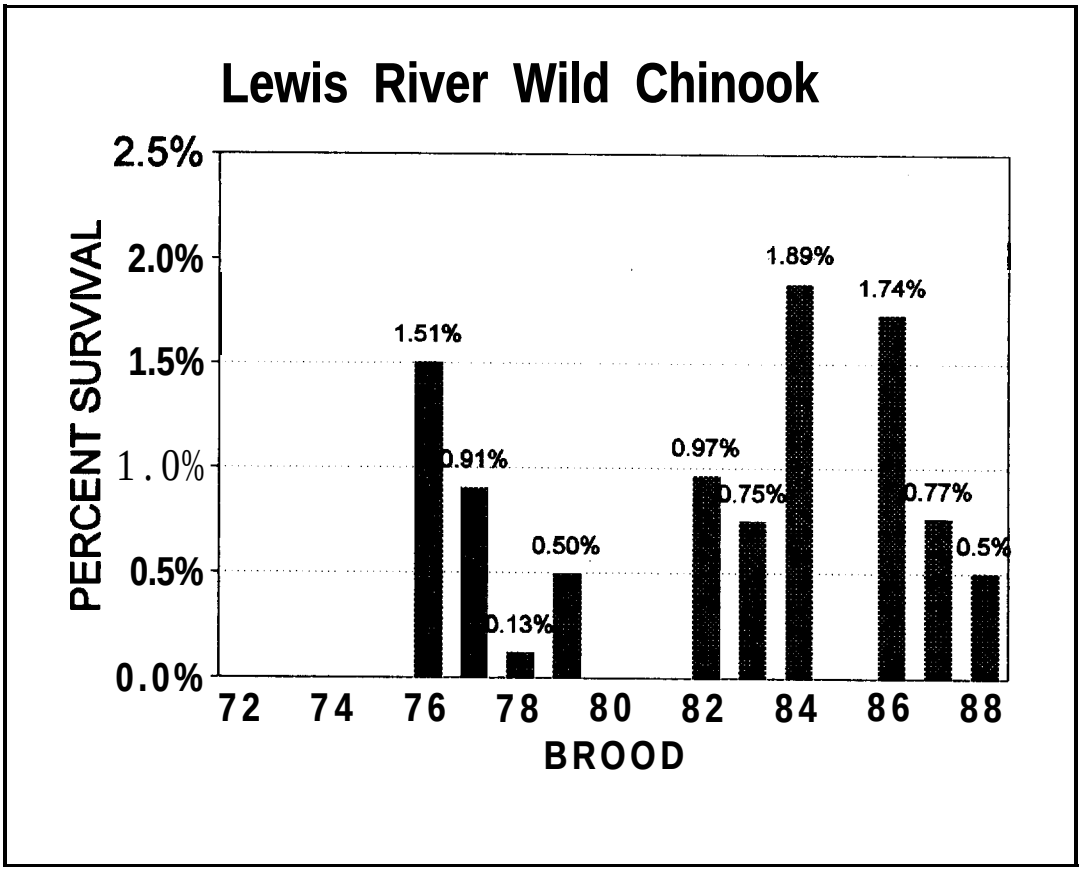

Figure 28 Survival of Lewis River wild fall chinook by brood. some years represent an average of several tagged releases and others a single point estimate of survival.

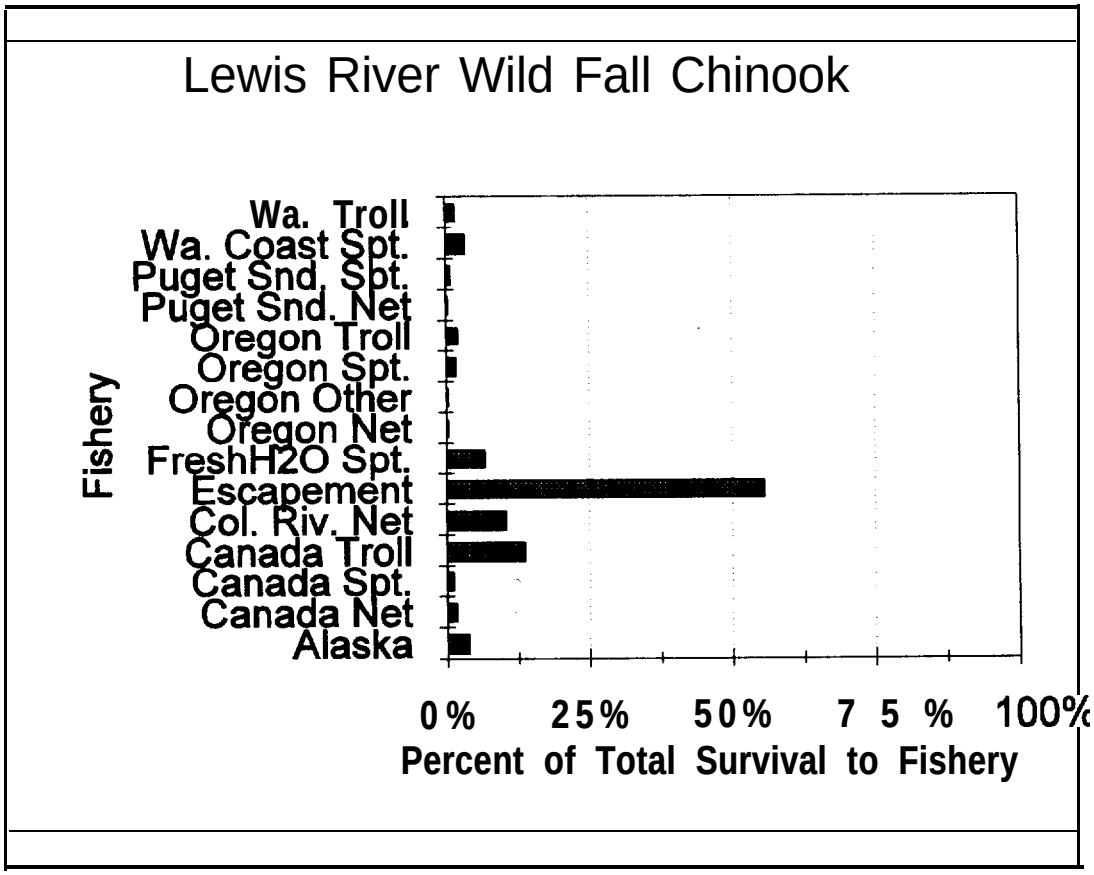

Figure 29 Percent of total survival to fisheries of Lewis River wild fall chinook. Average of broods 1986-1988.

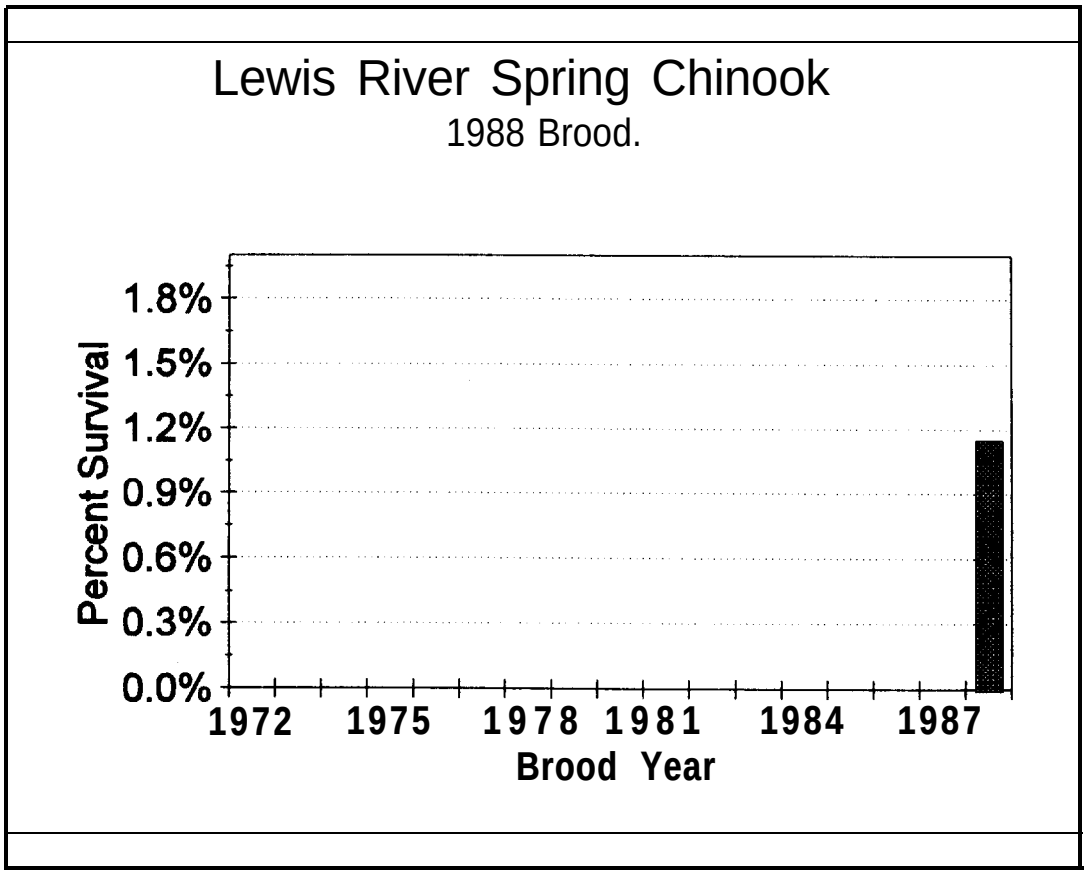

Figure 30 Survival of 1988 brood Lewis River Hatchery spring chinook.

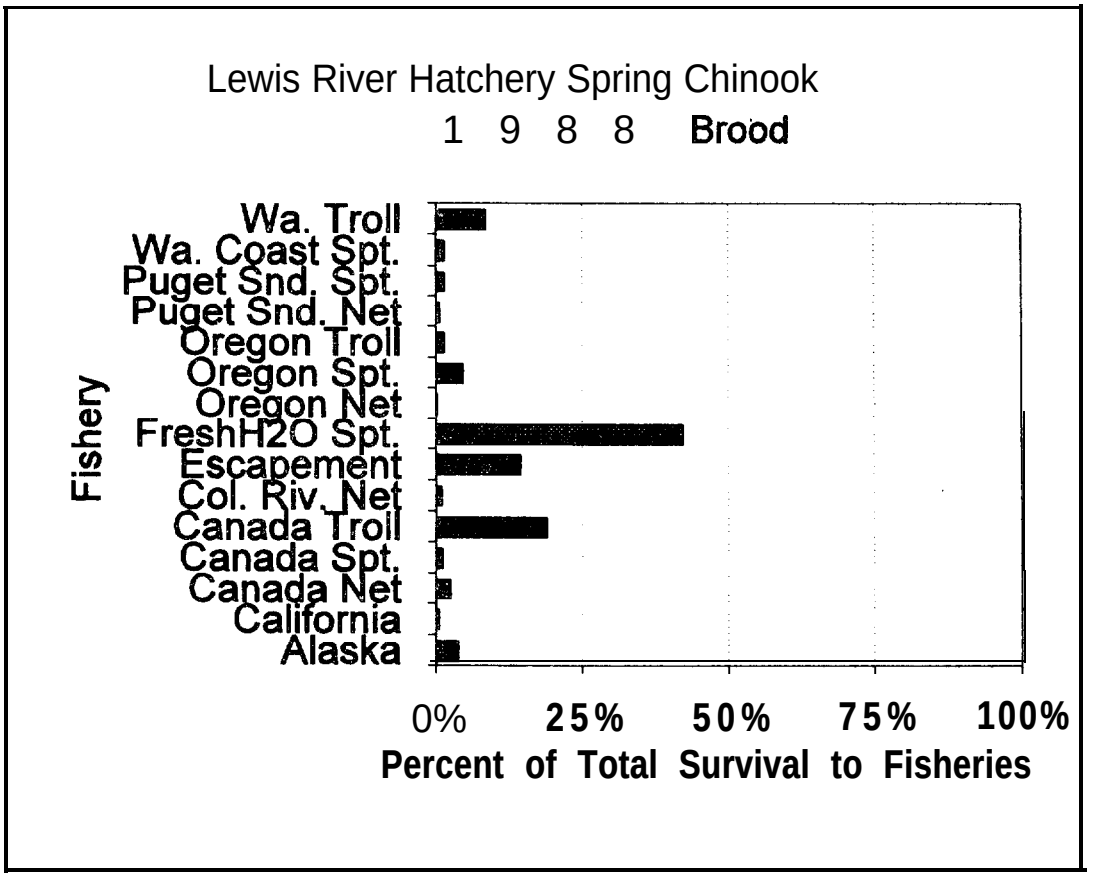

Figure 31 Percent of total survival to fisheries for Lewis River Hatchery spring chinook. Average for 1988 brood only.

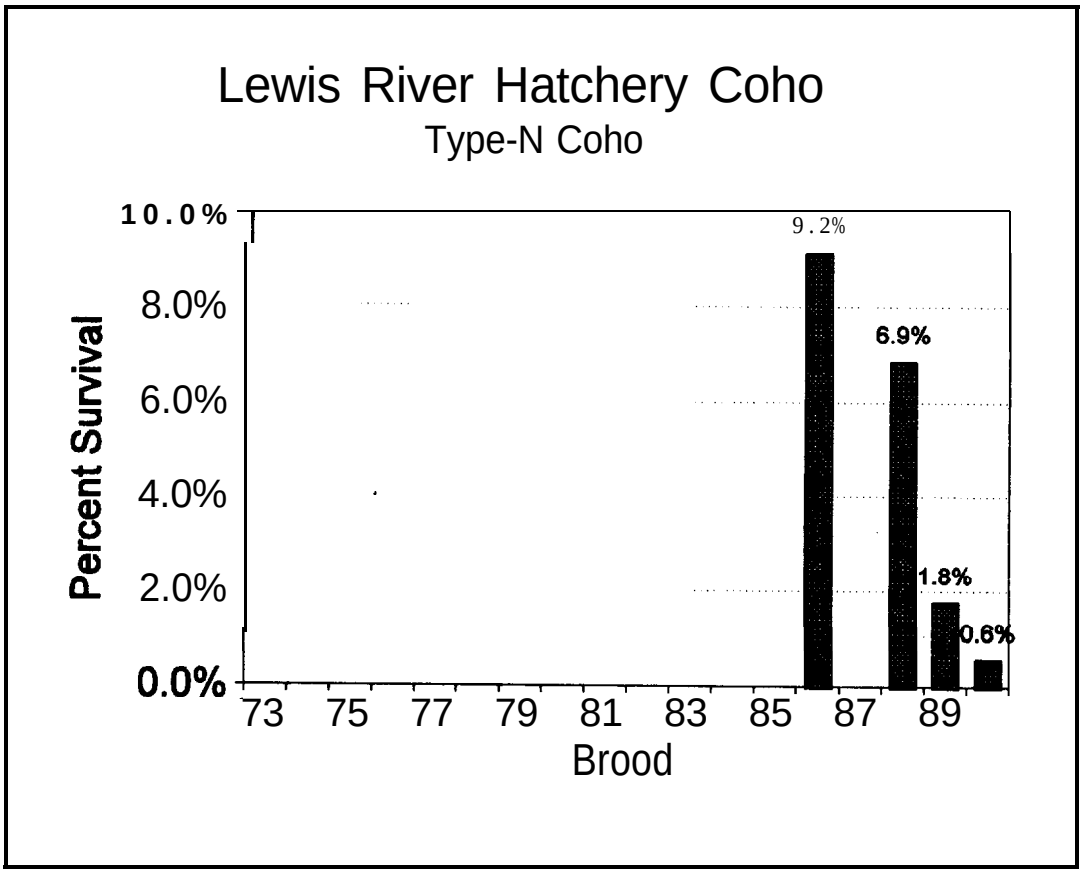

Figure 32 Survival of Lewis River Hatchery Type-N coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

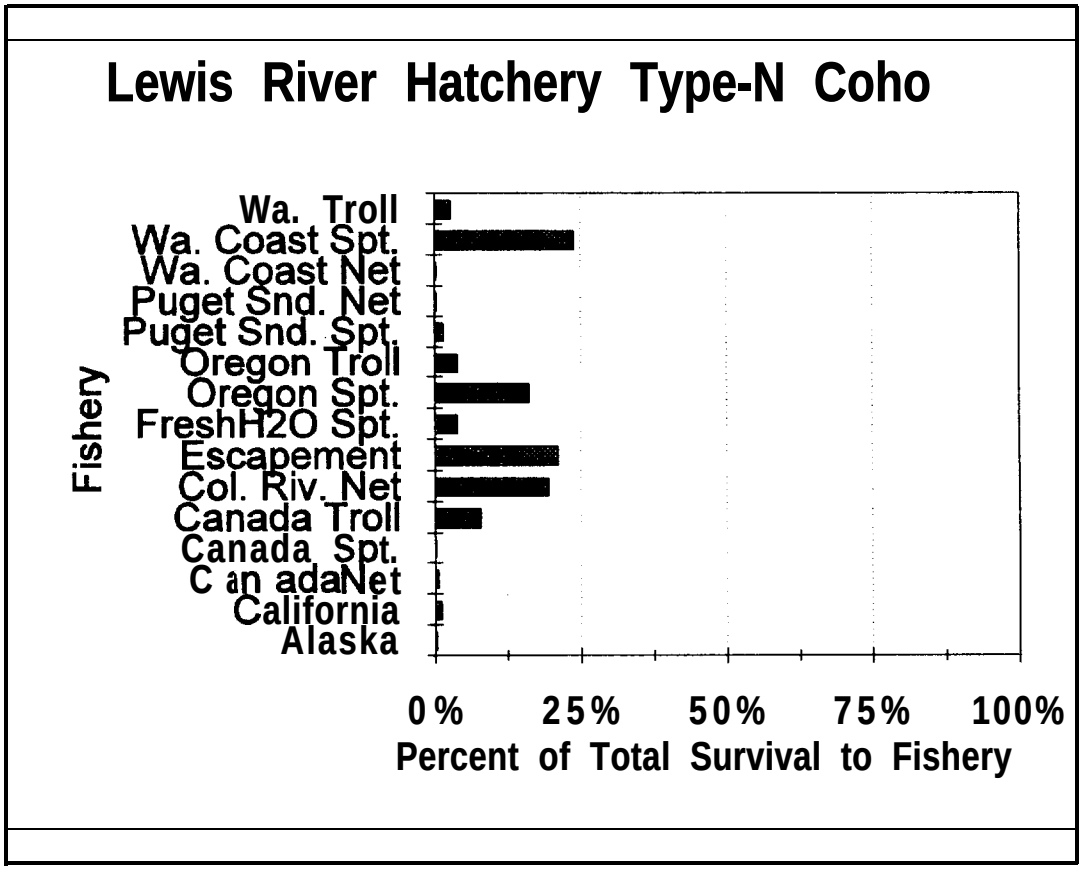

Figure 33 Percent of total survival to fisheries for Lewis River Hatchery Type-N coho. Average of 1988-1990 broods.

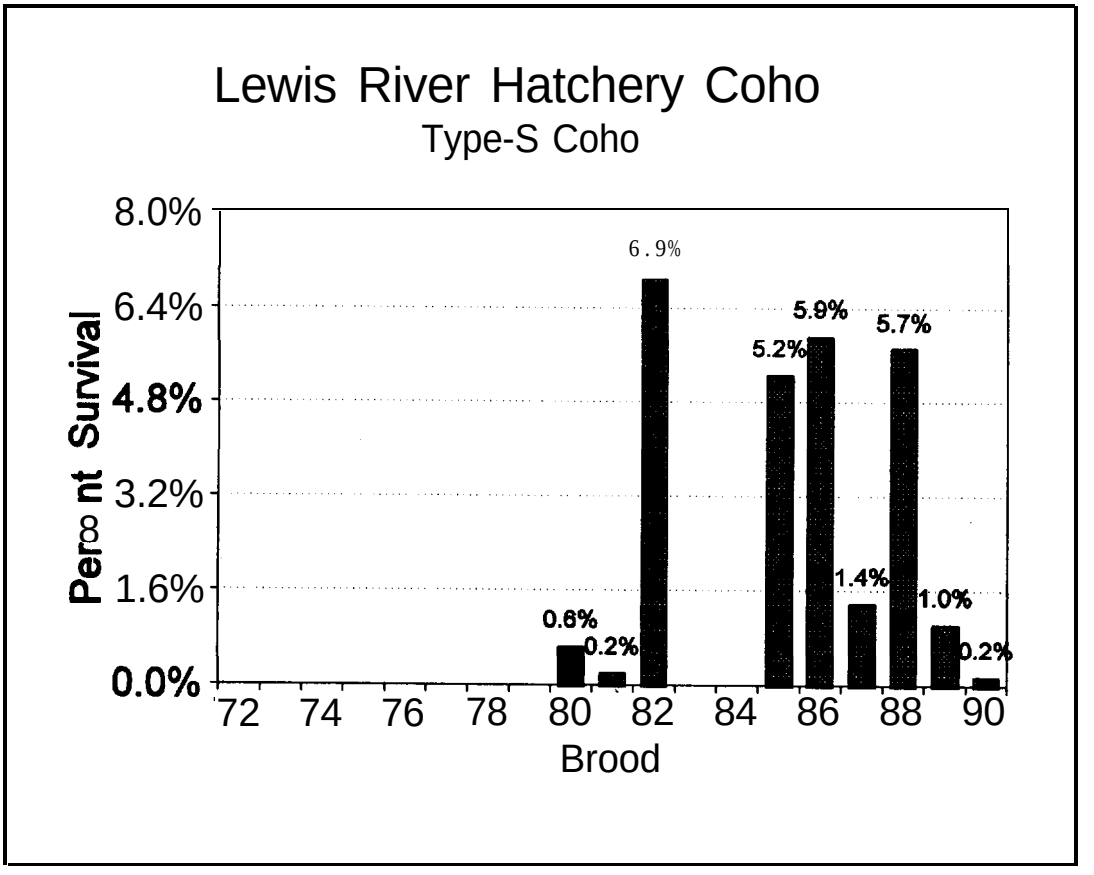

Figure 34 Survival of Lewis River Hatchery Type-S coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

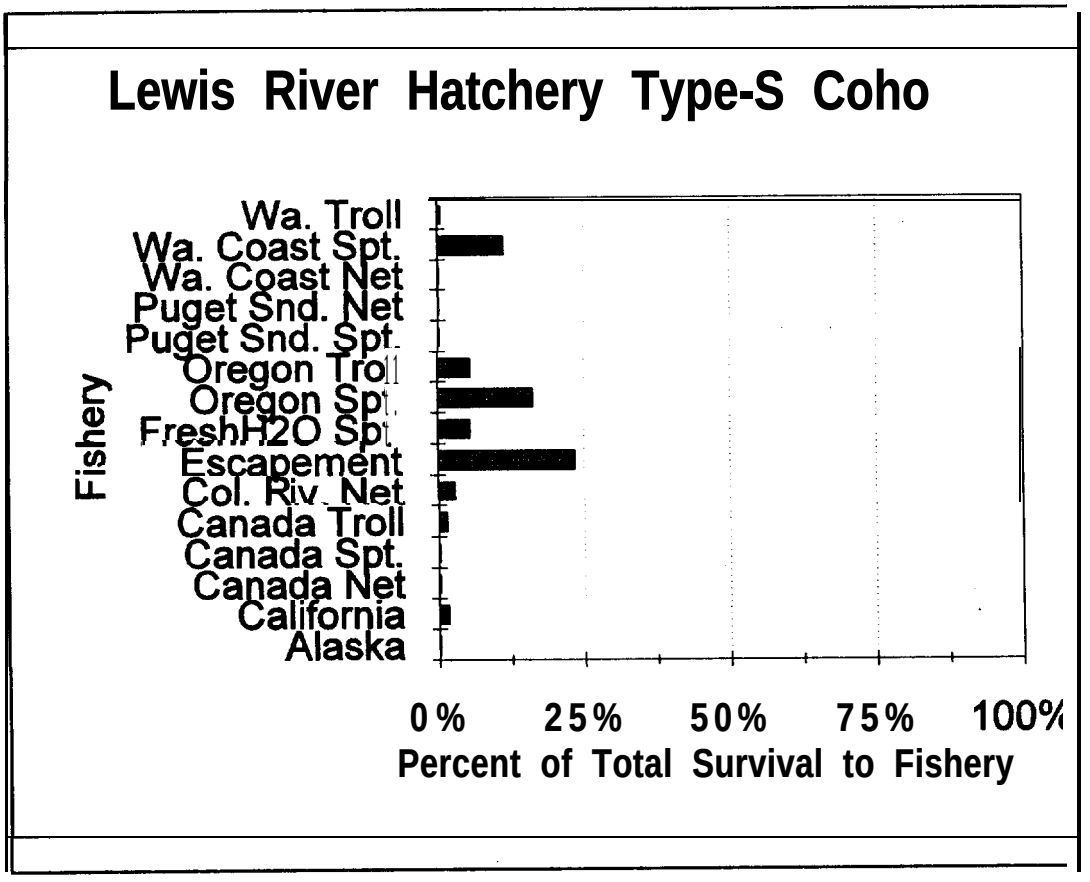

Figure 35 Percent of total survival to fisheries for Lewis River Hatchery Type-S coho. Average of 1988-l 990 broods.

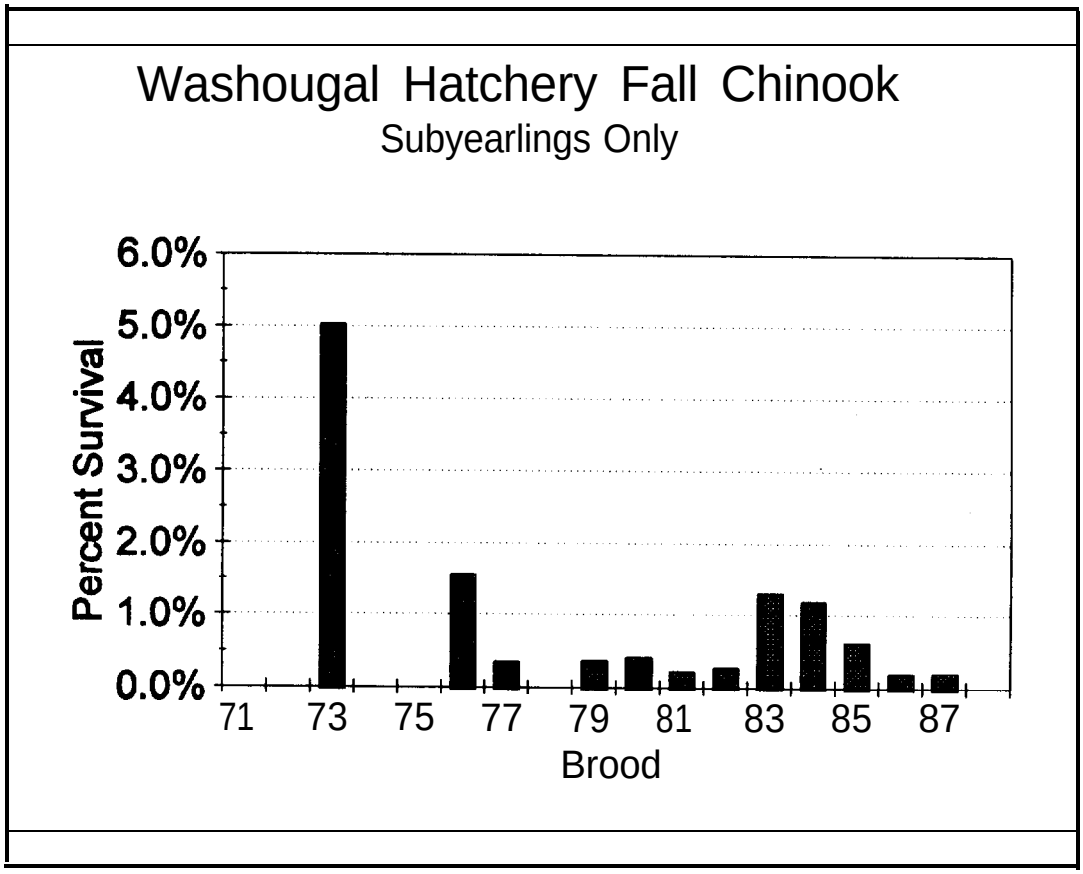

Figure 36 Survival of Washougal Hatchery tule fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

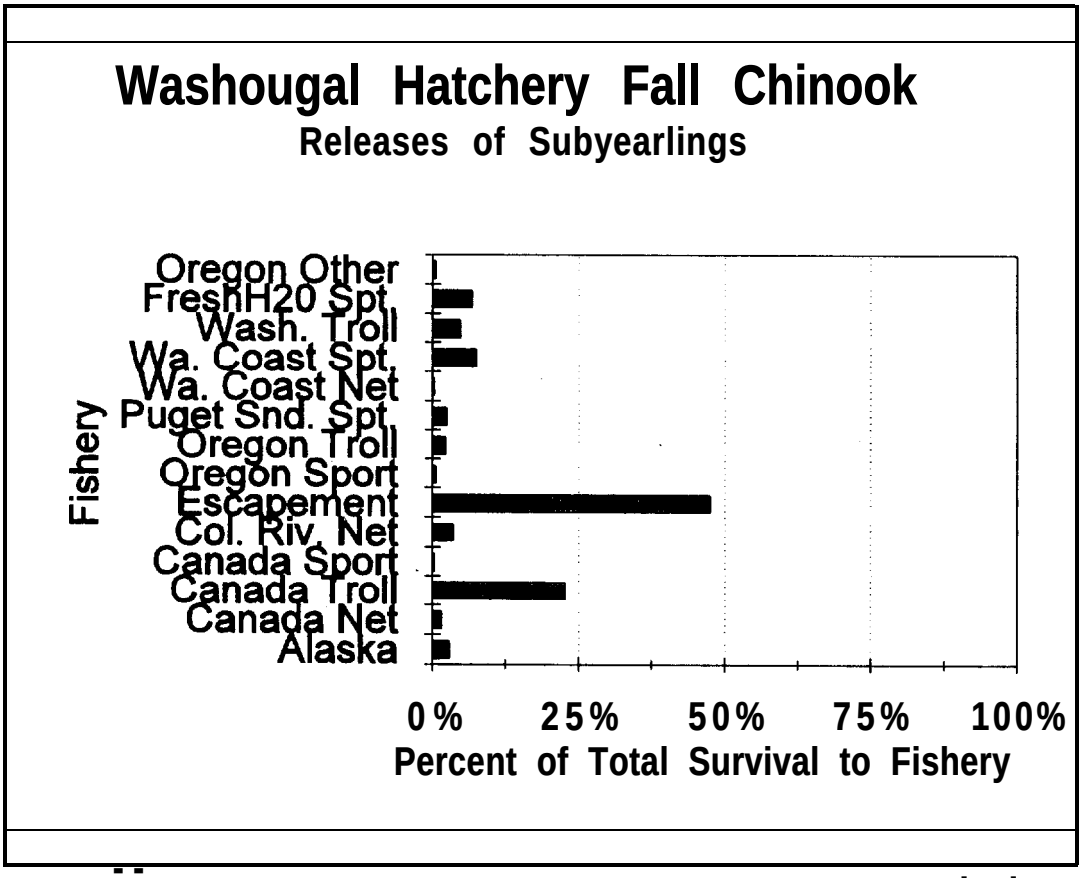

Figure 37 Percent of total survival to fisheries for Washougal hatchery tule fall chinook. Average of broods 1986-1988.

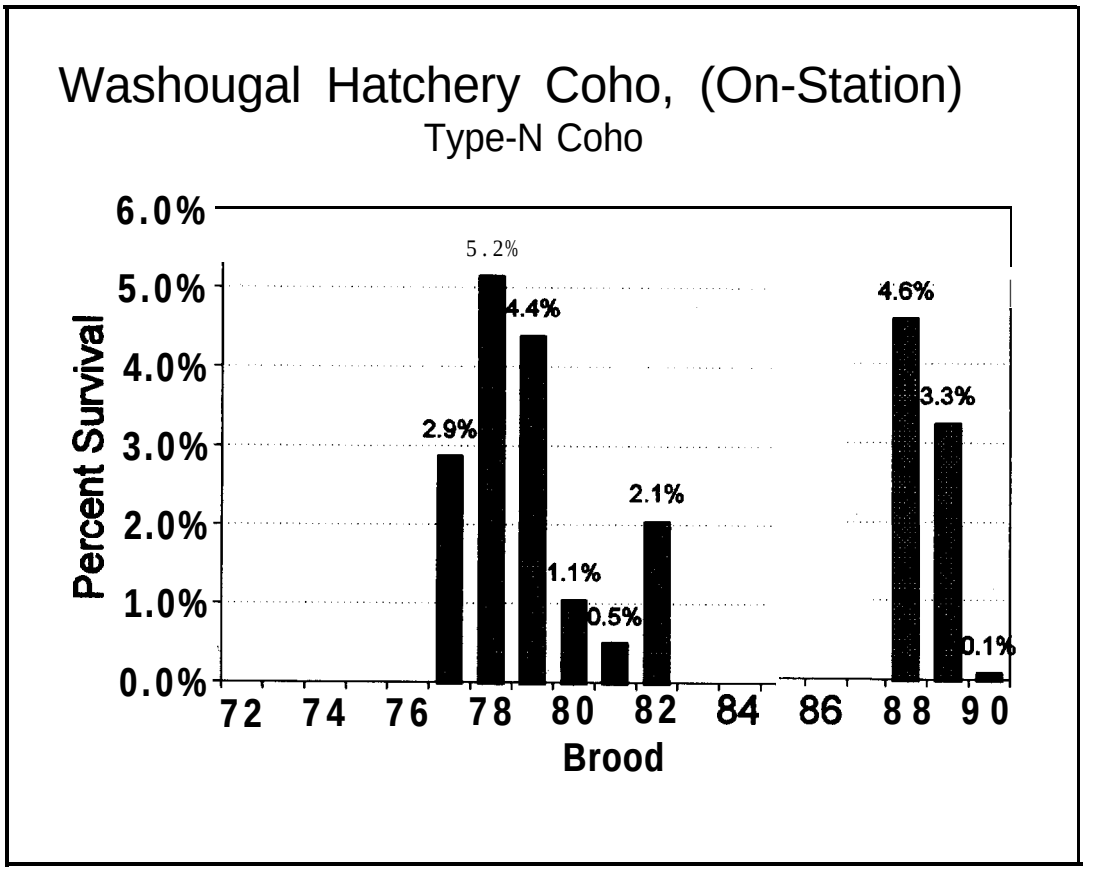

Figure 38 Survival by brood of Washougal Hatchery Type-N coho released on-station. Some years represent an average of several tagged releases and others a single point estimate of survival.

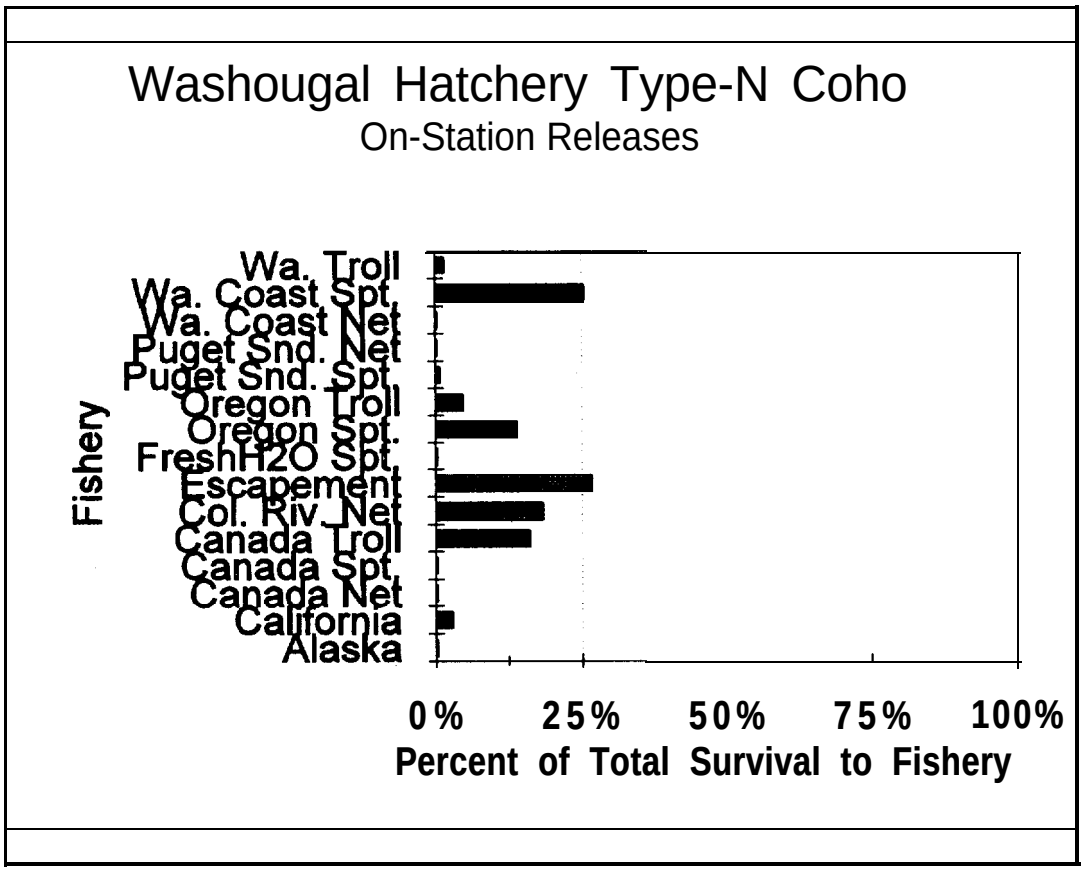

Figure 39 Percent of total survival to fisheries for Washougal Hatchery Type-N coho released on-station. Average of broods 1988-1990.

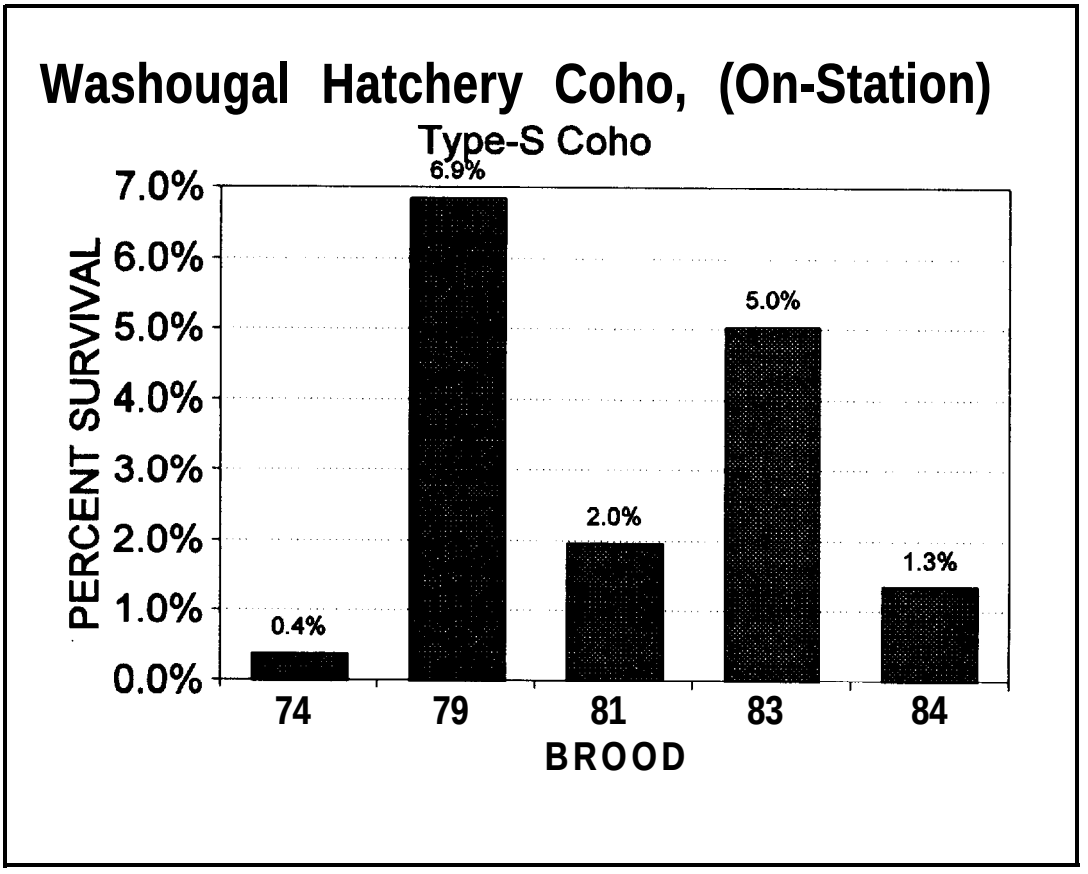

Figure 40 Survival of Washougal Hatchery Type-S coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

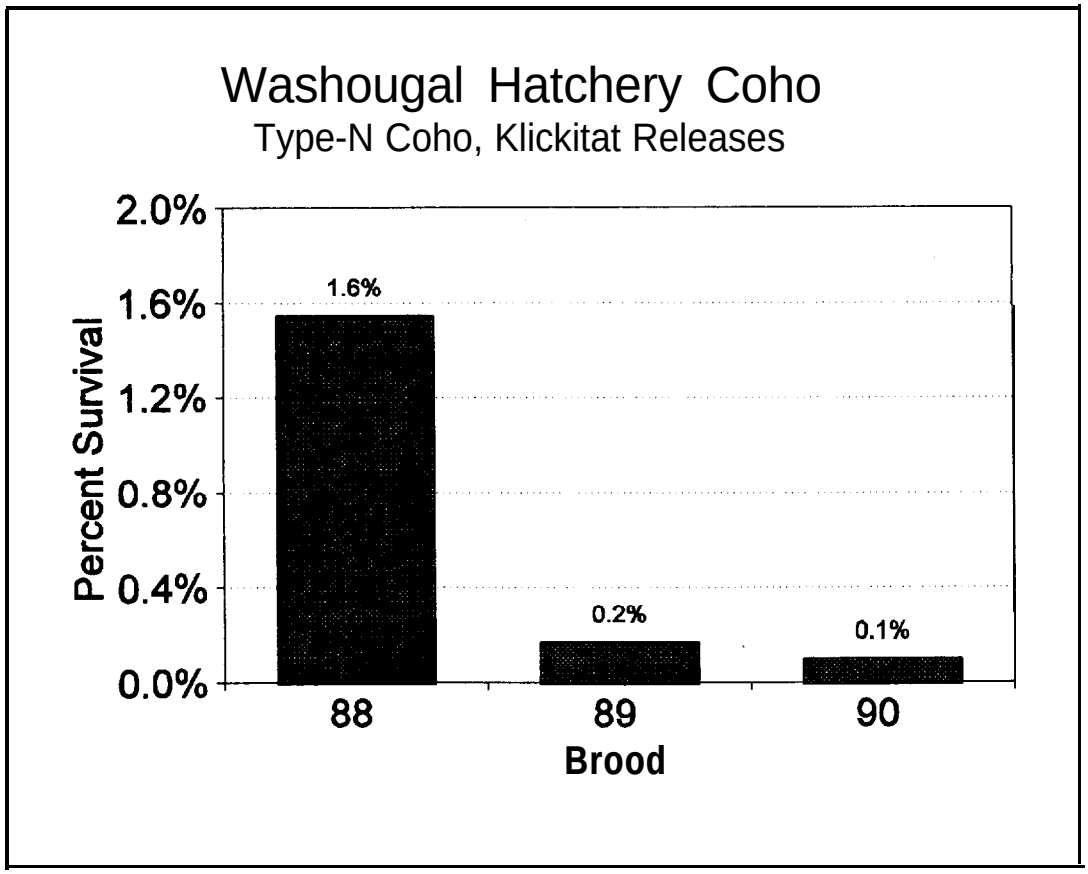

Figure 41 Survival by brood of Washougal Hatchery Type-N coho released off-station into the Klickitat River. Each survival estimate is an average of two tagged releases.

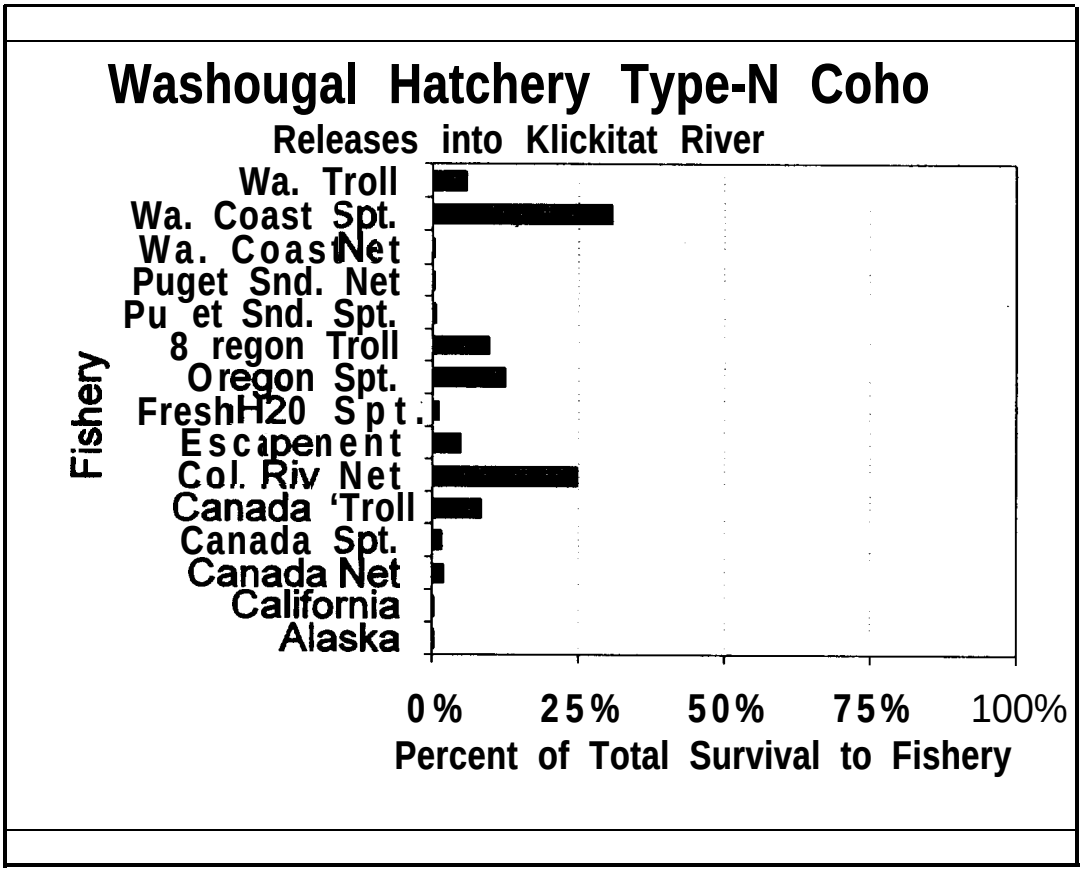

Figure 42 Percent of total survival to fisheries for Washougal Hatchery Type-N coho released off-station in the Klickitat River. Average of broods 1988-1990.

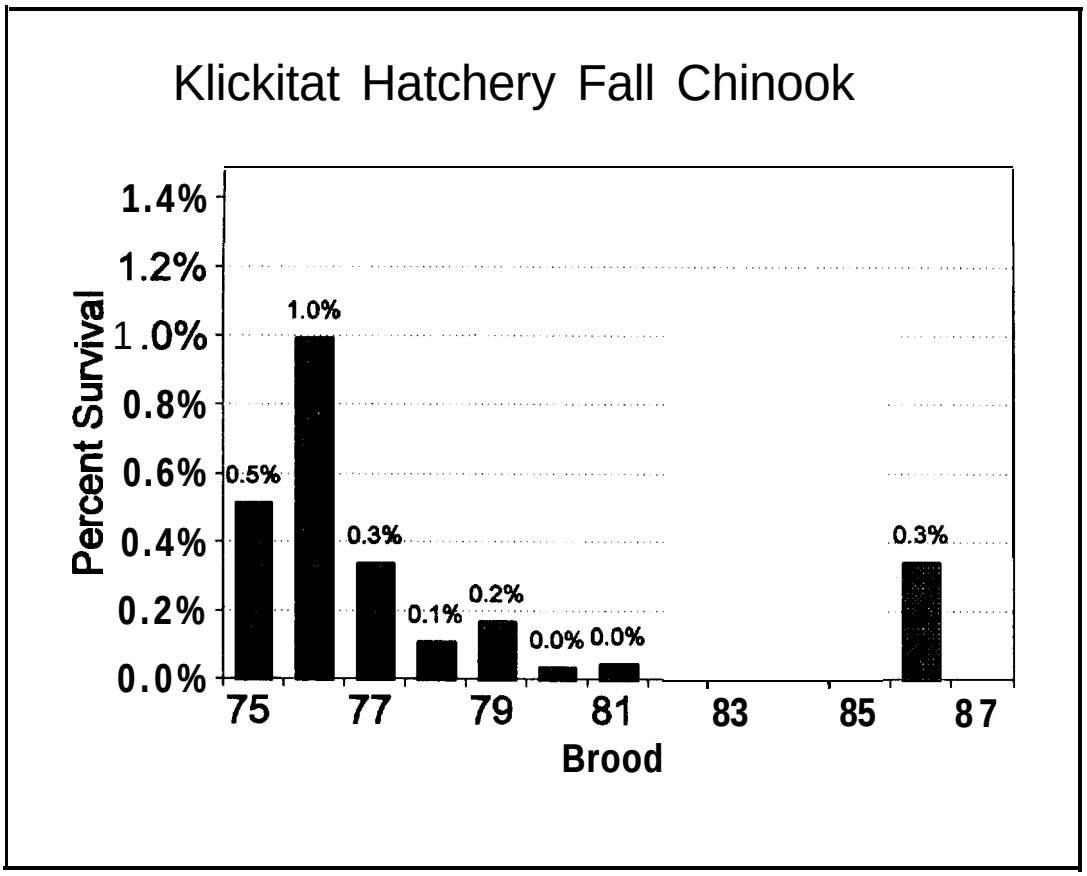

Figure 43 Survival of Klickitat Hatchery fall chinook by brood. Earlier broods consisted of tule fall chinook and later broods consisted of upriver bright fall chinook. Some years represent an average of several tagged releases and others a single point estimate of survival.

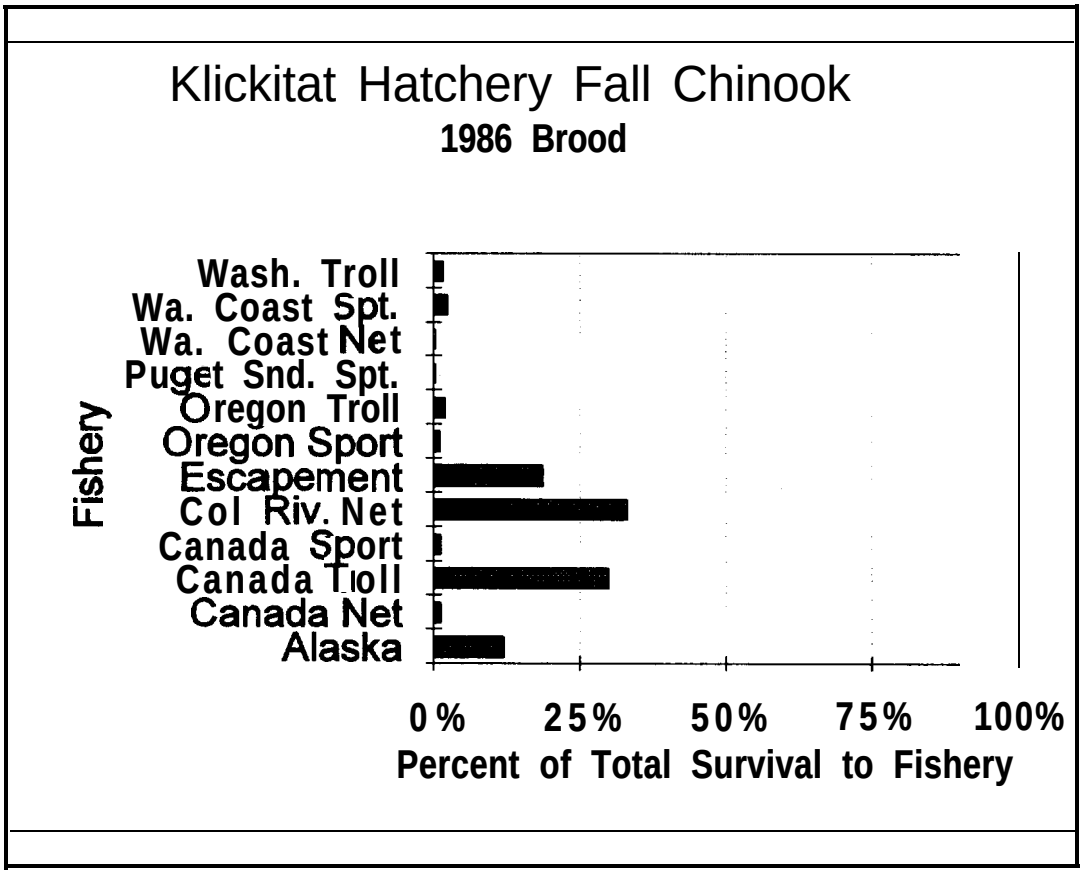

Figure 44 Percent of total survival to fisheries for Klickitat Hatchery 1986 brood URB fall chinook.

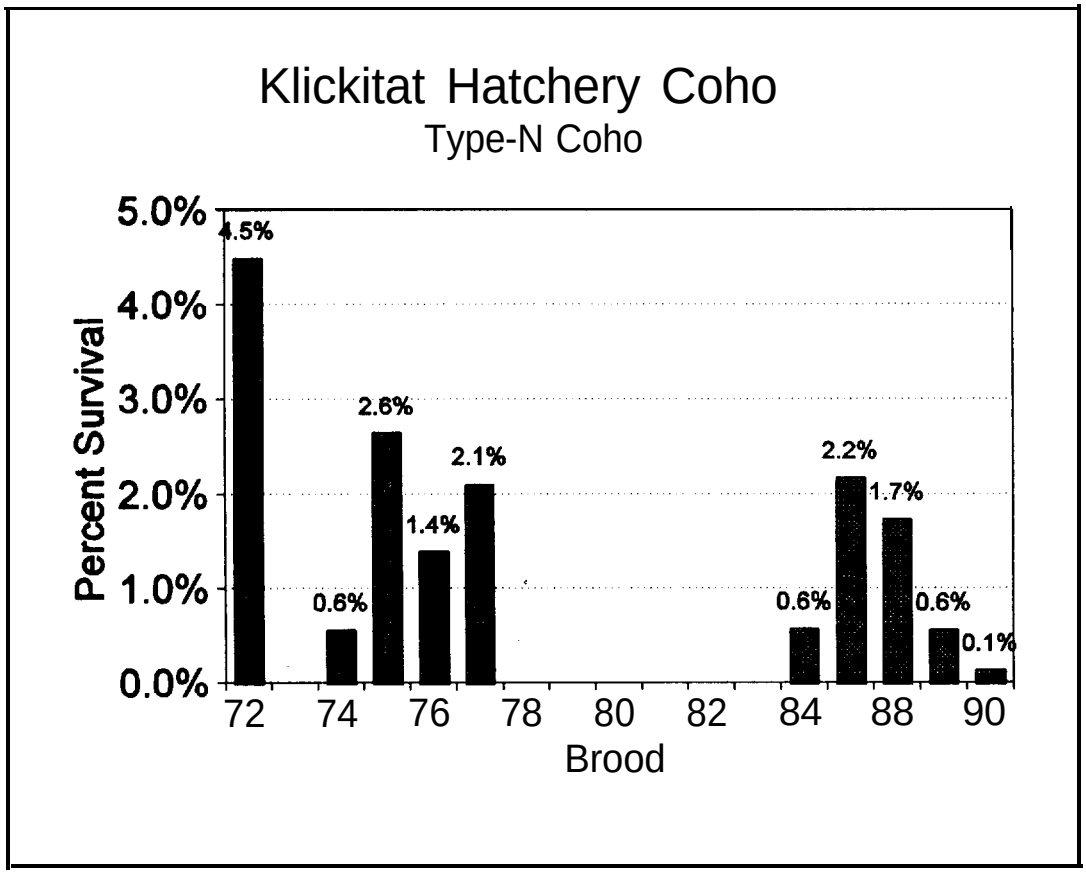

Figure 45 Survival of Klickitat Hatchery Type-N coho by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

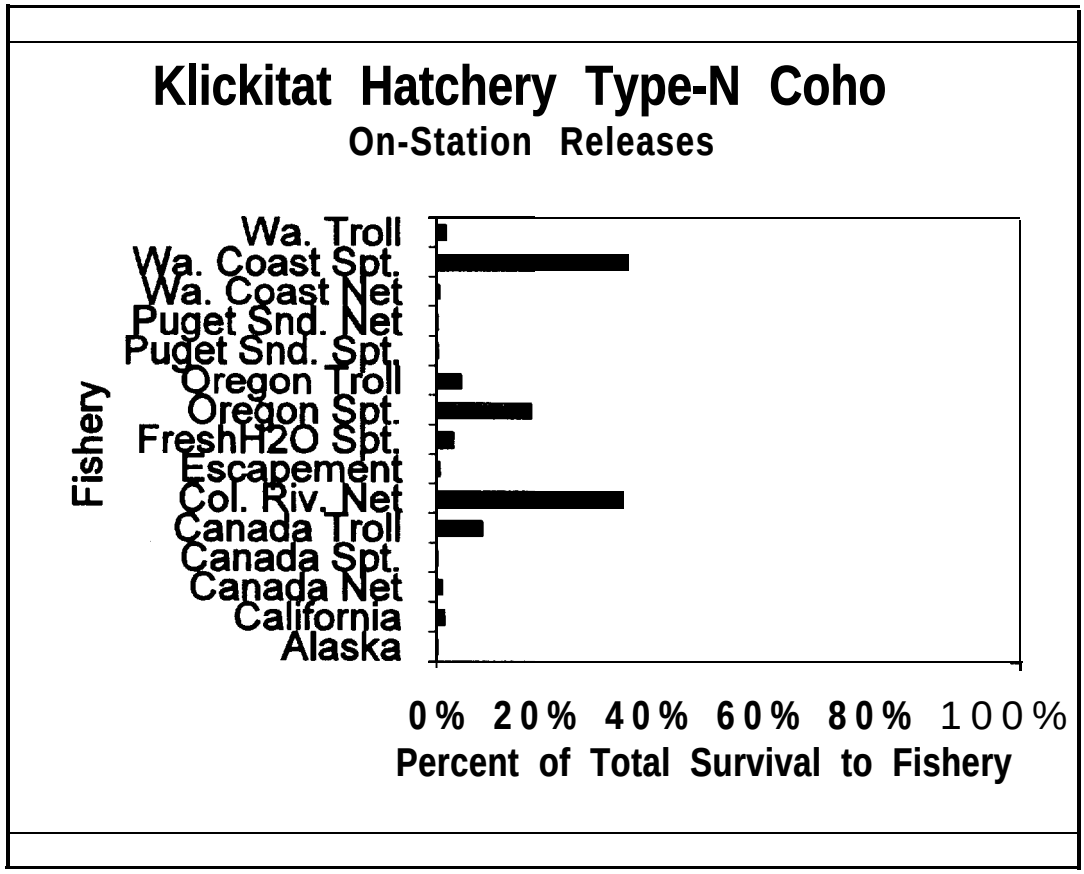

Figure 46 Percent of total survival to fisheries for Klickitat Hatchery Type-N coho. Average of broods 1988-1990.

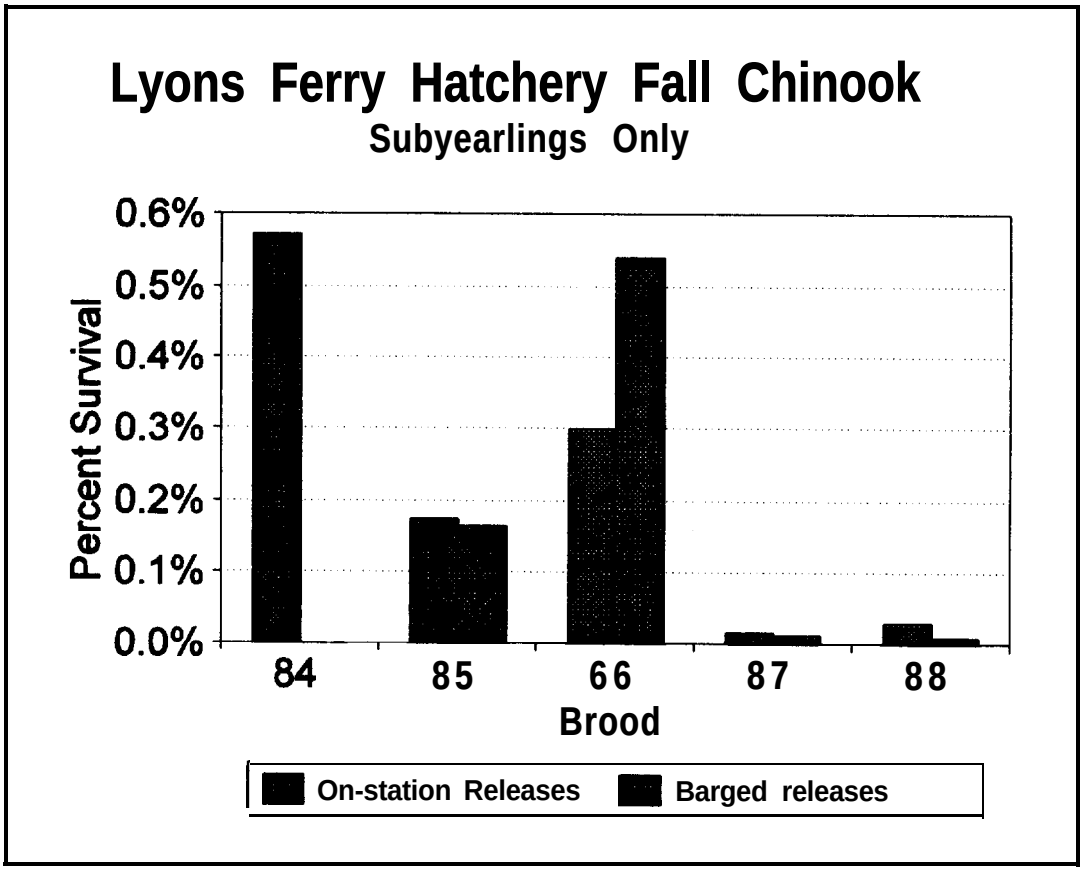

Figure 47 Survival by brood of Lyons Ferry (Snake River) Hatchery subyearling fall chinook. Data are for fish released on-station or barged downstream and released.

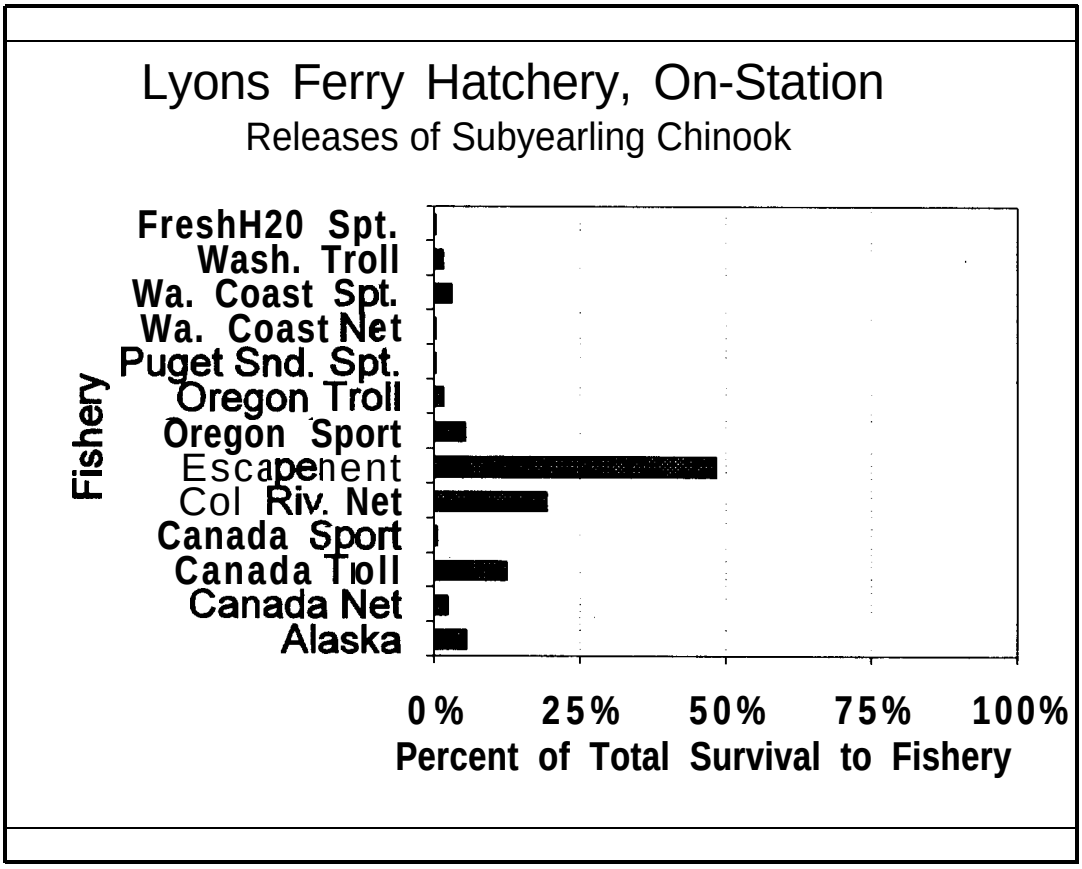

Figure 48 Percent of total survival to fisheries for Lyons Ferry Hatchery fall chinook. Data for subyearlings released on-station. Average of broods 1986- 1988.

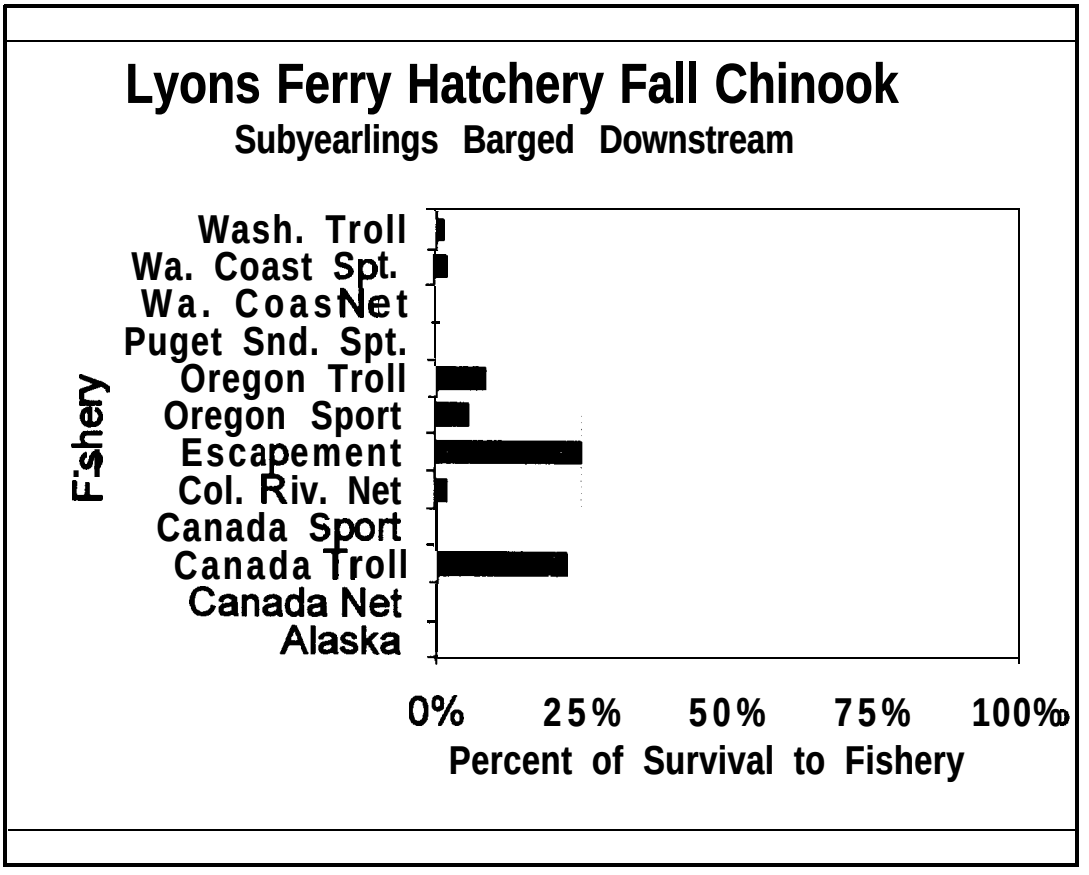

Figure 49 Percent of total survival to fisheries for Lyons Ferry Hatchery fall chinook. Data for subyearlings barged downstream of hatchery. Average of broods 1986-1988.

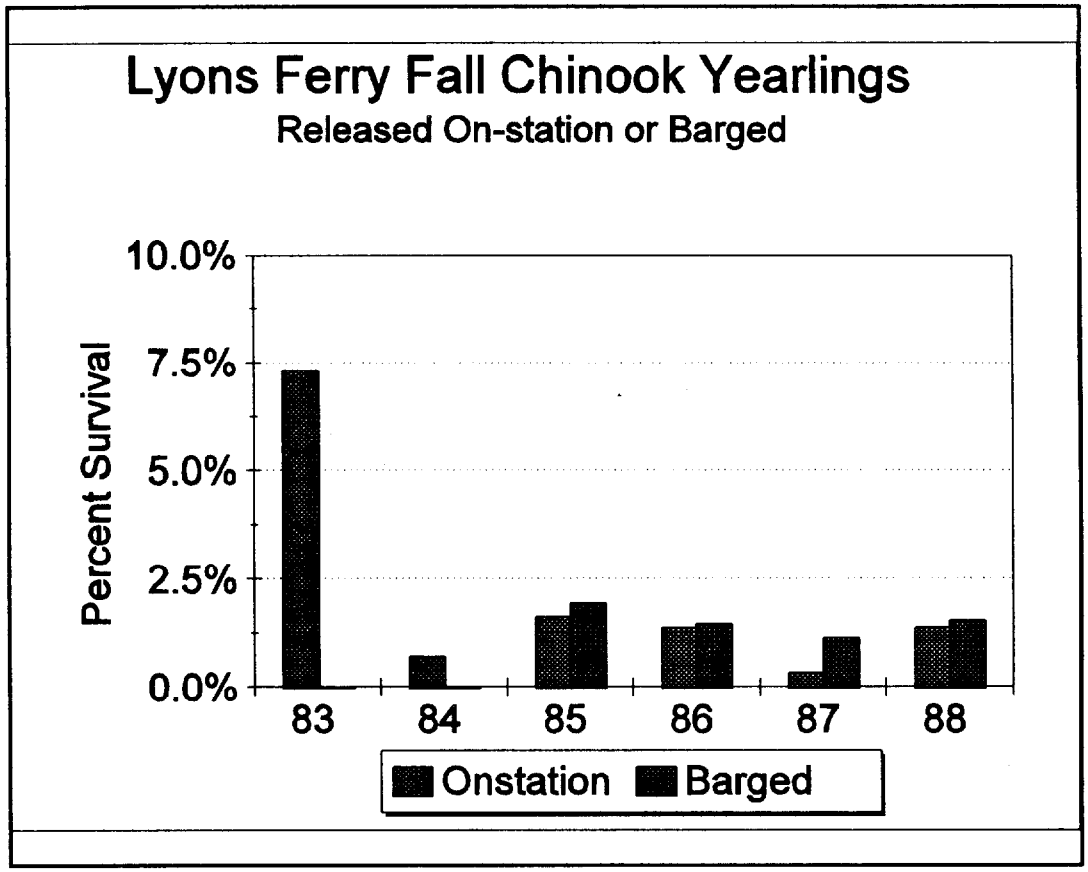

Figure 50 Survival by brood of Lyons Ferry Hatchery yearling fall chinook. Data for fish released on-station or barged downstream and released. Each year represents an average of several tagged releases.

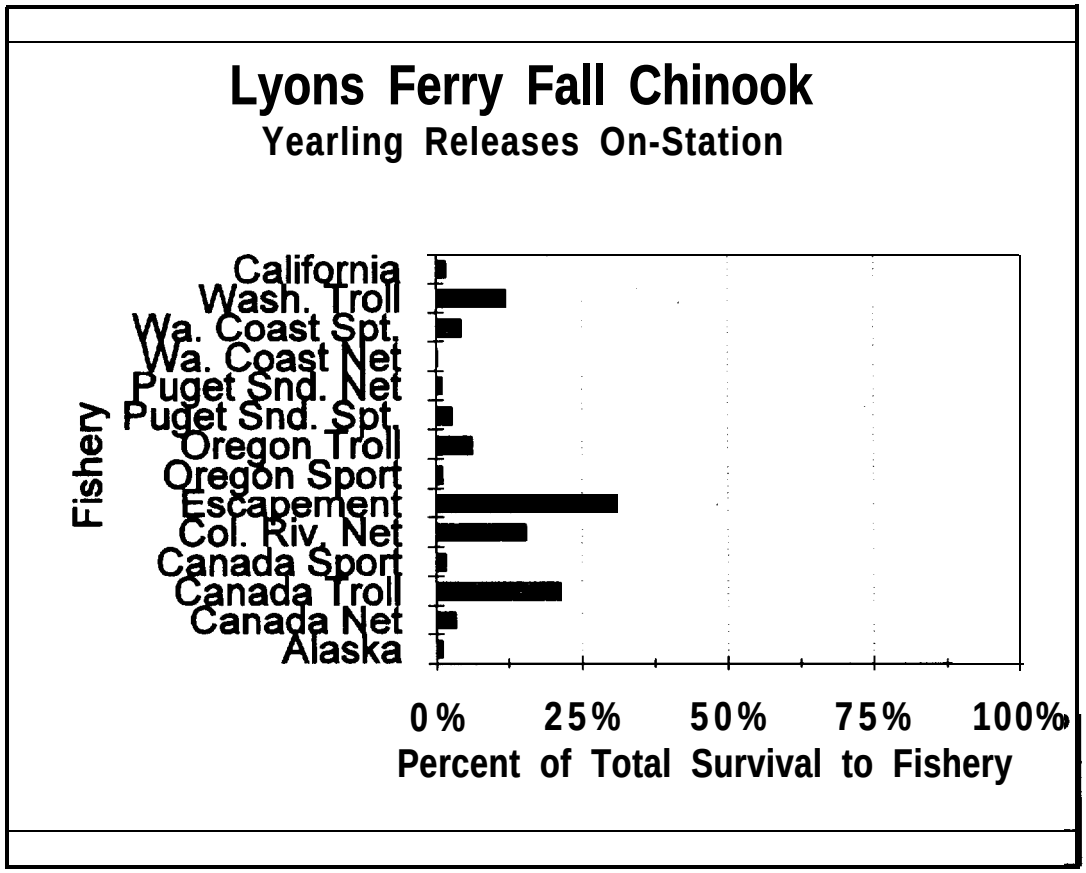

Figure 51 Percent of total survival to fisheries for Lyons Ferry Hatchery yearling fall chinook released'on-station. Average of broods 1986-1 988.

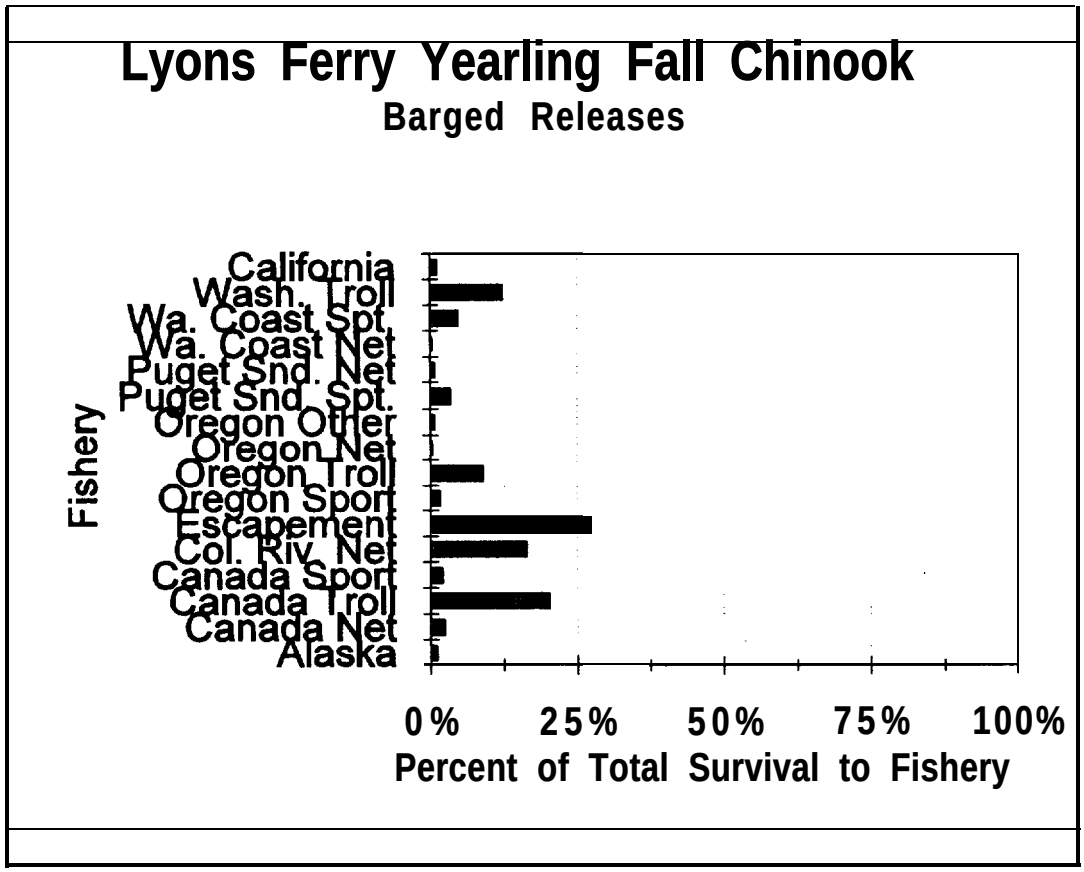

Figure 52 Percent of total survival to fisheries for Lyons Ferry Hatchery fall chinook yearlings released after barging downstream of the hatchery.

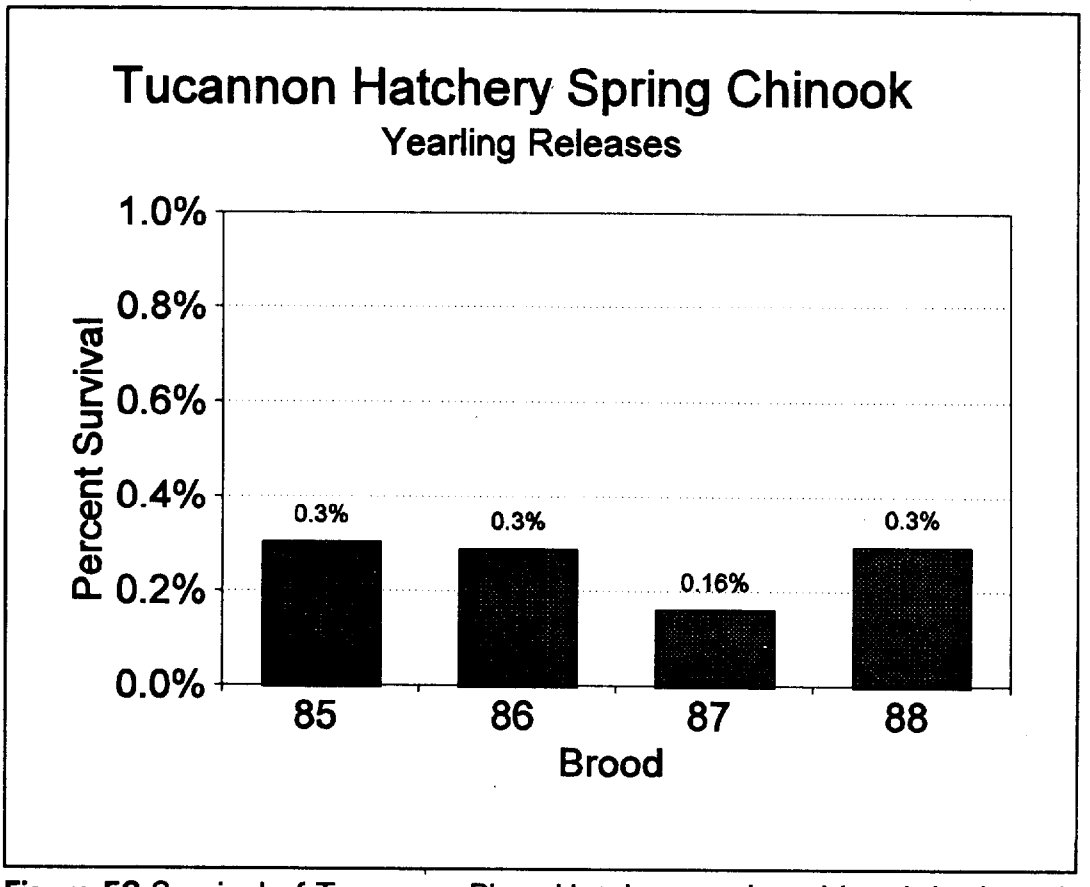

Figure 53 Survival of Tucannon River Hatchery spring chinook by brood. Each brood year, except 1985, is an average of several tagged releases.

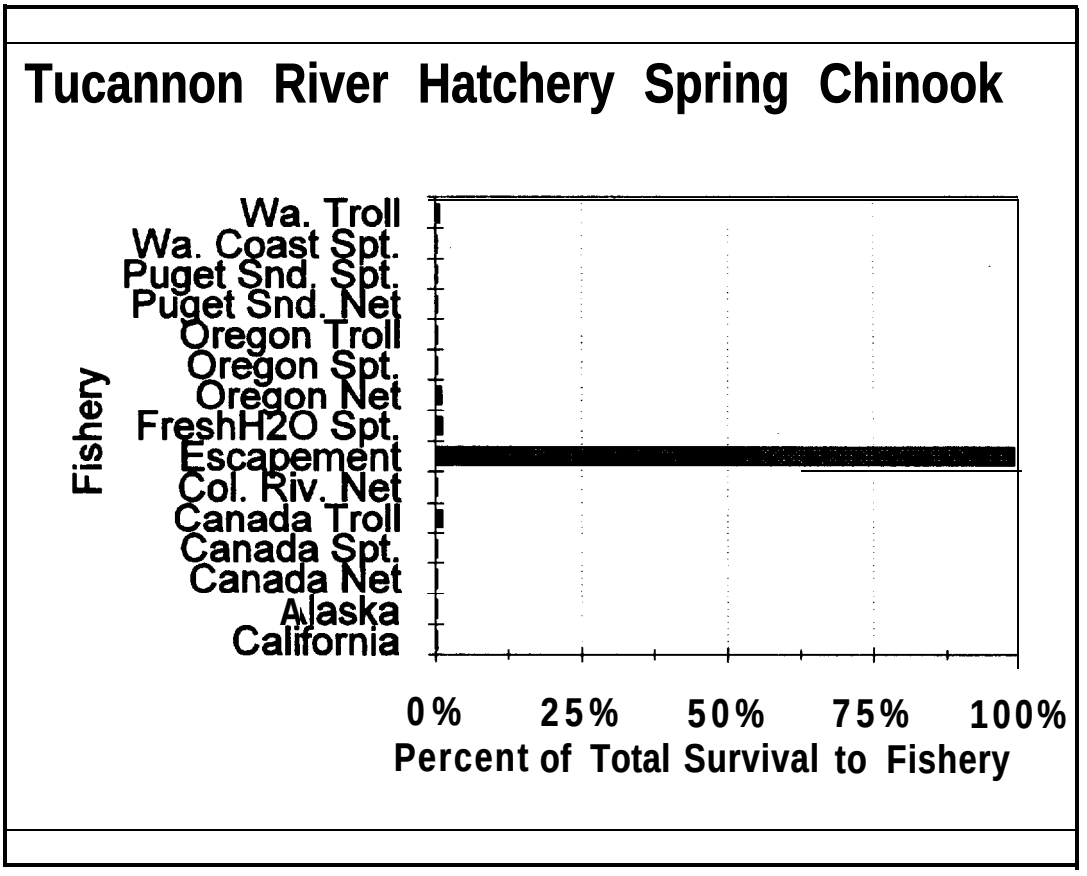

Figure 54 Percent of total survival to fisheries for Tucannon River Hatchery spring chinook. Average of broods 1986-l 988.

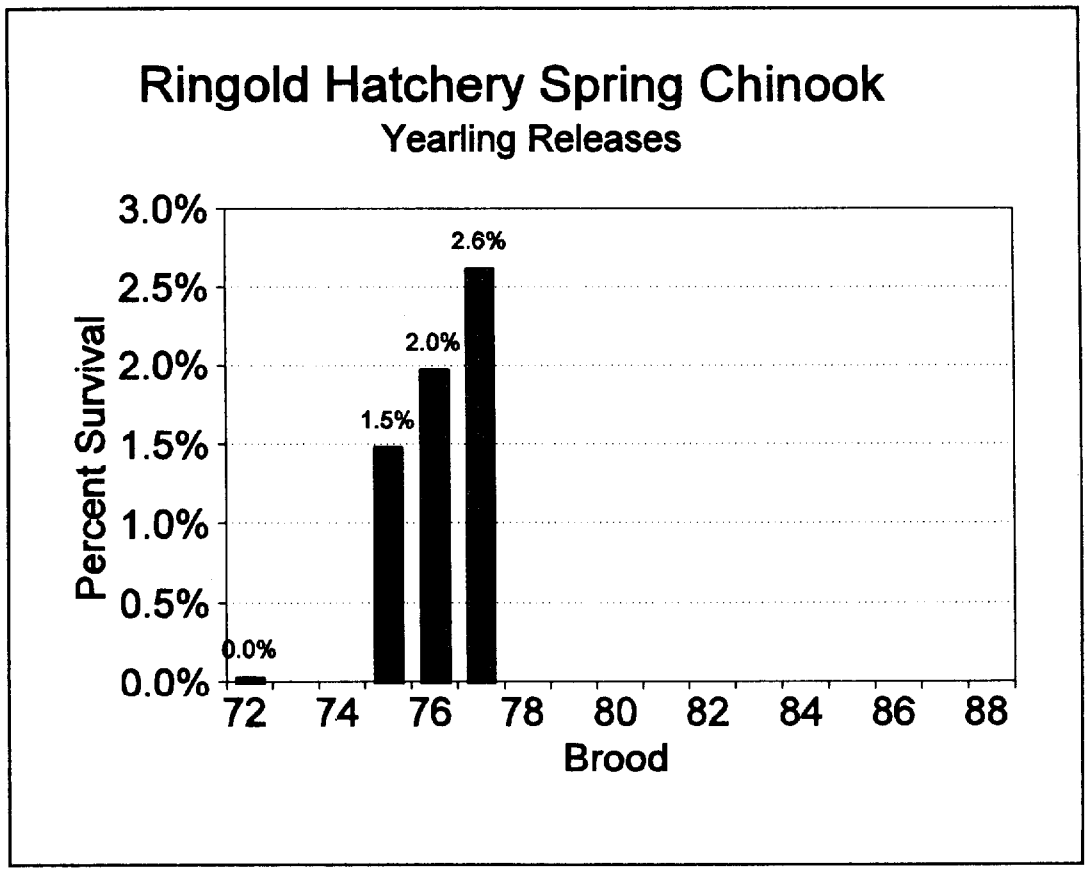

Figure 55 Survival of Ringold Hatchery spring chinook by brood.

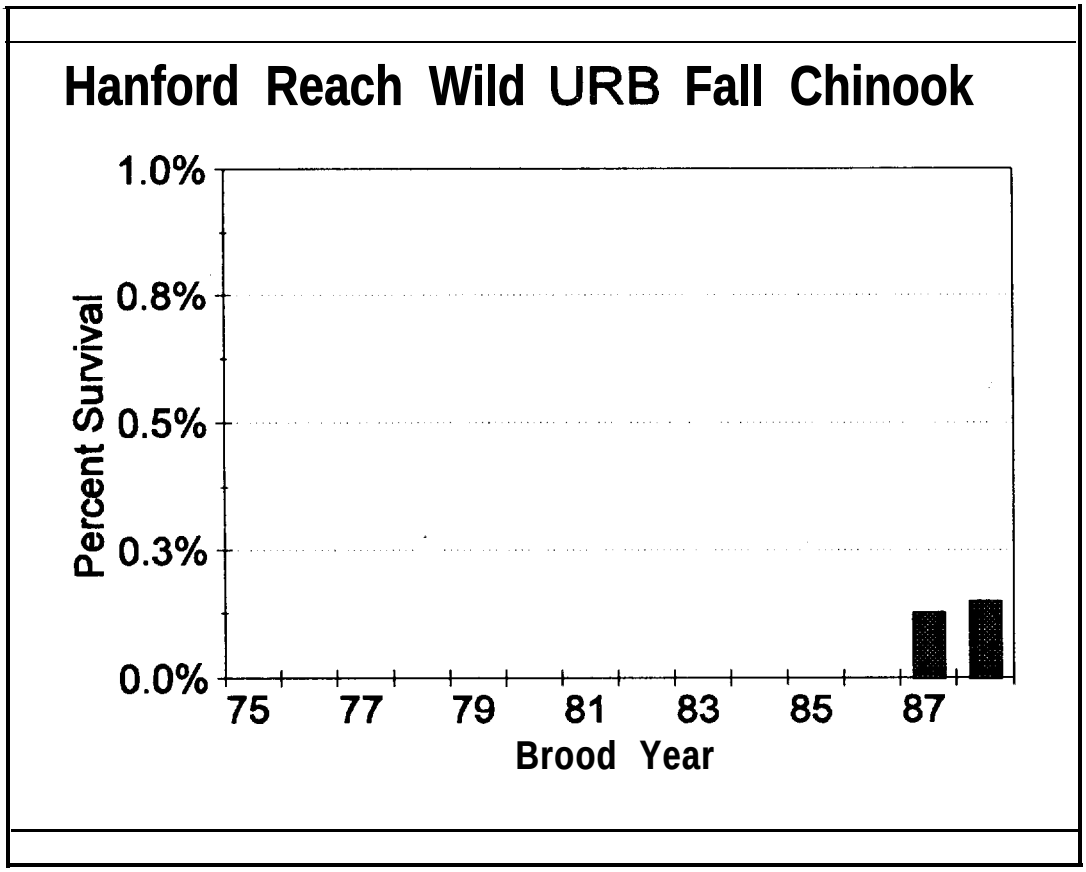

Figure 56 Survival by brood of Hanford Reach wild URB fall chinook. Each year represents a single point estimate of survival.

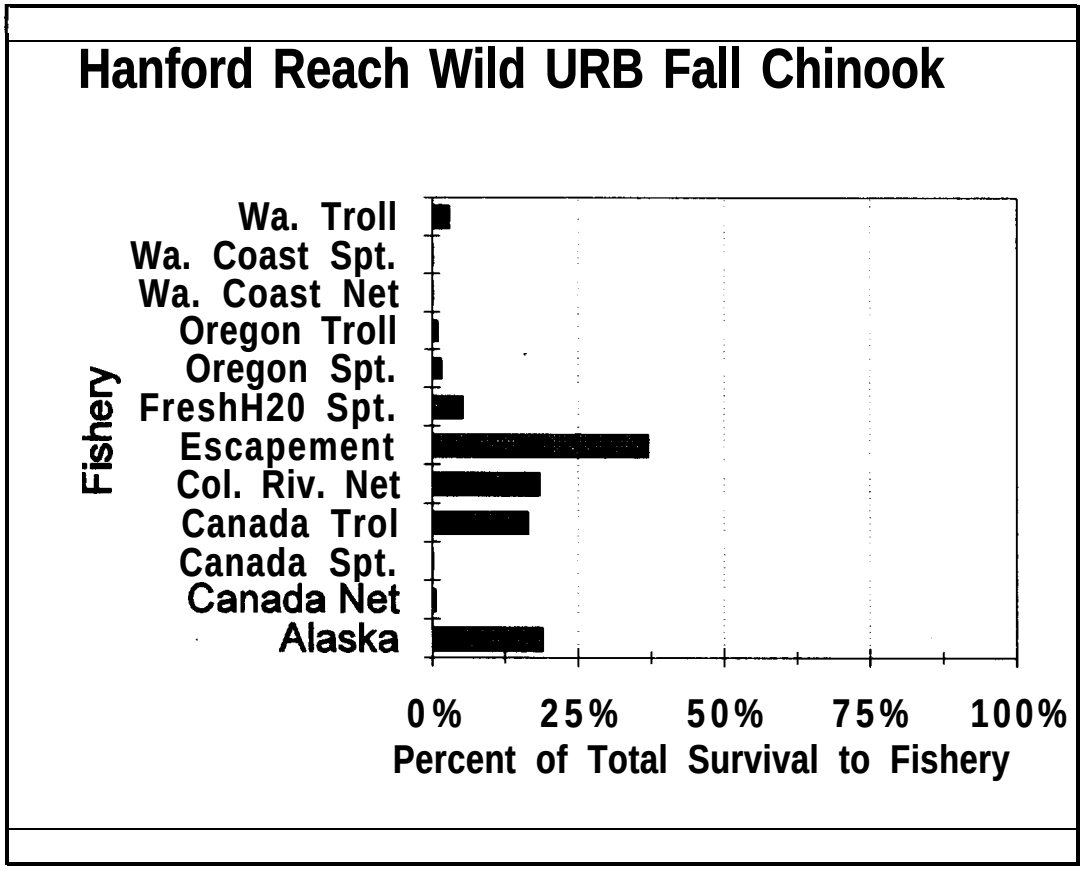

Figure 57 Percent of total survival to fisheries for Hanford Reach wild URB fall chinook. Average of broods 1987 and 1988.

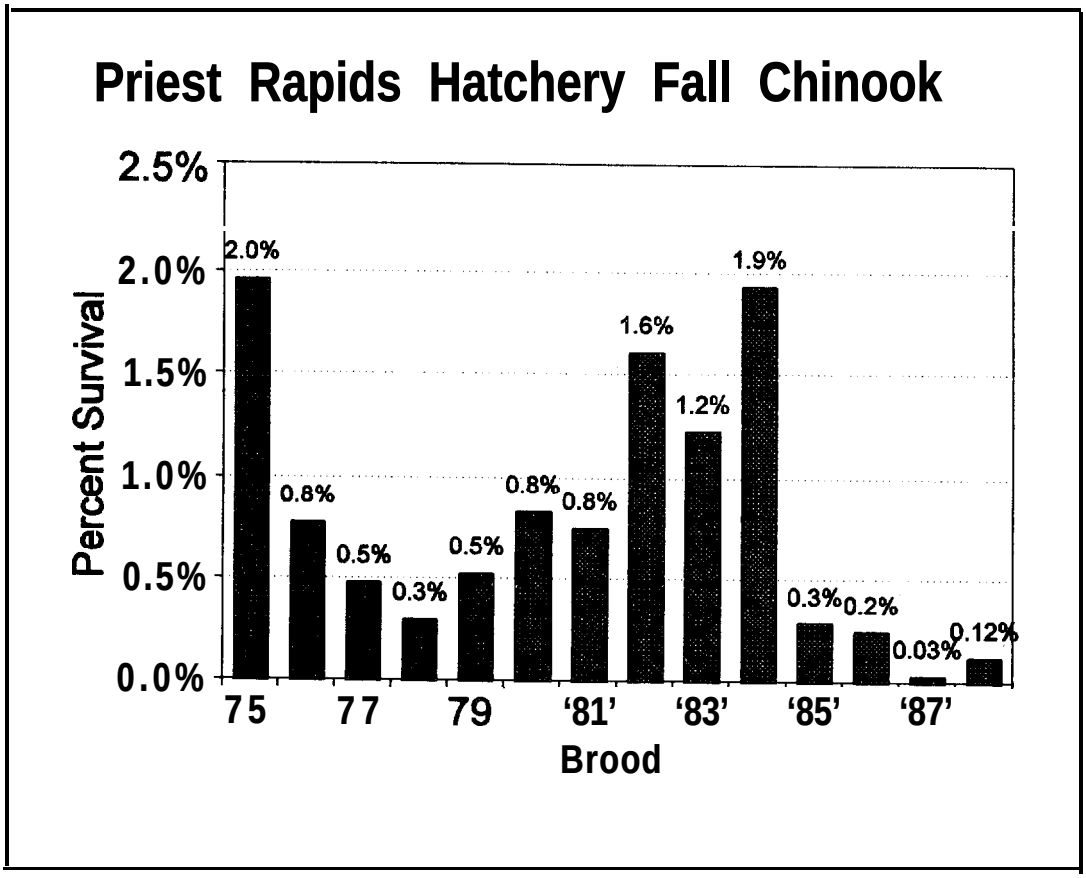

Figure 58 Survival of Priest Rapids Hatchery URB fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

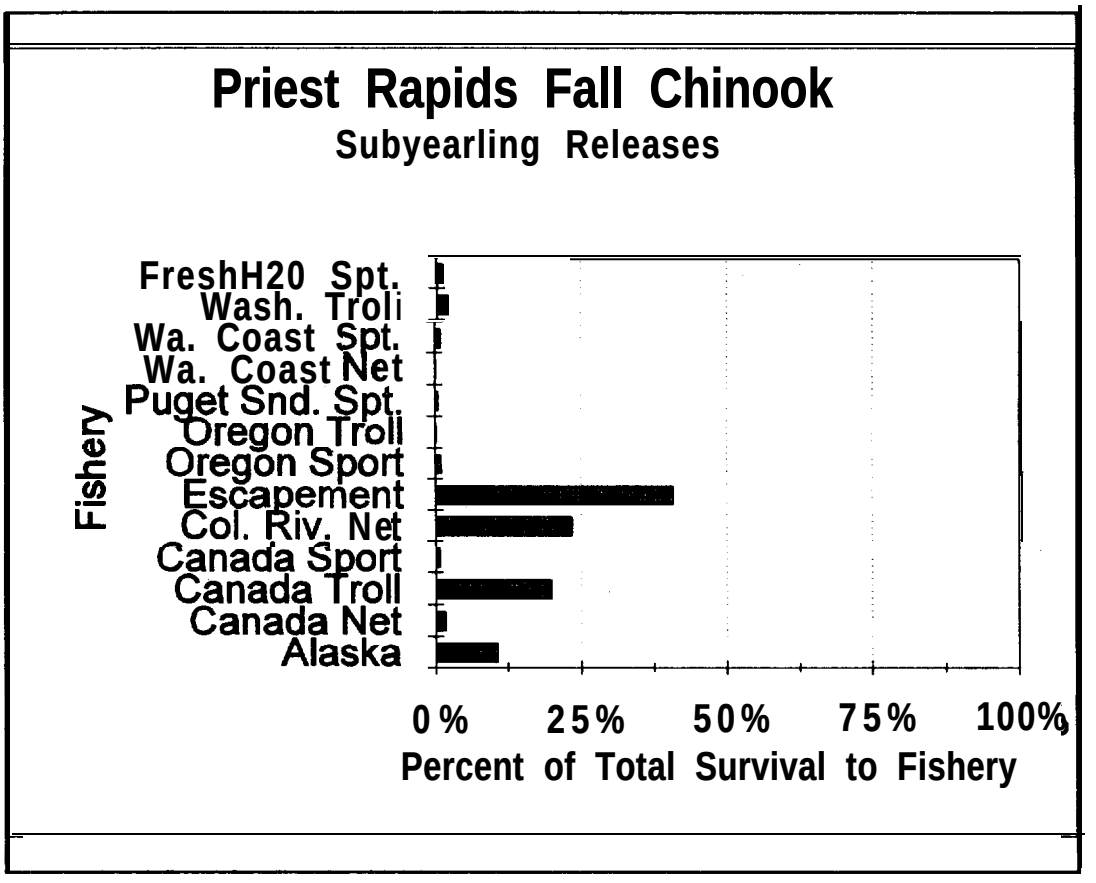

Figure 59 Percent of total survival to fisheries for Priest Rapids Hatchery URB fall chinook. Average of broods: 1986-I 988.

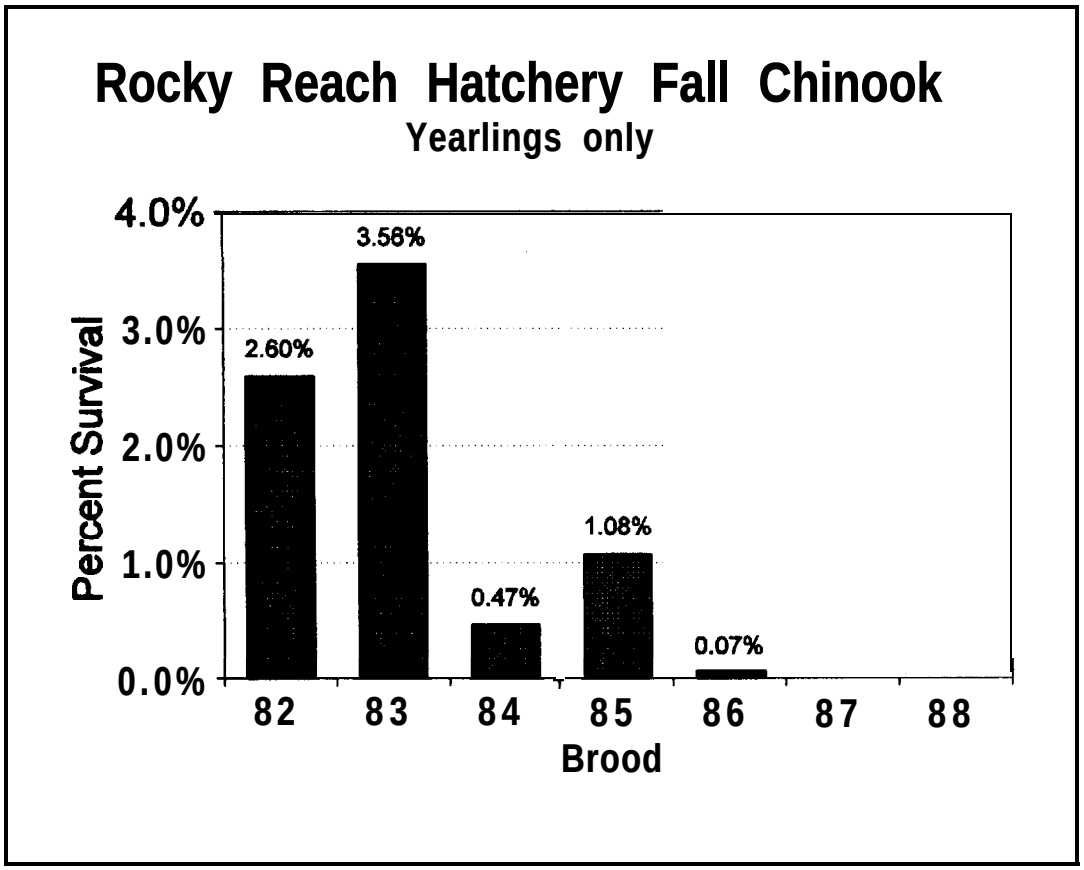

Figure 60 Survival of Rocky Reach Hatchery URB fall chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

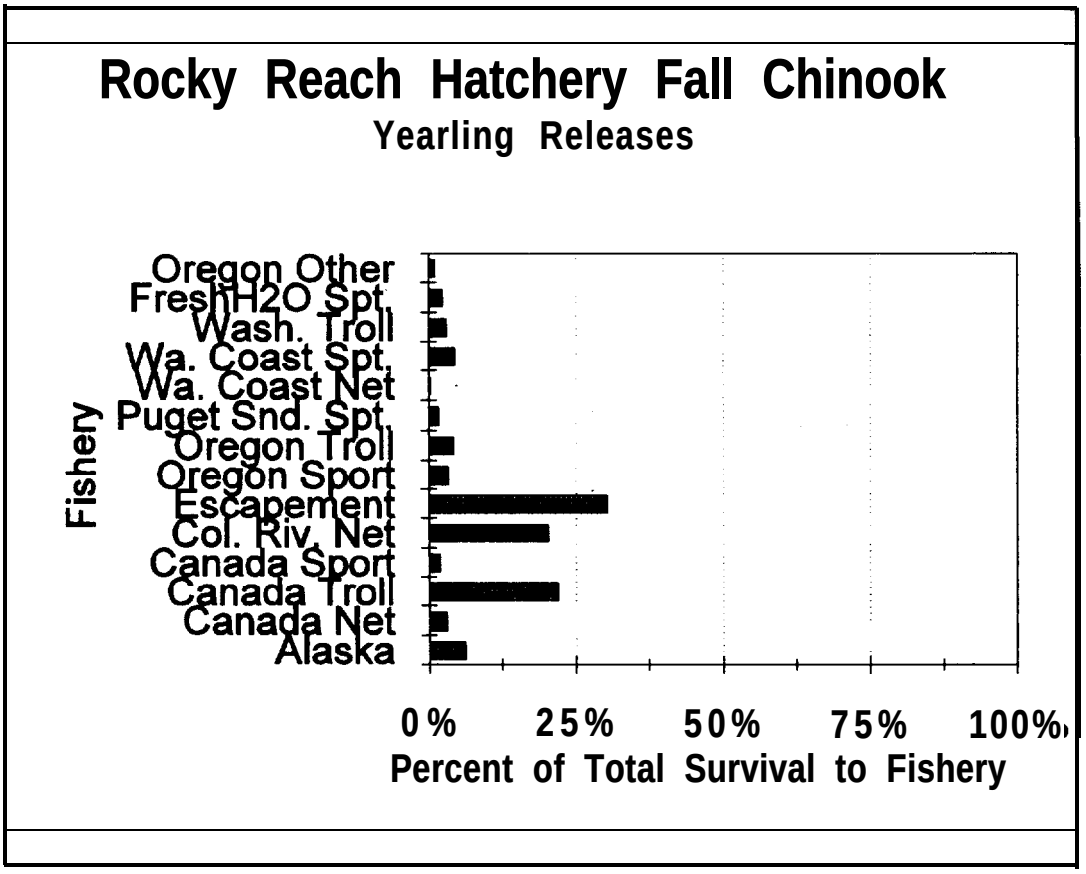

Figure 61 Percent of total survival to fisheries for Rocky Reach Hatchery URB fall chinook. Average of broods 1986 and 1987.

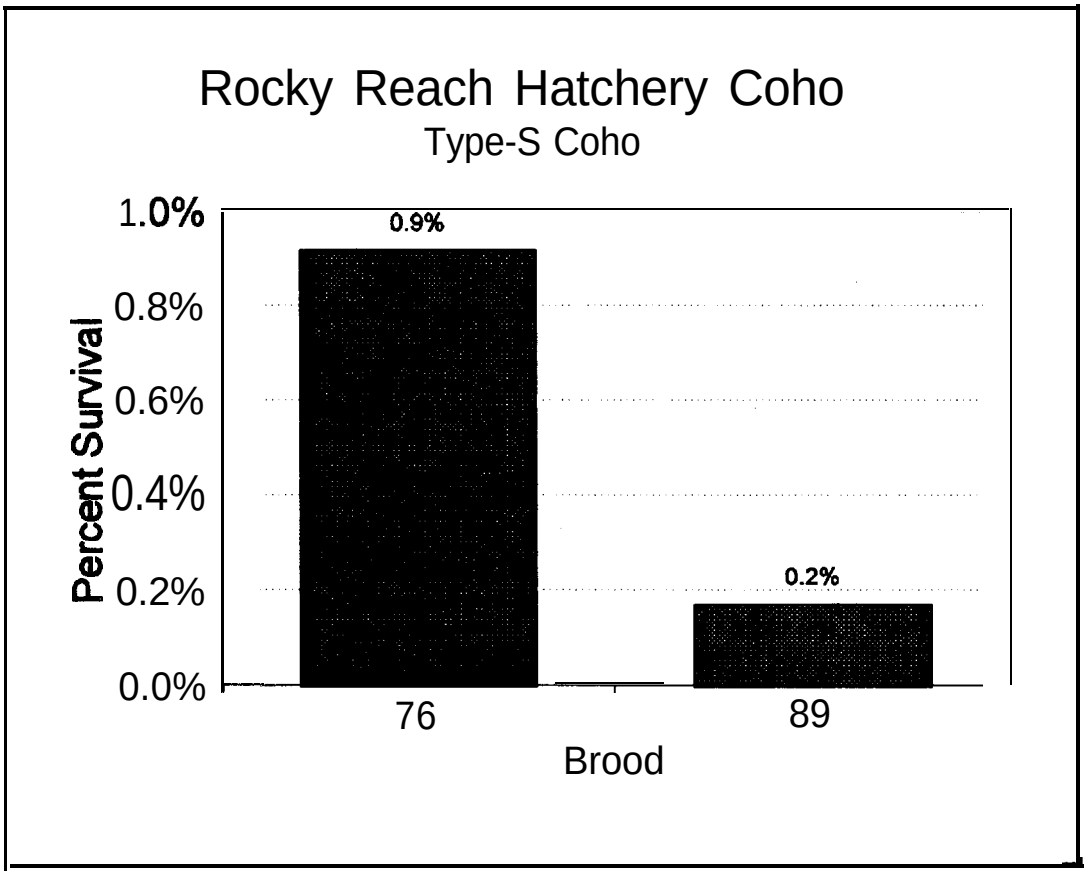

Figure 62 Survival of two broods of Rocky Reach Hatchery Type-S coho. Each year represents a single point estimate of survival.

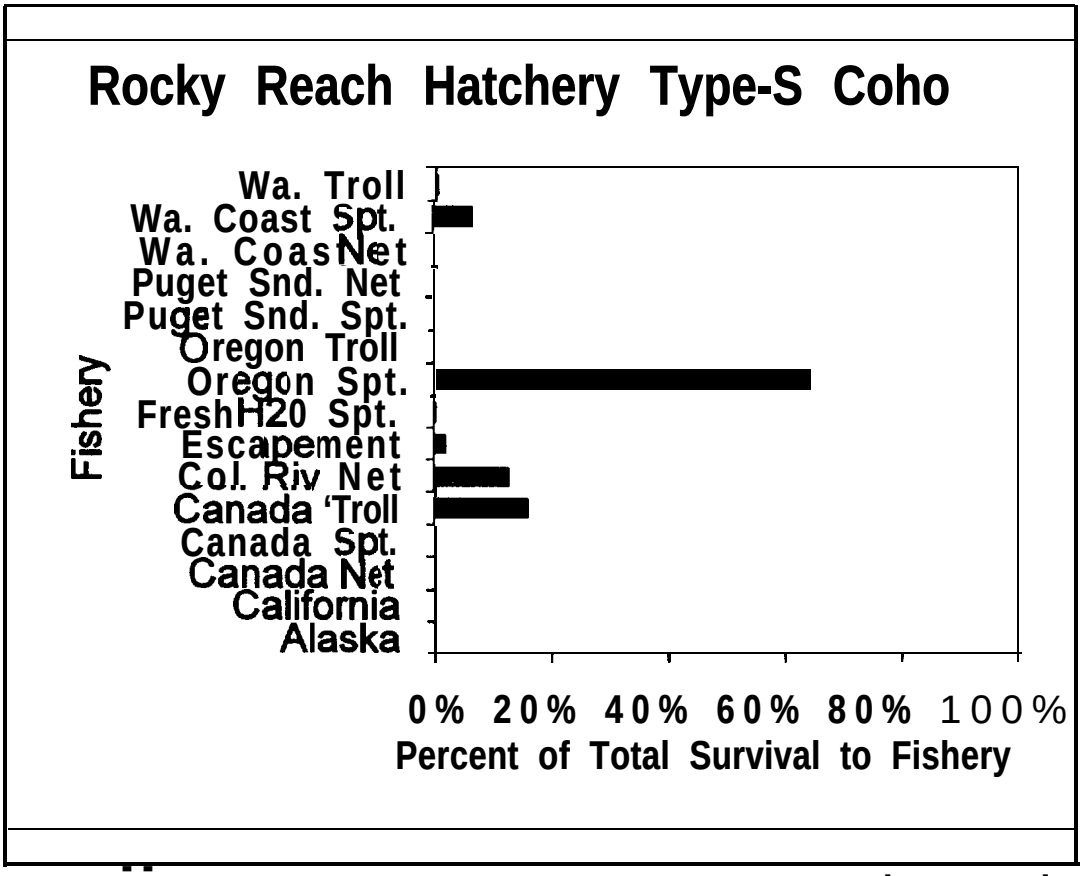

Figure 63 Percent of total survival to fisheries for 1989 brood Rocky Reach Type-S coho.

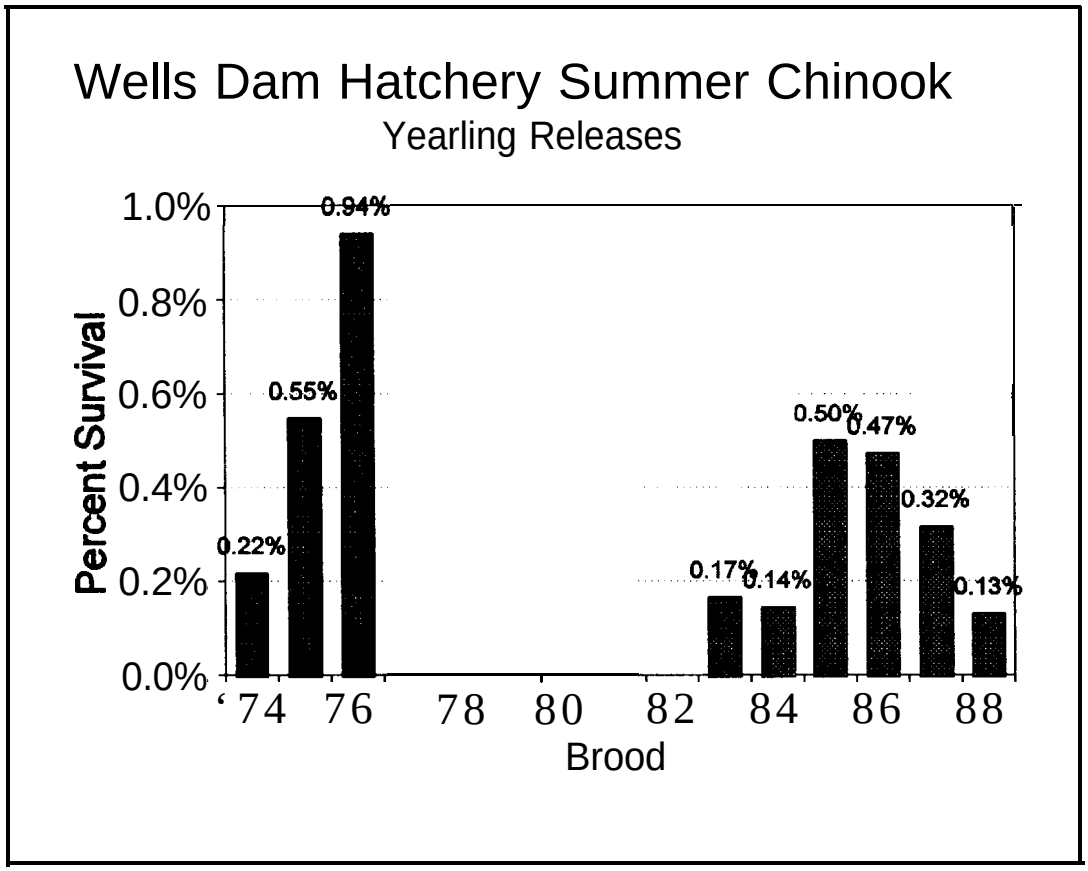

Figure 64 Survival of Wells Hatchery yearling summer chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

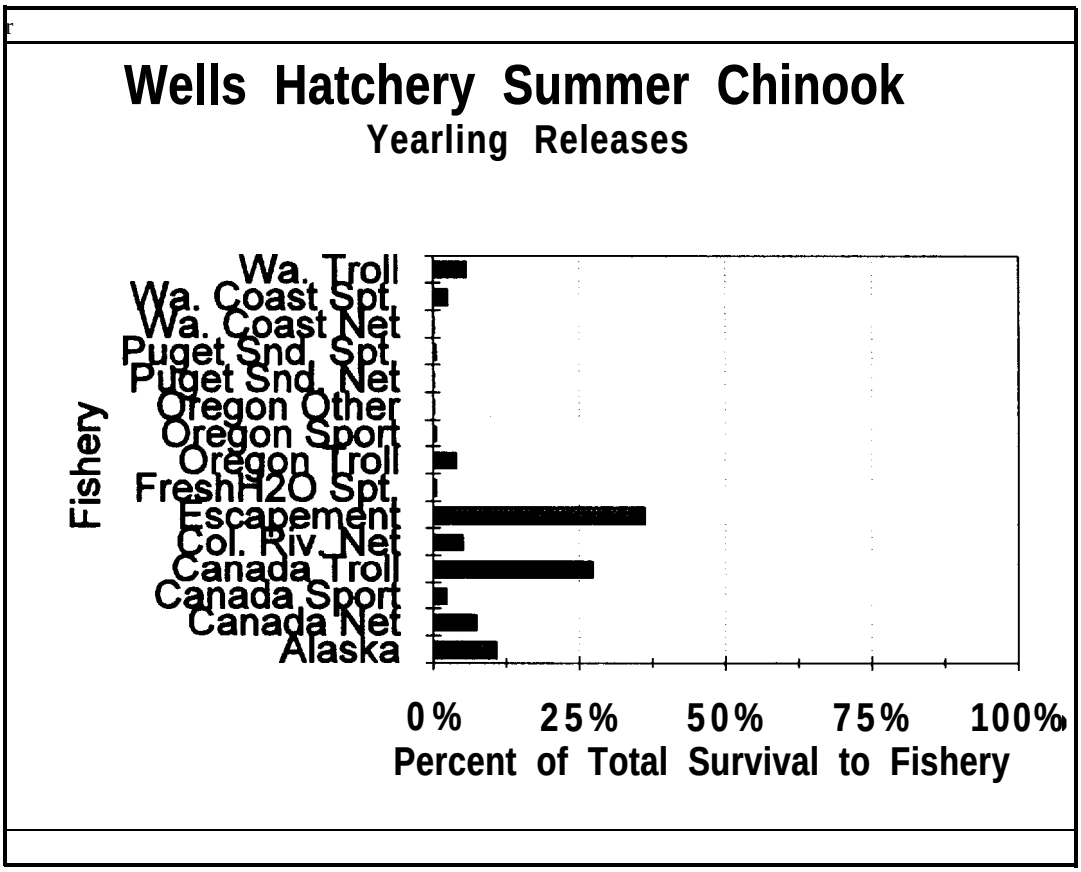

Figure 65 Percent of total survival to fisheries for Wells Hatchery yearling summer chinook. Average of broods 1986-l 988.

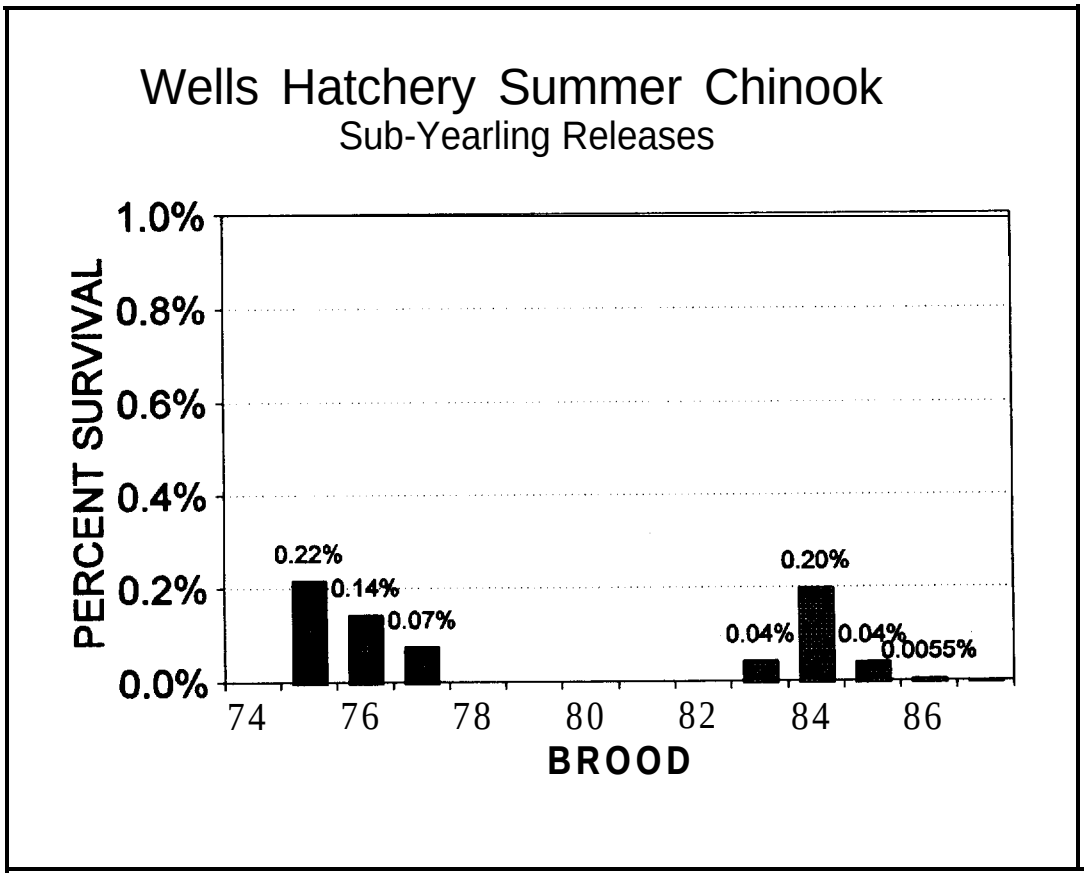

Figure 66 Survival of Wells Hatchery subyearling summer chinook by brood. Some years represent an average of several tagged releases and others a single point estimate of survival.

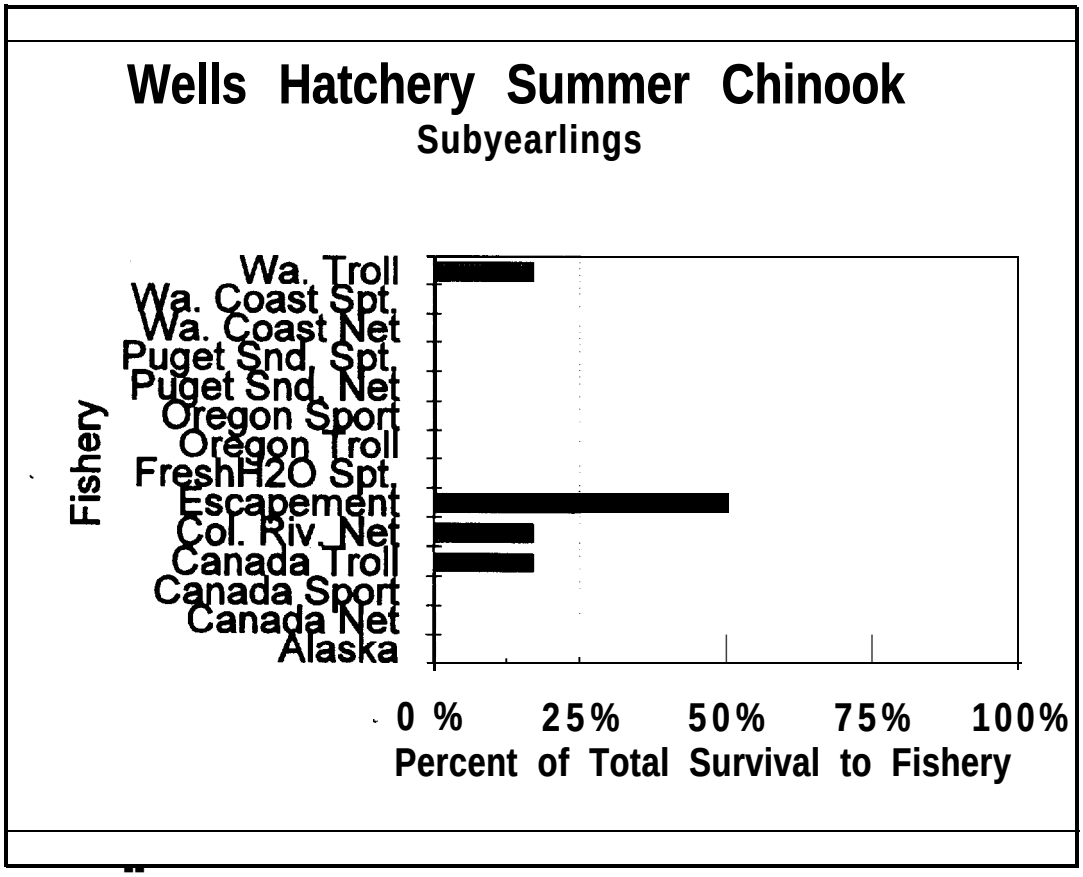

Figure 67 Percent of total survival to fisheries for Wells Hatchery subyearling summer chinook. Average of broods 1986 and 1987.